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471. NOTES ON PALMAEAN LEAF FROM THE ÔARAI FLORA (UPPER CRETACEOUS), ÔARAI MACHI, IBARAKI PREFECTURE, JAPAN*

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and

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大洗植物群（上部白堊紀）に産出したヤシ科の葉片について：このヤシ科の葉片は，1963年4月，松尾が金沢大学学生をつれて，茨城大学斎藤登志雄助教授の案内で，大山が報告した大洗植物群の産出地を見学した際に，学生の一人である石田財司が現場の転石中に発見したものである。不完全な標本であるが，葉軸先端部のヤシ科特有の三角状を残しているので，既産の化石種と比較検討した。

本邦既産の *Sabalites nipponicus*, *S. taishuensis* よりも大型で，北米始新世産 *S. powelli*，同じく漸新世産 *S. apalachicolensis* に似ている。この葉片の産出層準が上部白堊系であることも考慮に入れて，既産のものと区別し，原産地名をとって *Sabalites ooaraiensis* と新称する。ヤシ科葉片としては，我が国のみならず全東亜においても最古の種である。また，大洗植物群の古植物地理を考察するのに重要な構成員の一つでもある。　大山年次・松尾秀邦

I. Introduction

Two species of the palmaean leaves are hitherto known; one of them is *Sabalites nipponicus* (*Sabal nipponica* KRYSHTOFOVICH, 1918) emended by S. ENDÔ, 1934; the other is *Sabalites taishuensis* established by K. TAKAHASHI in 1958 as a new species.

The former species occurred in the Eocene coal-fields of Takashima, Nagasaki Prefecture, Kyûshû, of Bibai in Hokkaidô, and in the Oligocene coal-fields in Northern Kyûshû, and Ube City, Yamaguchi Prefecture. The latter species was yielded in Tsushima Islands, Nagasaki Prefecture, but S. ENDÔ doubts its being different from *Sabalites nipponicus*.

In the continental Eastern Asia, *Sabalites chinensis* was described by S. ENDÔ from the Fu-shun coal-field in southern Manchuria (North-Eastern Province of China), where the Palaeogene strata occur. In the continent of America, however, this genus has been known by the upper Cretaceous forms. Thus, the genus *Sabalites* is known to occur since Cretaceous period in the Northern Hemisphere.

Ôarai flora is considered by T. ÔYAMA, that it grew in abundance in the late

* Received May 20, 1964; read Nov. 10, 1963.

Cretaceous age in Japan, though the occurrence of the genus *Nilssonia* of the primitive Cycas common in the Mesozoic flora is not recognized in this flora. Consequently, there are two interpretations on the age of the Ôarai flora: first, if *Sabalites* has been found only in the Palaeogene formation in Japan, the Ôarai flora may possibly have been considered Palaeogene in age: secondary, if the Ôarai flora is of the upper Cretaceous age, then, this *Sabalites* species must be the oldest in Eastern Asia.

Nevertheless, T. ÔYAMA recognized in the Ôarai flora the following Mesozoic species, suggesting that it is of the upper Cretaceous age. They are: *Thallites yabei* (KRYSHTOFOVICH) HARRIS, *Coniopteris burejensis* (ZALESSKY) SEWARD, *Zamites megaphyllus* (PHILLIPS) SEWARD, *Otozamites* sp., etc.

Here, the writers wish to express their sincere thanks to Dr. T. SAITÔ of the Ibaraki University, and also to Dr. I. HAYASAKA for his kind criticism and for reading of the manuscripts.

II. Geological Notes on the Oarai Formation

This Ôarai formation was established by H. OZAKI and T. SAITÔ in 1955, and was believed to continuously lie under the Nakaminato formation, which yielded some ammonites. It is evident, therefore, that with various plant fossils must be of Mesozoic age. These Mesozoic plant fossils were described by T. ÔYAMA as the Ôarai flora of the upper Cretaceous age in the years 1956 to 1959. Of the animal fossils, especially turreted ammonites and an echinoid, T. SAITÔ published notes in 1958 and 1959, and concluded that they are of upper Senonian age, as they very closely resemble those of the Minato shale of Awaji Island, Kinki District, Japan.

The Ôarai formation is 1,300 m in thickness, and consists of many conglomeratic layers intercalating three horizons of the plant beds.

The columnar section along the coast of Nakaminato City by T. SAITÔ, 1958, is shown in Fig. 1.

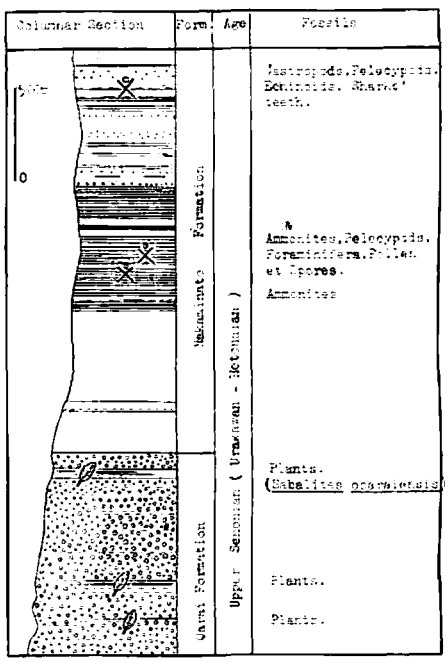

Fig. 1: The Columnar Section along the Coast of Naka-Gawa (T. SAITÔ, 1958).

III. Occurrence of the new species

This *Sabalites ooaraiensis* was discovered by S. ISHIDA, a student of the Kanazawa University from the upper of these plant-bearing beds, when H. MATSUO and several students of Kanazawa University visited the locality of the Ôarai flora, guided by T. SAITÔ

in April, 1963. The materials collected were all incomplete fragments, except for this characteristic palmaean form which shows the deltoid-form at the base of the leaf. The slab of rock with the fossil leaf was found up-side down on the fluvial deposits on the coast of the Naka-gawa. However, it is certain that the rock must have been derived from the black sandy layer and medium grey sandstone layer in alternation, representative of the Ôarai formation.

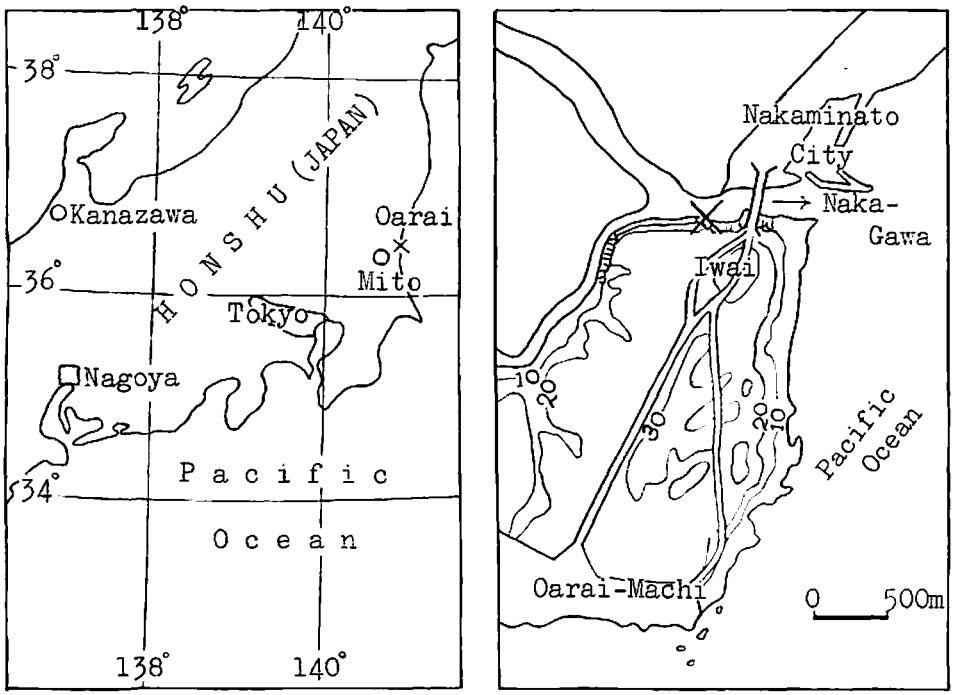

Fig. 2: Map showing principal locality of the Ôarai Flora.

IV. Description of the new species

Monocotyledoneae

Palmae

Sabalites SAPORTA, 1865

Sabalites ooaraiensis new species

Fig. 4.

Description:—Incompletely preserved small palmaean leaf; flabellate. Rachis 42 mm in *width*, and up to 86 mm in *length* on the surface; ligule large, triangular, adherent to the upper side of the rachis. Rayssl ightly carinate, 44 in numbers; midrib of rays slender; lateral veins parallel to midrib, indistinctly.

Discussion:—Only a specimen is at disposal, but it shows the characteristic deltoid rachis which closely resembles previously known forms of *Sabalites*. The writers have measured dimentions of other known species from Japan, Manchuria and elsewhere: the result is given in the following table.

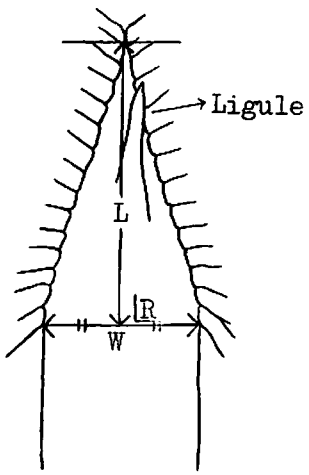

Fig. 3: Relation between Length and Width in the Rachis.
L: Length; W: Width

The taxonomic relations of all these species are not clear from what are given in the table below. But this new species differs from the other in its wider rachis, longer ligule, and thinner texture. The new species appears, however, to have a very close resemblance to *Sabal major* HEER (1855) in the Tertiary of Switzerland, which was established by F. UNGER in 1841 as *Flabellaris major* (UNGER, F., 1841: 42, XIV, fig. 2); nevertheless, it differs from these specimens (HEER, O. 1855: XXXV; XXXVI, fig. 2) in its more numerous rays: it differs from the Kuma-form of the upper Eocene of Shikoku, *Sabalites nipponicus* (NAGAI, K, 1957: II, fig. 2) in its fewer rays and larger size: it differs from Bibai-form of the Oligocene of Hokkaidô, *S. nipponicus* ENDÔ (KRYSHTOFOVICH, A, 1918: XLI, fig. 1) in its wider rachis and more numerous rays: it differs from *Sabalites taishuensis* TAKAHASHI (1958: XXVIIa) in its larger size.

Further, the present species is closely allied to *Sabalites powelli*, described by E. W. BERRY (1930: X, fig. 6 resembles especially very closely the new species) from the Wind River Basin of Green

Table 1: The measurement of rachis and rays in numbers of the palmaean leaf.

Species Name	Age	Width	Length	L/W	Numbers of Ray	Rays in Complete leaf (Estimation)
Sabalites chinensis, ENDO	Oligocene	22 mm	75 mm	3.4	27+	35-45
S. nipponicus, ENDO	Oligocene	22	58	2.6	33+	35-40
S. taishuensis, TAKAHASHI	Oligocene	26	54+	2.1+	45+	45-50
S. nipponicus, NAGAI	Up. Eocene	22	62	2.8	55+	55-60
Sabal major, HEER	Tertiary	27	60	2.2	30+	30-40
Sabal major, REID & CHANDLER	Oligocene	30	?		14+	Numerous
Sabalites apalachicolensis, BERRY	Oligocene	20-40	?			40-60
S. powelli, BERRY	Eocene	?	?			Numerous
Sabalites ooaraiensis n. sp.	Up. Cretaceous	42	86+	2.0	44+	45-50

River Age, but differs from the latter in being smaller in size, and from the Bembridge-form, *Sabal major* (UNGER) (REID & CHANDLER, 1926: IV, fig. 26) in being larger in size and the rays being numerous.

This new species represents the oldest known occurrence of the genus *Sabalites*, being the upper Cretaceous of Japan and the Eastern Asia in general.

Occurrence:—Ôarai flora (Upper Cretaceous).

Locality:—At the right bank of the Naka-gawa 350 m up from the Kaimon-kyô (bridge), Iwai-machi, Ôarai Machi, Higashi-ibaraki Gun, Ibaraki Prefecture, Kantô District, Japan. (Lat. 36°19′28″ N. and Long. 140°35′27″ E.)

Fig. 4: *Sabalites ooaraiensis* n. sp. Holotype; Reg. no. 14012.

Collection:—Holotype; Reg. No. 14012.
Repository:—Department of Geology, College of Liberal Arts, Kanazawa University.

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Awaji Island	淡路島	Kuma	久万
Bibai	美唄	Naka-gawa	那珂川
Fu-shun	撫順	Takashima	高島
Iwai-machi	祝町	Tsushima Island	対馬
Kaimon-kyô	海門橋		

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 55, pp. 247-255, pl. 36, Sept. 20, 1964

472. SOME MOLLUSCAN FOSSILS FROM THE TERTIARY MURO GROUP IN THE KII PENINSULA, JAPAN*

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第三系牟婁層群の貝化石：紀伊半島南部の四万十帯中の第三系牟婁層群から産出した貝化石の新種 *Solemya* (*Acharax*) *muroensis*, n. sp., *Pitar hataii*, n. sp., *Pitar kotoi*, n. sp. を記載し、産出層準について考察した。 名取博夫

Introduction and Acknowledgements

The southern part of the Kii Peninsula of Wakayama Prefecture, is occupied by the so-called Shimanto Terrain, which consists of the undifferentiated Mesozoic (?) Hitakagawa Group and the Tertiary Muro, Kumano and Tanabe Groups.

The Muro Group is characterized by the very thick flysch type deposits composed of sandstone, shale and an alternation of sandstone and shale. These rocks are distributed in a mozaic pattern which reflects the intensive disturbance by folding and faulting. The group is almost barren of fossils except for a few problematica, and some molluscs (e. g., HARATA, TOKUOKA and MATSUMOTO, 1963), which suggest the Oligocene to lower Miocene age.

From two localities in the Muro Group Jiro KOTO of the Ishiwara Sangyo Company was successful in collecting a few molluscan fossils of rather good preservation although without the original shell material. These molluscs are all new to science and consist of *Solemya* (*Acharax*) *muroensis*, n. sp., *Pitar hataii*, n. sp. and *Pitar kotoi*, n. sp. In this paper, the molluscs from one of the two localities are described.

Acknowledgements are due to Professor Kotora HATAI of the Institute of Geology and Paleontology, Faculty of Science, Tohoku University, for his contiguous guidance and encouragement during the course of the present study. Thanks are also due to Dr. Shozo HAYASAKA of the same Institute, for his valuable suggestions on taxonomy and paleoconchology; Mr. Hiroshi NODA of the same Institute, for his kind information on the Miocene molluscan fauna of Japan; and Dr. Koichiro MASUDA of the Department of Geology, Faculty of Education, Tohoku University, for his suggestions on the conchology. The writer also wishes to thank Mr. Jiro KOTO, for kindly donating his collection of molluscan fossils from the Muro Group to the writer for study.

* Received June 10, 1964; read June 7, 1964 at Kyoto.

Notes on the Stratigraphy, Paleontology and Correlation

According to OHWAKI (1962), the so-called Shimanto Terrain in the central

part of the South Kii Peninsula can be classified by the Nakaheji fault into two parts which are known as the Hitakagawa Group on the north and the Muro Group on the south of the thrust fault. The Hitakagawa Group nearly corresponds with the lower group of the unknown Mesozoic strata described by SUZUKI (1939) and the Muro Group is also equivalent to the upper group. The Hitakagawa Group is correlated with the lower part of the Mesozoic Shimantogawa Group (KATTO, KOJIMA, SUYARI and SAWAMURA, 1961) distributed in the Muroto Peninsula, Kochi Prefecture in Shikoku based upon the close resemblance in their lithology, geological structure and occurrence of identical problematical fossils.

According to HARATA, *et al.* (1963) the Muro Group can be subdivided into three parts based upon the lithological features. These are named the Otonashigawa-Muro, Yomurakawa-Muro and Ukekawa-Muro Formations in ascending order. The Otonashigawa-Muro Formation, which is composed of flysch type alternations of sandstone and shale with interbedded medium grained sandstone and some acidic tuff beds, is conformably superposed by the Yomurakawa-Muro Formation of medium grained sandstone and flysch type alternation of sandstone and shale. The Yomurakawa-Muro Formation is overlain with unconformity by the Ukekawa-Muro Formation which is composed of conglomerate and flysch type alternations of sandstone and shale.

From the middle part of the Ukekawa-Muro Formation a few molluscan species have been reported by HARATA, *et al.* (1963); These are *Venericardia* (*Cyclocardia*) *tokunagai* YOKOYAMA, *Costacallista* cfr. *shikokuensis* KATTO, *Portlandia* (*Portlandella*) sp., and *Acila* (*Acila*) *elongata* NAGAO et HUZIOKA.

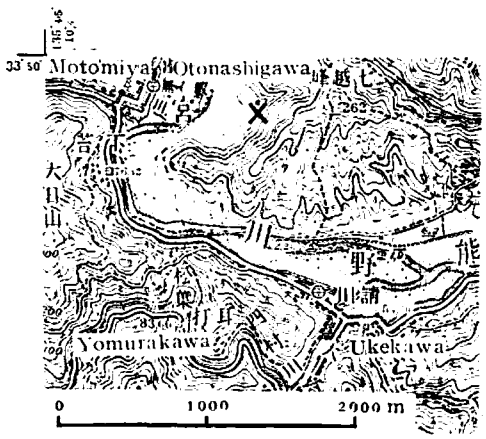
Among these species, *Venericardia* (*Cyclocardia*) *tokunagai* was described by YOKOYAMA (1924, p. 18, pl. 3, figs. 10-12) originally from the Asagai Formation of the Joban coal-field, Fukushima Prefecture, and has been recorded from the Tanagura Formation of Fukushima Prefecture, the Nenokami Sandstone of the Chichibu Basin, Saitama Prefecture, the Onishibetsu Formation of Hokkaido and the Togari formation of Gifu Prefecture, all of which may belong to the Oligocene to lower Miocene. *Costacallista shikokuensis* was originally described by KATTO (1960, p. 109, pl. 1, fig. 4) from the Misaki Formation (Upper Oligocene) of Shikoku. *Acila* (*Acila*) *elongata* was first described by NAGAO et HUZIOKA (1941, p. 113, pl. 31, figs. 1-4) from the Kawabata Formation of Hokkaido, and has also been found from the Momijiyama Formation of Hokkaido. With regard to the geological age of the Momijiyama and Kawabata Formations, different views have been expressed (listed by KANNO and OGAWA, 1963). The views presented place the formations in an age ranging between lower Oligocene to lower Miocene.

The new species to be described in this article are *Solemya* (*Acharax*) *muroensis*, *Pitar hataii* and *Pitar kotoi*, and were collected from the rather upper part of the Ukekawa-Muro Formation of the classification worked out by HARATA (HARATA, *et al.*, 1963).

Morphologically, the present new species as an assemblage resemble, in many features, the Oligocene to Miocene species of Japan and the Oligocene species of Washington, Northwest America. However, valves of both *P. hataii* and *P. kotoi* are very thick, and in this respect differ from the other species of

the genus *Pitar*.

By the data at hand, it is thought that the geological age of the present new species may be Oligocene or less probably lower Miocene.



Text-fig. 1. Map showing the locality of the Mollusca from the Ukekawa-Muro Formation.

Description

Family Solemyidae

Genus *Solemya* LAMARCK, 1818

Subgenus *Acharax* DALL, 1908

Solemya (*Acharax*) *muroensis* NATORI, n. sp.

Pl. 36, fig. 1.

One right valve was examined. Shell small, subrectangular and compressed. Beak weak, inconspicuous, situated well toward posterior end. Antero-dorsal margin elongated, straight and parallel with straight ventral margin; postero-dorsal margin short, slightly convex and excavated near the beak. Posterior end acutely rounded; anterior end unknown.

Surface with numerous radiating, broad, flat-topped, weakly incised ribs; ribs stronger on middle surface of shell, weaker and obscure on anterior and posterior ends; ribs broader on posterior than on anterior part of shell; interspaces of radiating ribs sculptured with a pair of two radiating lines extending from near beak to ventral margin; interspaces between two radiating lines narrow. Concentric lines of growth strong and irregular.

Dimensions:—Holotype (IGPS coll. cat. no. 85727); length about 22.0 mm., height about 10.5 mm., thickness about 2.3 mm. (right valve).

Remarks:—The genus *Solemya* has been recorded from the Jurassic System to the Recent deposits of Japan. From the Tertiary rocks of Japan the following species have been described.

Solemya n. sp., KATTO, KOJIMA, SUYARI and SAWAMURA, 1961, pl. 4, fig. 17 (no description), Naharigawa Formation (Eocene) of the Shimanto Terrain, Kochi Prefecture.

Solemya (*Acharax*) *bosoana* HATAI and KOIKE, 1957, p. 86, pl. 4, fig. 1, Okuzure Conglomerate (Oligocene), Chiba Prefecture.

Solemya (*Acharax*) *dalli* CLARK, 1925, p. 73, pl. 22, fig. 3, Upper Oligocene of Washington, Northwest America; Ushikubitoge Formation (Aquitanian) of the Chichibu Basin, Saitama Prefecture.

Solemya (*Acharax*) *tokunagai* YOKOYAMA; *Solemya tokunagai* YOKOYAMA, 1925, p. 31, pl. 6, figs. 1-6, Miocene and Pliocene deposits of the Joban coal-field, Fukushima Prefecture; Mochiki and Tofutsu Beds (lower Pliocene) of South Saghalien; Kunnui Formation (Miocene) of Hokkaido; Poronai Formation (Oligocene) of Hokkaido; Oiwake Formation (lower Pliocene) of Hokkaido; Kadonosawa Formation (Miocene) of Iwate Prefecture; Nitta Formation (lower Pliocene) of Niigata Prefecture; Teradomari Formation (Miocene) of Niigata Prefecture; Hiranita Formation (Burdigalian) of the Chichibu Basin; Itahana Formation (Mio-

cene) of Gunma Prefecture: Itsukaichi Formation (Miocene) of Tokyo-to; Amatsu Group (Miocene) and Nishihata Formation (Pliocene) of Chiba Prefecture; Ennichi Formation (Miocene) of South Korea.

Solemya (*Acharax*) *gigas* KANNO, 1960, p. 187, pl. 50, figs. 1-2, Hiranita Formation (Burdigalian).

Solemya tokunagai elongata AOKI, 1954, p. 30, pl. 1, fig. 15, Miocene deposits of the Joban coal-field.

Solemya yessoensis KANEHARA, 1937, p. 155, pl. 15, fig. 12, Oiwake Formation (lower Pliocene).

Solemya labeosa YOKOYAMA, 1928, p. 361, pl. 68, fig. 11, Kaigasawa Formation (Pliocene) of Niigata Prefecture.

As compared with the above-mentioned species, the present new species resembles *Solemya* (*Acharax*) *dalli* CLARK, but differs form the latter by its curved postero-dorsal margin and small shell. *Solemya* n. sp. figured by KATTO *et al.* (1961) differs from the present new species in having the antero-dorsal margin extending obliquely with the ventral margin and by the larger shell.

Locality: — Motomiya, Motomiya-cho, Higashimuro-gun, Wakayama Prefecture. Ukekawa-Muro Formation of the Muro Group.

Geologic age: — Oligocene or lower Miocene.

Family Veneridae

Subfamily Pitarinae

Genus *Pitar* RÖMER, 1857

Pitar hataii NATORI, n. sp.

Pl. 36, figs. 3a-b.

One right valve was examined. Shell of medium size, strongly inflated and elongate ovate. Beak small, high, strongly curved inward and forward, situated from anterior end at a distance of about one-fourth the length of shell. Antero-dorsal margin rather convex, very strongly excavated near beak and very steeply inclined downward and running into back; postero-dorsal margin nearly straight and passing into a rounded posterior end. Anterior end narrowly but well rounded and passing into a broadly arcuate ventral margin. Lunule and escutcheon obscure.

Surface with numerous, rather rough and fine concentric, and irregularly spaced lines of growth.

Dimensions:—Holotype (IGPS coll. cat. no. 85728); length about 43 mm., height about 33 mm., thickness about 15 mm. (right valve)

Remarks:—From the Tertiary rocks of Japan the following species of *Pitar* have been described.

Pitar sorachiensis OYAMA et MIZUNO, 1958, p. 603, pl. 4, figs. 1-6, Wakkanabe Formation (Eocene) of the Ishikari Group, Hokkaido; Shitakara Formation (Eocene) of the Ishikari Group.

Pitar (?) *sannosawaensis* (YOKOYAMA); *Venus* (?) *sannosawaensis* YOKOYAMA, 1932, p. 239, pl. 3, fig. 6, Upper Shiroki Formation of the Uryu Group (Eocene), Hokkaido.

Pitar takashimaensis (NAGAO); *Pitaria takashimaensis* NAGAO, 1928, p. 72, pl. 11, figs. 11a-b, Okinoshima Formation (Lutetian-Priabonian) of the Takashima coal-field, Nagasaki Prefecture; Kawamagari Formation (Eocene) of the Asakura coal-field, Fukuoka Prefecture; Meinohama Sandstone (Aquitanian) of the Fukuoka coal-field, Fukuoka Prefecture.

Pitar kyushuensis (NAGAO); *Pitaria kyushuensis* NAGAO, 1928, p. 70, pl. 12, figs. 1-10, Sakasegawa Group (Lutetian) of the Amakusa coal-field, Kumamoto Prefec-

ture; Okinoshima Formation; Iojima Formation (Lattorfian) of the Takashima coal-field; Kawamagari Formation; Kiriyama Formation (Lutetian-Lattorfian) of the Isahaya coal-field, Nagasaki Prefecture; Funatsu Sandstone (Lattorfian) of the Takashima coal-field; Nango and Takigahirayama Formations (Chattian-Aquitanian) of the Nichinan Subgroup, Miyazaki Prefecture.

Pitar yokoyamai (NAGAO); *Pitaria yokoyamai* NAGAO, 1928, p. 74, pl. 11, figs. 10-11, Kakinoura Formation (Oligocene) of Nagasaki Prefecture; Nagayo Formation (Lattorfian) of the Isahaya coal-field.

Pitar matsumotoi (NAGAO); *Pitaria matsumotoi* NAGAO, 1928, p. 73, pl. 11, fig. 13, pl. 13, figs. 4-6, Ashiya Group (Aquitanian) of the Chikuho coal-field, Fukuoka Prefecture; Meinohama Sandstone; Yamaguchi Formation (Aquitanian) of the Isahaya coal-field; Tokuman Member of the Nishisonogi Formation (Aquitanian) of the Sakito coal-field, Nagasaki Prefecture; Karatsu Formation (Aquitanian) of the Kitamatsu-Karatsu coal-field, Nagasaki and Saga Prefectures; Takigahirayama Formation (Aquitanian) of the Nichinan Subgroup; Asagai formation (Oligocene) of the Joban coal-field, Fukushima Prefecture.

Pitar ashiyaensis (NAGAO); *Pitaria ashiyaensis* NAGAO, 1928, p. 72, pl. 9, fig. 12, pl. 13, figs. 1-3, Yamaga Formation of the Ashiya Group (Aquitanian).

Pitar (?) *altoumbonata* (NAGAO); *Pitaria* (?) *altoumbonata* NAGAO, 1928, p. 75, pl. 11, figs. 14-15, 19, Kishima Formation (Aquitanian) of Saga Prefecture.

Pitar (*Costellipitar*) *concentrica* KANNO, 1958, p. 177, pl. 2, figs. 8-9, Kamiyokoze Formation (Aquitanian-Burdigalian) of the Chichibu Basin, Saitama Prefecture.

Pitar itoi (MAKIYAMA); *Pitaria itoi* MAKIYAMA, 1926, p. 157, pl. 13, fig. 7, Mankodo Formation (Miocene) of Korea; Kase Formation (middle Miocene) of the Kitamatsu-Karatsu coal-field.

Pitar okadana (YOKOYAMA); *Venus okadana* YOKOYAMA, 1932, p. 240, pl. 11, figs. 8-9, Okada, Nomura and Poroshin Formations (Miocene) of the Uryu coal-field, Hokkaido.

Pitar yabei OTUKA, 1934, p. 617, pl. 48, figs. 49-50, Kadonosawa Formation (Miocene) of Iwate Prefecture.

Pitar hokkaidoensis NOMURA, 1935, p. 35, pl. 4, figs. 1-2, Takikawa Formation (Pliocene) of Hokkaido; Togeshita Formation (Miocene) of Hokkaido.

Pitar sendaica NOMURA, 1938, p. 258, pl. 35, figs. 1-3, 10a-b, Tatsunokuchi Formation (Pliocene) of Miyagi Prefecture; Some Pliocene deposits of the Pacific side of Japan.

Pitar sendaica monstrosa NOMURA, 1938, p. 259, pl. 35, figs. 8a-b, 9a-b, Tatsunokuchi Formation (Pliocene).

As compared with the above-mentioned species, the present new species resembles *Pitar* (*Costellipitar*) *concentrica* KANNO in the outline, but differs from the latter by the thicker valve, smaller beak, stronger convexity and excavated antero-dorsal margin, and also by the surface ornamentations of the shell. *Pitar kyushuensis* (NAGAO) is another species allied to the present one but is distinguished from the present one by its more broadly rounded anterior and posterior ends, more regularly ventral margin, and higher and thinner valve. In the thickness of the valve, the present new species is relatively thicker than the ones above-mentioned.

The present specimen seems to have been slightly deformed by subsequent agencies, therefore its characteristic features are judged to be the straight postero-dorsal margin, very strong convexity and curved antero-dorsal margin, and very thick valve.

MASUDA (1963) discussed on the relationships between the fossil specimens with shell materials and those without

them in *Dosinia* (*Phacosoma*) *japonica* (REEVE), and pointed out that on the inner mold specimen the postero-dorsal margin carves much less than in specimens with the shell material and the anterior part is more concave toward the antero-dorsal margin because of the relatively thicker shell materials than the other parts of the shell. Similar features can be observed in the present specimen.

Locality: — Motomiya, Motomiya-cho, Higashimuro-gun, Wakayama Prefecture, Ukekawa-Muro Formation of the Muro Group.

Geologic age: — Oligocene or lower Miocene.

Pitar kotoi NATORI, n. sp.

Pl. 36, figs. 4a-b.

One left imperfectly preserved valve was examined. Shell large, strongly inflated and elongate ovate. Beak very large, high, curved inward and forward. Antero-dorsal margin slightly concave, excavated and gently sloping backward; postero-dorsal margin unknown. Anterior end narrowly rounded, passing into a broadly arcuate ventral margin; posterior end unknown. Lunule and escutcheon unknown.

Surface ornamented with numerous, rough concentric, irregularly spaced lines of growth; concentric lines sometimes distinct and more or less elevated so as to become narrow concentric lamellae.

Dimensions:—Holotype (IGPS coll. cat. no. 85729); length unmeasurable, height about 58 mm., thickness about 15 mm. (left valve).

Remarks:—The present new species differs from *Pitar hataii*, n. sp. in having a larger beak, and concave, regularly excavated and gently sloping backward antero-dorsal margin, while the latter has smaller beak, convex, very strongly excavated and very steeply sloping backward antero-dorsal margin, weaker growth lines and smaller size. *Pitar kyushuensis* (NAGAO) is distinguished from the present new species by its smaller beak, rather broadly rounded anterior end, regularly convex ventral margin and rather thin valve. The present new species, in outline and surface ornamentation of the shell, resembles *Pitar* (*Lamelliconcha*) *clarki* (DICKERSON) figured by TEGLAND (1929, p. 279, pl. 22, figs. 2-3) from the Eocene deposits of Cowlitz River, Washington, Northwest America, but differs by its larger beak, narrower anterior end and thicker valve. In the thickness of the valve, this new species is relatively thicker than the above-mentioned species of *Pitar* except for *Pitar hataii*, n. sp.

Locality: — Motomiya, Motomiya-cho, Higashimuro-gun, Wakayama Prefecture, Ukekawa-Muro Formation of the Muro Group.

Geologic age: — Oligocene or lower Miocene.

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Explanation of Plate 36

(All figures in natural size unless otherwise stated)

Fig. 1. *Solemya* (*Acharax*) *muroensis* NATORI, n. sp.
Right valve, Holotype. IGPS, coll. cat. no. 85727. Loc. Motomiya, Motomiya-cho, Higashimuro-gun, Wakayama Prefecture. Ukekawa-Muro Formation of the Muro Group.

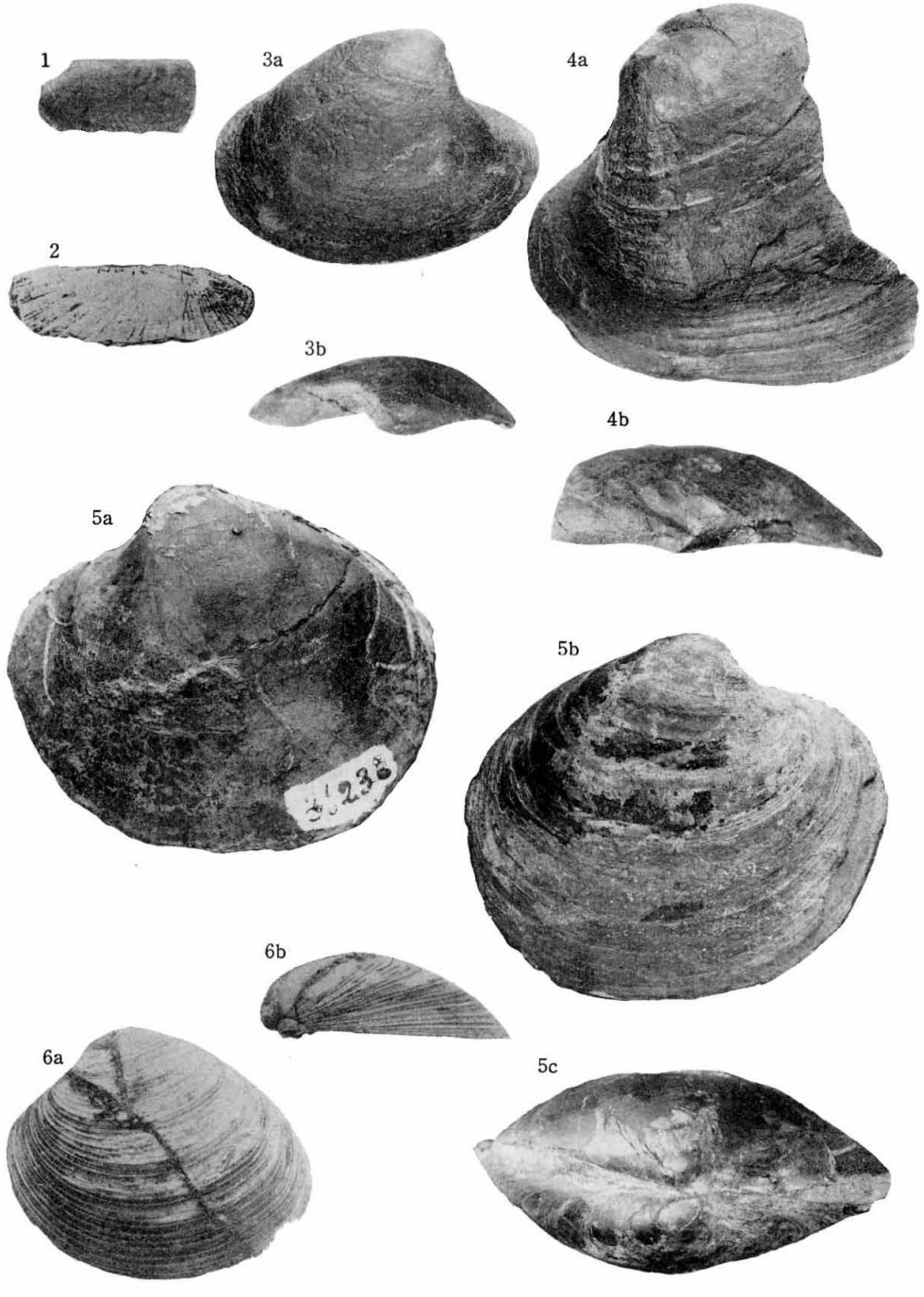
Fig. 2. *Solemya* (*Acharax*) *dalli* CLARK ×0.7
Left valve, Holotype figured by WEAVER (1958, p. 20, pl. 5, fig. 5). S.U. 5238. Loc. One and one-half miles of Twin Rivers, Clallam County, Washington, Northwest America. Sandy shale of the upper Oligocene.

Figs. 3a-b. *Pitar hataii* NATORI, n. sp.
Holotype. IGPS, coll. cat. no. 85728. 3a; Right valve. 3b; Apical view of fig. 3a. Loc. Motomiya, Motomiya-cho, Higashimuro-gun, Wakayama Prefecture. Ukekawa-Muro formation of the Muro Group.

Figs. 4a-b. *Pitar kotoi* NATORI, n. sp.
Holotype. IGPS, coll. cat. no. 85729, 4a: Left valve. 4b; Apical view of fig. 4a. Loc. Same as above.

Figs. 5a-c. *Pitar kyushuensis* (NAGAO)
Holotype described by NAGAO (1928, p. 70) as *Pitaria kyushuensis*. IGPS, coll. cat. no. 36238. 5a; Left valve. 5b; Right valve. 5c; Apical view. Loc. West coast of Okinoshima, Nagasaki Prefecture. Okinoshima Formation (Lutetian-Priabonian).

Figs. 6a-b. *Pitar clarki* (DICKERSON)
Topotype figured by TEGLAND (1929) as *Pitaria* (*Lamelliconcha*) *clarki* DICKERSON. U.C. No. 31543. 6a; Left valve. 6b; Anterior view of fig. 6a. Loc. Lower Cowlitz Valley, southwestern Washington, North America. Upper Eocene Cowlitz Formation.



KUMAGAI photo.

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Motomiya	本宮	Otonashigawa	音無川
Muro	牟婁	Ukekawa	請川
Nakaheji	中辺路	Yomurakawa	四村川

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 55, pp. 256-262, pl. 37, Sept. 20, 1964

473. A CRETACEOUS TRIGONID FROM THE MIOCENE MISAKI FORMATION IN THE MIURA PENINSULA, KANAGAWA PREFECTURE*

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三浦半島の中新世三崎層より産出した白亜紀三角貝：三浦半島南端，神奈川県三浦市三崎町の三崎港東岸で三崎層から中新世化石と共に三角貝化石が採集された（薄井二郎，1952）。これを検討した結果，*Pterotrigonia* 属に属し，我国白亜紀の *P. hokkaidoana* に非常に近似するものである事がわかった。これを記載し，二次化石と結論した。　　的場保望

Introduction

It is well known that trigonids were abundant and had wide distribution during the Mesozoic Era, especially the Jurassic and Cretaceous. However, during the Cenozoic Era only a few descendants have been found in Australia and they range from Tertiary to Recent.

In 1952, a trigonid fossil was collected by Mr. Jiro USUI with other Miocene fossils from a single locality and horizon of the Misaki Formation, at the southernmost part of the Miura Peninsula, during his geological work in the peninsula. The writer had an opportunity to study this specimen under the instruction of Prof. Kotora HATAI. The aim of this work is to determine whether the specimen can be considered to be a Miocene species or whether it should be interpreted as derived from an unexposed formation of Cretaceous age.

The writer here expresses his sincere thanks to Professor Kotora HATAI of the Institute of Geology and Paleontology, Tohoku University, for the opportunity to study the interesting specimen and for his kind instruction throughout this work. Acknowledgements are due to Dr. Hiroshi OZAKI of the Natural Science Museum in Tokyo for his kind suggestions and deep interest concerning the occurrence of the trigonid shell.

* Received June 10, 1964; read June 7, 1964 at Kyoto.

Occurrence

The specimen was collected by USUI from a calcareous sandstone bed situated at the east side of the Misaki harbour, Misaki-cho, Miura City, Kanagawa Prefecture (Fig. 1). According to USUI (1952), "... at the boundary between the upper and lower parts of the Misaki Formation, at about 200 meters east of the inlet of the Misaki harbour, there are intercalated calcareous sandstone beds. The calcareous beds are considered to correspond to the limestone beds near Misaki which have been studied by YOSHIWARA (1902). At the outcrops east of the Misaki harbour, calcareous conglomeratic sandstone alternates with medium to fine grained

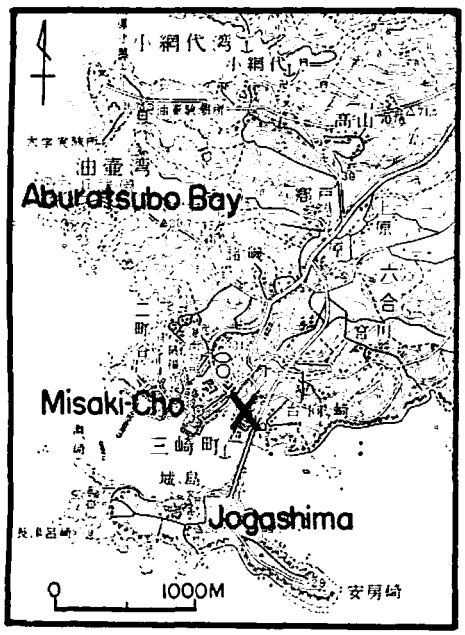

Fig. 1. Locality of *Pterotrigonia* cf. *hokkaidoana* (YEHARA).

tuffaceous sandstone and mudstone, and has yielded abundant molluscan shells. From one of these outcrops already mentioned a molluscan fossil belonging to the genus *Trigonia* was collected.... Its stratigraphic position is the uppermost part of the Lower Misaki Formation...."

The occurrence of a well preserved isolated valve of a trigonid from the compact, yellowish colored, fossiliferous sandstone of the Neogene age, situated on the eastern side of the Misaki harbour is of interest. According to Prof. K. HATAI of the Institute of Geology and Paleontology, Tohoku University, who sponsored J. USUI's graduation thesis in the field and laboratory, the molluscan shell was found from a sandstone containing abundant remains of small *Ostrea*, fragments of balanids and other pelecypods. The small oysters are well preserved and some even retain their original coloration, whereas the fragments of balanids and other pelecypods were more or less with faded original coloration, some even showing evidence of wear due to aqueous agencies. The trigonid shell, however, is rather well preserved, showing its external sculpture in detail and the interior features could be observed after cleaning with a hand-drill. However, the sandstone adhering to the trigonid shell is different from that in which it was found.

From the same bed, USUI collected other fossils as *Chlamys miurensis* YOKOYAMA, *Chlamys* n. sp., *Dentalium yokoyamai* MAKIYAMA, *Balanus rostratus* HOEK, *Odonthocyathus*-like corals, Bryozoa etc., and concluded its geologic age to be Middle or Lower Miocene upon the evidence of the fossils and also from the stratigraphic consideration.

From where the trigonid shell came and how it was embedded in the Neogene sandstone is problematical. It could have been drifted with other materials by rafting and deposited after the raft was destroyed by rottening, possibly it could have been washed out by disintegration of an erratic which may have been fossiliferous, because of the small size and thick shell of the trigonid it is evident that its resistance against foreign agencies would be strengthened, and it seems that there may be other agencies which could have brought the trigonid shell to its site of deposition. Whatever the answer be, it is evident that the trigonid shell was collected from a fossiliferous sandstone of Neogene age, and the true explanation for the occurrence must be reserved.

Paleontological and Geological Notes

Because of the importance in stratigraphy and abundant occurrences as well as large variety of forms, studies on the trigonids have begun early in the history of the molluscs, and many workers have attempted to classify the genus *Trigonia* into finer divisions. AGASSIZ in 1841 divided the genus into eight sections, namely, Scaphoidae, Clavellatae, Quadratae, Scabrae, Undulatae, Costatae, Glabrae and Pectinatae. This classification was adopted with some modification and additions by subsequent workers. LYCETT (1872-79) investigated in detail the Jurassic and Cretaceous trigonids of England and classified them into eight sections, added the new section Byssiferae to those previously recognized by AGASSIZ except Pectinatae. STOLICZKA (1871) divided the genus into six groups in his study of Indian trigonids. Several authors, on the other hand, subdivided *Trigonia s. lat.* generically. After BAYLE's *Miophorella* (1878) and COSSMAN's *Eotrigonia* and *Neotrigonia* (1912) were proposed, modern workers like VAN HOEPEN (1929), CRICKMAY (1932), COX (1952) and others erected new genera and subgenera. In COX's scheme of classification the Trigoniidae are restricted to *Trigonia s. lat.* and classified into 23 genera and 11 subgenera. Recently KOBAYASHI (1954) and others studied the Mesozoic trigonids of Japan and adjacent countries and proposed a systematic classification of the trigonids.

The specimen of Scabrae-type trigonid treated in this article, having wing-shaped, very inequilateral outline and opithogyrous umbo, obviously belongs to the subfamily Pterotrigoniinae. This subfamily is in a position far from the subfamily Neotrigoniinae KOBAYASHI (1954), the known post-Cretaceous trigonids, which consists only of two genera, *Neotrigonia* and *Eotrigonia*. The subfamily Pterotrigoniinae was proposed by VAN HOEPEN (1929) and it included six genera. Recently KOBAYASHI and NAKANO (1957) re-examined the subfamily and classified it into three genera and one subgenus, namely genus *Petrotrigonia* VAN HOEPEN, subgenus *Rinetrigonia* VAN HOEPEN, genus *Scarbrotrigonia* DIETRICH and genus *Acanthotrigonia* VAN HOEPEN. The present specimen differs from *Acanthotrigonia* and *Scabrotrigonia* in the arrangement of costellae on the area. It is asigned to *Pterotrigonia s. str.* in many characters as described later, being distinguishable from the subgenus *Rinetrigonia* in not having discrepant costae on the flanks. In Japan *Pterotrigonia s. str.* is well represented by seven species from the Cretaceous formation (KOBAYASHI and NAKANO, 1957, 1958, NAKANO, 1960). The present specimen of the trigonid shell from the Miocene Misaki Formation is closely related to *P. hokkaidoana* (YEHARA) as described later, though it seems to be an immature form.

As mentioned above, the present specimen is morphologically a typical *Pterotrigonia s. str.* which is cosmopolitan in the Lower to "Middle" Cretaceous of the eastern hemisphere excluding Australia. "Middle" to Upper Cretaceous of North and South America, and Europe (NAKANO and NUMANO, 1961). None of its members, however, have been reported from Post-Cretaceous deposits of any country. Although the present specimen was collected from a marine formation of Miocene age, it seems to be more reasonable to consider

that the specimen was derived from a Cretaceous deposit rather than to interpret it as a relict species.

Pterotrigonia hokkaidoana is widely distributed in the Lower and "Middle" Cretaceous rocks in Japan (KOBAYASHI and NAKANO, 1957, 1958, NAKANO, 1960). The occurrence of *P. hokkaidoana* from Cretaceous formations nearest to Misaki, is the Sanchu graben in the Kanto massif (YABE, NAGAO and SHIMIZU, 1926), about 120 km northwest of Misaki. Another fossil locality of Cretaceous age which yielded trigonids similar to the present one is the Choshi peninsula, about 130 km northeast of Misaki, from where *P. pocilliformis* (YOKOYAMA) has been reported (YAMANE, 1921) (Fig. 2).

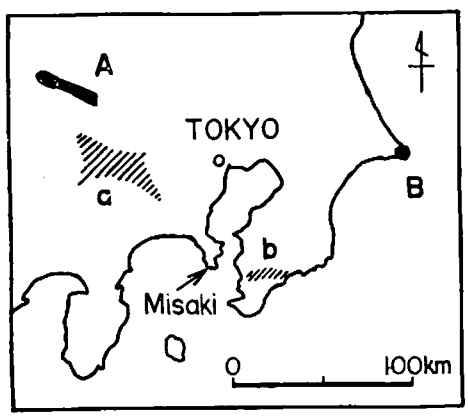

Fig. 2. Localities of the Cretaceous formations which yielded *Pterotrigonia* (A, B), and the Cretaceous and the unknown Mesozoic or Paleogene formations (a, b) in the Kanto region.

A: Sanchu graben.
B: Choshi.
a: Kobotoke Formation.
b: Mineoka Formation.

Judging from the degree of the preservation of the specimen, it seems possible that it may have been reworked from some Cretaceous deposits not so remote from Misaki. Therefore, it is inferred that there may have been exposed Cretaceous deposits bearing such fossils as *Pterotrigonia* near Misaki during the Miocene Epoch.

Description

Subfamily Pterotrigoniinae
VAN HOEPEN, 1929

Genus *Pterotrigonia* VAN HOEPEN, 1929

Pterotrigonia cf. *hokkaidoana* (YEHARA)

Pl. 37, figs. 1-3.

Compared with:

1915. *Trigonia hokkaidoana* YEHARA, *Sci. Rep. Tohoku Imp. Univ., Vol. 2, No. 2*, p. 39, pl. 1, figs. 1-8.
1923. *Trigonia hokkaidoana* YEHARA, *Jour. Geol. Soc. Tokyo, Vol. 30*, p. 5-6, pl. 7, figs. 3-5.
1923. *Trigonia hokkaidoana* YEHARA, *Japan. Jour. Geol. Geogr., Vol. 2, No. 3*, p. 70-71, pl. 11, figs. 9-10, pl. 12, fig. 5.
1926. *Trigonia hokkaidoana*? YABE, NAGAO and SHIMIZU, *Sci. Rep. Tohoku Imp. Univ., Vol. 9, No. 2*, p. 46-47, pl. 14, fig. 3.
1931. *Trigonia hokkaidoana* YEHARA, *Trigoniae from Japan*, p. 15-17, text-fig.
1957. *Pterotrigonia hokkaidoana* KOBAYASHI and NAKANO, *Japan. Jour. Geol. Geogr., Vol. 28, No. 4*, p. 229-230, pl. 16, fig. 4,
1958. *Pterotrigonia hokkaidoana* KOBAYASHI and NAKANO, *Ibid., Vol. 29, Nos. 1-3*, p. 148, pl. 9, figs. 9-11.

Description:—Shell small in size, subcrescentic, inflated anteriorly, produced and slightly attenuated posteriorly; anterior margin rounded, passing gradually into gently arcuate ventral one; siphonal margin rounded; dorsal margin

long and concave. Umbo small, prominent, opisthogyrous, and pointed at a fourth from the anterior end. Carinae obsolete except near umbo. Escutcheon broad, slightly depressed, with about 10 tuberculate transverse costellae; costellae arranged more closely near umbo. Area narrow and raised, narrower anteriorly but wider posteriorly, provided with a few transverse costellae in early stage; median furrow shallow, not so distinct. Flank with 15, tuberculate diagonal costae; four near umbo concentric; next six on most inflated part, slightly curved and oblique anteriorly; last five straight and oblique posteriorly.

Length 24 mm. Height 15 mm.

Remarks: — The specimen described here is a right valve and fairly well preserved. Its ventral margin and some costae on the most inflated part of the flank are broken. It seems to be an immature form because of its small size, so therefore it may have nearly indistinct median furrow and rather few costae.

P. hokkaidoana is very similar to *P. pocilliformis* (YOKOYAMA), but the former is distinguishable from the latter in its tall and subcrescentic to trigonal outline and more numerous costae on the flank. The present specimen has not so many costae as the typical *P. hokkaidoana*, but the intercostal spaces of it are narrow as in *P. hokkaidoana*. It is comparable with *Pterotrigonia hokkaidoana* (YEHARA) in many features. Especially it resembles to the syntype of fig. 2 (YEHARA, 1915, pl. 1) except for the narrower umbo and the larger size of the latter. On the other hand, the present specimen is more related with the syntype of YEHARA (pl. 37, figs. 4a and 4b) which was collected from the same locality but different horizon, as that of the specimens illustrated in figs. 1 and 2 (YEHARA, 1915, pl. 1), in its outline and costal arrangements.

The specimen in fig. 5 illustrated by YEHARA (1915, pl. 1) has been questioned by authors and sometimes even regarded as another species. KOBAYASHI and NAKANO (1957) considered that it resembles *P. pocilliformis yamanokamiensis* KOBAYASHI and NAKANO from its elongate and rostrate outline. While NAKANO and NUMANO (1961) stated that it is similar to certain *P. brevicula* (YEHARA) rather than the typical *P. hokkaidoana* from its narrow area and sinuation on the ventral part. However, from the writer's observation on the syntype of *Trigonia hokkaidoana* YEHARA preserved in the Institute of Geology and Paleontology, Tohoku University, the specimen illustrated in fig. 5 (YEHARA, 1915, p. 1) is poor in preservation, and its posteroventral margin is slightly broken as seen in the figure, therefore it is not adequate to argue the taxonomic position of the specimen merely from its vague outline.

P. hokkaidoana is widely distributed in the Lower and "Middle" Cretaceous formations in Japan (NAKANO, 1960). Although *Pterotrigonia* has been known to extend up to the late Cretaceous in North America and New Zealand, none of its members are known from the Tertiary and the later deposits of the world.

Occurrence:—Calcareous conglomeratic sandstone which yields abundant molluscan shells, the uppermost part of the Lower Misaki Formation, at the east side of the Misaki harbour, Misaki-cho, Miura City, Kanagawa Prefecture. The geologic age of the Misaki Formation is considered to be Middle of Lower Miocene.

IGPS coll. cat. no. 85720.

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Misaki 三崎

Sanchu 山中

Explanation of Plate 37

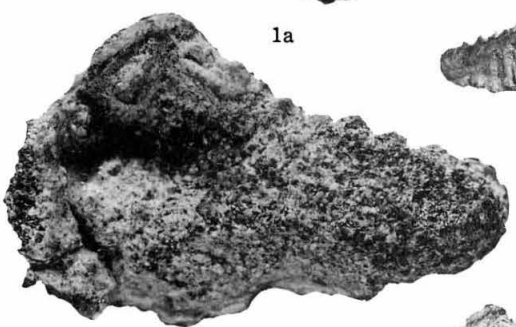
Figs. 1-3. *Pterotrigonia* cf. *hokkaidoana* (YEHARA).
- 1a-c. Right valve (×3). Misaki Formation (Miocene). Misaki-cho, Miura City, Kanagawa Pref. IGPS coll. cat. no. 85720.
- 2a-b. Same specimen in natural size.
- 3. Teeth of the same specimen (×5).

Figs. 4-5. *Pterotrigonia hokkaidoana* (YEHARA).
- 4a-b. Right valve (×1), syntype; not illustrated by YEHARA. Lower *Astarte* Zone. Hiraiga I, Miyako City, Iwate Pref. IGPS coll. cat. no. 4225.
- 5. Right valve (×1), syntype; the same specimen in fig. 1 illustrated by YEHARA (1915, pl. 1). *Cucullaea* Zone. Hiraiga I, Miyako City, Iwate Pref. IGPS coll. cat. no. 4335.

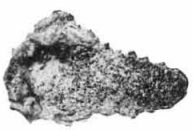
Figs. 6-7. *Pterotrigonia pocilliformis* (YOKOYAMA).
- 6. Internal mould of a right valve (×1). Nagasaki quarry, Choshi City, Chiba Pref. IGPS coll. cat. no. 35064.
- 7. Clay cast of a left valve (×1). So-yama, Kureta-cho, Nangoku City, Kochi Pref. IGPS coll. cat. no. 22072.

1a

2a



1b



2b

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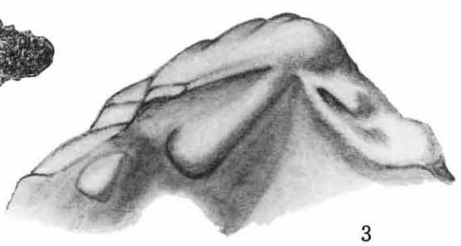
4a

4b



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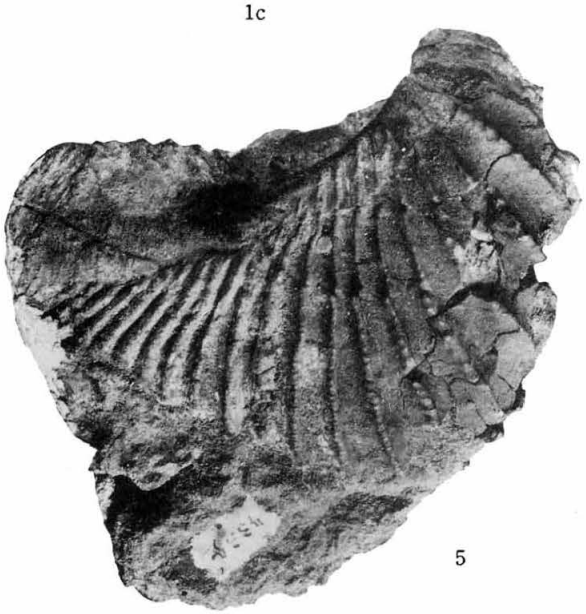

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KUMAGAI photo.

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 55, pp. 263-270, pl. 38, Sept., 20, 1964

474. DISCOVERY OF A FOSSILS *PEROTROCHUS* IN THE MIIKE COAL-FIELD, KYUSHU, JAPAN*

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and

HIDEO URATA

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九州三池炭田産巻貝の 1 新種： 九州三池炭田のいわゆる勝立化石層から, *Perotrochus* の新種が発見されたので *Perotrochus eocenicus* と命名する。 同属化石については, 日本からは新第三紀以降からしか知られておらず, 始新世のものが報告されるのは今回が最初である。
黒田秀隆・浦田英夫

Introduction and Acknowledgements

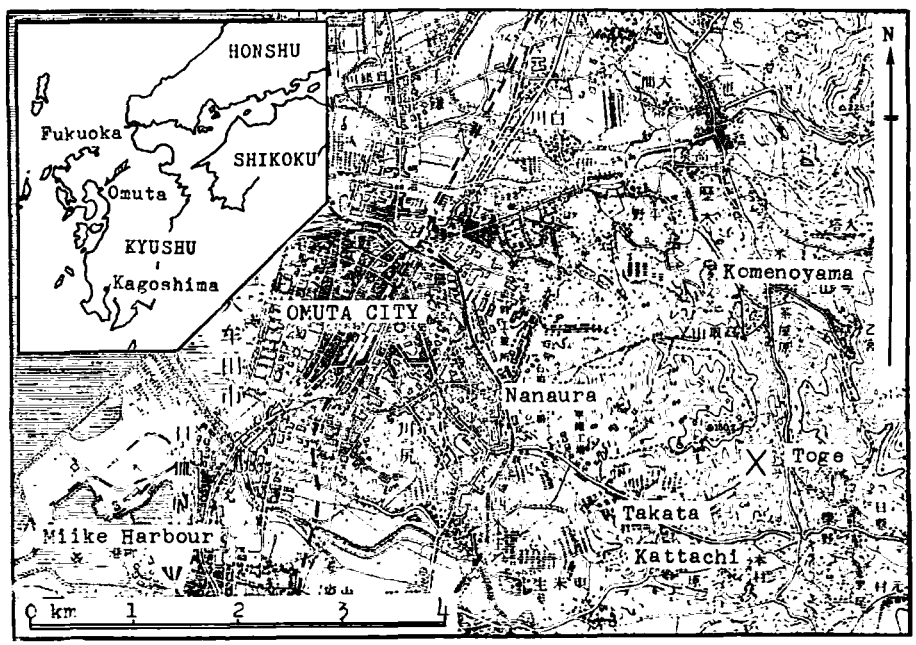
The Miike Coal-field of the south-western part of Fukuoka Prefecture, Kyushu, consists of lower Paleogene formations, in which four fossil beds were recognized by MATSUSHITA (1949). Although many fossil molluscs have been known to occur in these fossil beds, no fossil pleurotomariid has hitherto been reported from Kyushu or from Paleogene formation in any other part of Japan. We have recently found a rare but interesting pleurotomariid in the lower Nogata fossil bed in the Kattachi formation. This paper consists of a description of the newly discovered pleurotomariid together with discussions on the characteristics and significance of the fauna.

* Received June 15, 1964; read Sept. 29, 1962, at Tokyo.

We wish to offer our best thanks to Professor Hisamichi MATSUSHITA, Professor Ryuzo TORIYAMA, Assistant Professor Ryohei TAKAHASHI and Assistant Professor Tsugio SHUTO, of the Department of Geology, Faculty of Science, Kyushu University, for their kind advice and encouragement and for reading the manuscript. We are also greatly indebted to Dr. L. R. COX, of the British Museum, London, Dr. Tadashige HABE, of the Natural Science Museum, Tokyo, and Dr. Saburo KANNO, of the Institute of Geology and Mineralogy, Faculty of Science, Tokyo University of Education, for their very helpful advice and kind suggestions concerning the biological, ecological and systematic problems and for reading the typescript. Finally, particular thanks are due to Mr. Akira ISHIDA, of the Miike Mine, Mitsui Mining Co. for allowing us to study his collection.

Geological Occurrence and Characteristics of the Kattachi Fauna

The Eocene Kattachi formation, the lowest member of the Manda group, is distributed widely in Omuta City, Fukuoka Prefecture, and mainly crops out in the neighbourhood of the Kattachi mine and in the southern to southwestern area of the Nanaura mine of the Mitsui Mining Co. It consists mainly of sandstone with intercalations of glauconitic sandstone, sandy shale and shale in the Kattachi area.

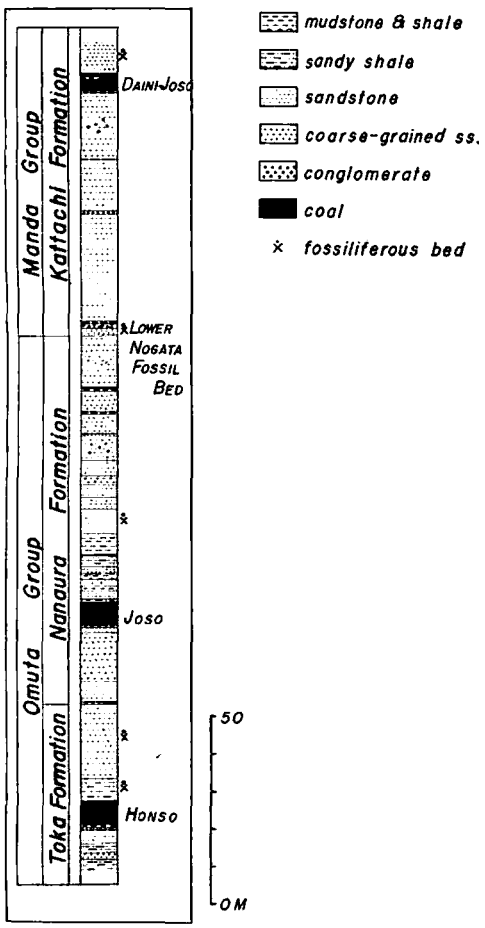


Text-fig. 1. Map showing the geographic position of the fossil locality.

In the lowest part of the formation, coarse-grained glauconitic sandstone with greenish grey calcareous sandstone is developed and yields many fossils. The Kattachi formation gradually merges into the underlying Nanaura formation, which comprises mainly bluish or light grey sandstone and conglomerate, and is overlain conformably by the Yotsuyama formation, consisting of dark grey fine-grained fossiliferous sandstone with intercalations of glauconitic sandstone and shale.

The fossiliferous part of the Kattachi formation is called the Kattachi fossil bed, in which we have found six pelecypods, three gastropods and one brachiopod, besides specimens of corals and sharks' teeth. These fossils are: *Lima nishiyamai* (YOKOYAMA), *Pholadomya* sp., *Brachidontes* sp., *Crassatellites nipponensis* YOKOYAMA, *Venericardia nipponica* (YOKOYAMA), *V.* cfr. *mandaica* (YOKOYAMA), *Perotrochus eocenicus* KURODA and URATA, n. sp., *Pseudoperissolax yokoyamai* SUZUKI and ITO,

Colus sp., *Carcharias* cfr. *cuspidatus* (AGASSIZ) and corals. In addition to them, according to YOKOYAMA (1911) and NAGAO (1928), *Neptunea* ? sp., *Volutilithes* ? sp. and *Aturia nagaoi* KOBAYASHI were discovered at the same horizon.



Text-fig. 2. Columnar section of the Omuta and the Manda groups in the Miike Coal-field.

The above-mentioned fossils are preserved mostly as separated valves, some more or less broken individuals being slightly deformed secondarily. The surface of the fossils, except the sharks' teeth, is frequently worn.

Crassatellites nipponensis and *Venericardia nipponica* are predominant in the present fauna and the innumerable individuals of the former species often occur in swarms, almost to the exclusion of any other fossils.

Short Note on the Pleurotomariid Gastropod

According to KURODA and HABE (1952), KURODA (1955), HIRAYAMA (1955), KIRA (1959) and HABE (1961), eight species of living Pleurotomariidae, belonging to three genera, are known in the world, and five species, representing three genera, are recorded from the seas adjacent to Japan. The Japanese species are: *Perotrochus teramachii* KURODA, *Mikadotrochus beyrichi* (HILGENDORF), *M. hirasei* (PILSBRY), *M. salmiana* (ROLLE) and *Entemnotrochus rumphii* (SCHEPMAN). The localities of the Japanese species are as follows:

P. teramachii	P: 33*	Off Tosa	(100 fms.)
M. beyrichi	P: 29?-35	Off Choshi, Sagami Bay and western coast of Kyushu	(150-350 fms.)
M. hirasei	P: 33-34	Kii Channel, Tosa Bay	(100-150 fms.)
		Off western Kyushu	(ca. 3 fms.)
M. salmiana	P: 33-34	Off Tosa and Sagami Bay	(150 fms.)
E. rumphii	P: 0-33	Off Tosa (Formosa, East-Indies)	

* After KURODA and HABE (1952b)

Though they are generally considered as deep-sea inhabitants, a few specimens of the species listed above have been collected from rather shallow sea bottoms. KURODA and HABE (1952a) have reported living *M. beyrichi* from a depth of about three fathoms, off the west coast of Kyushu. The living immature individual of the same species collected and reported by NIINO (1955) came from the banks near the Izu Islands, 50-90 fms. in depth.

"*Pleurotomaria*" have been recorded from formations ranging in age from Paleozoic to Recent. But the family Pleurotomariidae SWAINSON, 1840, as restricted in the "Treatise on Invertebrate Paleontology" (MOORE ed., 1960), includes 11 genera and ranges from Triassic to Recent. Among the genera, *Perotrochus* ranges from Oligocene to Pliocene and Recent, *Mikadotrochus* from Pliocene to Recent, and *Entemnotrochus* from Eocene to Miocene and Recent (MOORE ed., 1960).

In Japan, two Paleozoic pleurotomariid species were reported by HAYASAKA (1924, 1943): the one, "*Pleurotomaria*" cfr. *carinata* SOWERBY, was found in the Omi Limestone, Niigata Prefecture, and the other, "*Pleurotomaria*" *yokoyamai* HAYASAKA, in the Permian "Black Zone" of the Kinshozan area, Gifu Prefecture, but no pleurotomariid has been found in the Mesozoic* and Paleogene formations. On the other hand, five species of pleurotomariids have been collected from the Neogene deposits. They are: *Perotrochus yosiwarai* (OZAKI), *P. aosimai* OZAKI, *P. otoensis* KANNO, *Mikadotrochus yabei* (NOMURA and NIINO) and *M. prope-hirasei* (OZAKI).

P. yosiwarai, *P. aosimai* and *M. prope-hirasei* were obtained from the basal conglomerate of the lower Pliocene Naarai formation, Chiba Prefecture (OZAKI, 1954, 1958). *P. otoensis* is reported from the coarse-grained sandstone of the Miocene Kobana formation, Tochigi Prefecture (KANNO, 1961) and *M. yabei*, from the very coarse-grained sandstone of the Miocene Shirahama formation, Shizuoka Prefecture (NOMURA and NIINO, 1932).

Besides these, HIRAYAMA (1955) described an unidentified species of *Perotrochus*, but according to KANNO (1961), it seems to be conspecific with *P. otoensis*.

KURODA (1955) states that *M. yabei* seems to bear a close resemblance to *M. hirasei*.

Additional Note on the Ecological Environment of Fossil Pleurotomariids

It is well known that pleurotomariid gastropods now flourish on deep sea bottoms where gravel and coarse sand are distributed and where the influence of a warm current is felt. The only two exceptional cases of pleurotomariids occurring in shallow water are the examples from western Kyushu and from the bank near the Izu Islands.

On the other hand, the rocks and the fossil faunas in which pleurotomariids occur do not indicate such deep-water conditions.

HAYASAKA (1953) stated that the Permian Kinshozan fauna which includes "*Pleurotomaria*" *yokoyamai* represents a

* According to KANNO (private communication), "*Pleurotomaria*" sp., reported by NAGAO (1963) from the Hetonaian Akkeshi alternation, is a single Mesozoic pleurotomariid of Japan. The specimen is now under investigation by KANNO.

shallow sea environment, and further YABE (1936) considered that it suggests the sapropel deposits of mangrove swamps.

SCHENCK and KEEN (1958) are of opinion that the Danian pleurotomariid from Denmark may not have been an inhabitant of very deep-water because of the similarity between it and *Entemnotrochus adansoniana* (CROSSE and FISCHER), which was dredged from off Barbados in 60 fathoms.

OZAKI (1954) supposed the sedimentary environment of the Naarai formation to have been the gravelly bottom of an open sea about 200 m. deep, influenced by the Kuroshio.

According to HIRAYAMA (1955), the associated fauna and lithofacies suggest that the Miocene deposits from which *Perotrochus* sp. was collected represent a shallow sea environment.

On the other hand, KANNO (1961) mentioned that, though *Haliotis* and *Diodora* ? are found in the fauna, the molluscs, including *Perotrochus otoensis*, are somewhat deep-sea inhabitants. "Because of the few number of individuals and fragmental preservation of the just mentioned littoral molluscs (*Haliotis* and *Diodora* ?), it is inferred that they were removed from the shallow sea bottom to a rather deep one. The other molluscs associated with *Perotrochus* are *Cyclopecten*, *Cuspidaria*, *Fulgoraria* and brachiopods such as *Dallina*, *Terebratulina* and *Kamoica* all of them are usually rather deep-sea inhabitants."

Our new pleurotomariid specimens were collected from the lowest horizon of a very coarse-grained glauconitic sandstone occurring 60–70 m. above the coal seam (Jo-so) of the Nanaura formation. This glauconitic sandstone is about 45 m. thick and passes up into non-glauconitic coarse-grained sandstone, and about 25 m. above the top of the glauconitic sandstone the main coal seam (Daini Jo-so) of the Kattachi formation is developed.

According to YAGI (1932), glauconite is now being formed in the littoral to bathyal zone where warm and cold currents meet.

Among the associated molluscs, *Crassatellites* and *Venericardia* indicate a neritic environment, but *Pholadomya*, *Lima* and *Colus* are rather deep-sea inhabitants.

From the above discussion, it appears that the Kattachi fauna may be subneritic or bathyneritic and the rapid subsidence of the basement of the Kattachi formation might have taken place in the Miike Coal-field in the same manner as pointed out by KANNO (1961) in the Kobana formation.

Description

Family Pleurotomariidae

Genus *Perotrochus* FISCHER, 1885

Type species: *Pleurotomaria quoyana* FISCHER & BERNARDI. Recent in the Caribbean.

Perotrochus eocenicus KURODA & URATA, n. sp.

Pl. 38, figs. 1a, b, c, 2a, b, 3, 4, 5.

Material:—Holotype: GK-L 5163 (Coll. by Akira ISHIDA). Paratype: GK-L 5164 (op. cit.).

Description:—Shell rather thick, of medium size, turbiniform, broader than high; apical whorls broken, but 3.5 whorls observable, separated by shallow but well-defined sutures, somewhat

shouldered, moderately convex, last one subangular at periphery of base; selenizone just below mid-whorl, somewhat raised from shell surface and with 4 spiral striations separated by very shallow and narrow, sometimes obscure grooves; ornament fine cancellating spiral and collabral striations; spiral striations predominant between lower margin of selenizone and inferior suture and 6 in number on penultimate whorl, but very weak between upper margin of selenizone and superior suture; collabral striae oblique and strong above the selenizone and vertical, slightly convex in adapertural direction and rather obscure below the selenizone; slit unobservable, base slightly swollen, with numerous spiral lines which are crowded at marginal area but gradually become sparse towards the umbilical region, and are crossed by numerous very fine concentric growth-lines slightly convex in adapertural direction. Umbilical region not known in detail because of extreme hardness of mother rock, pseudumbilicus possibly present. Aperture broken.

Dimensions:—

	Holotype	Paratype
Height	60 mm. (estimated)	50 mm. (estimated)
Maximum diameter	72.0 mm.	.....
Minimum diameter	60.5 mm.	.....
Width of selenizone	1.6 mm. on the last whorl	1.6 mm. on the last whorl 1.2 mm. on the penultimate whorl
Apical angle	100°	.....
Incremental angle	85°	.....

Type locality and horizon:—Roadside, 1 km. ENE from the Kattachi mine, Shimo-takata, Omuta City, Fukuoka Prefecture. Lower Nogata fossil bed, basal part of the Kattachi formation, Manda group.

Distribution: — Only known from the type locality.

Comparision: — This new species is distinguished from all previously known Japanese Cenozoic pleurotomariids by its characteristic surface ornament, consisting, as described above, of strong collabral and weak spiral striations above the selenizone, and of weak collabral and strong spiral striations below it. This character is not seen in other Cenozoic pleurotomariids at all, but is clearly observable in the Permian "*Pleurotomaria*" *yokoyamai* HAYASAKA.

According to COX*, there is another species which is of the Oligocene or the lower Miocene in age, *Perotrochus allani* MARWICK, reported from Waikaripi, Chatham Island, New Zealand. This species shows some similarity to our new species, but the former has a slit-band situated at about median part of the whorl, and as ornamentation, it shows spiral cords.

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vol. 8, no. 1.

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Kinshozan	金勝山	Kattachi	勝立
Shimo-takata	下高田		

Explanation of Plate 38

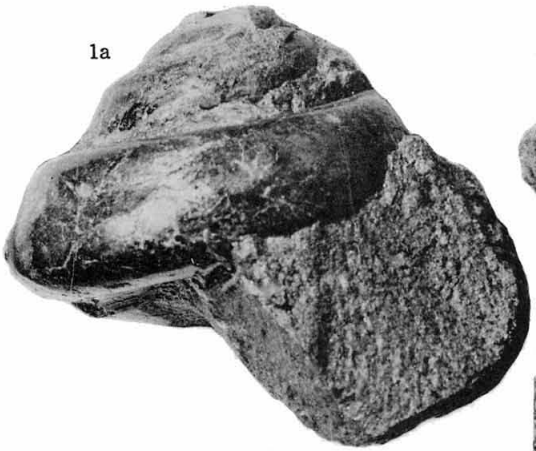
Fig. 1. *Perotrochus eocenicus* KURODA et URATA, n. sp., Holotype. ×1. a, apertural view; b, apical view; c, umbilical view.

Fig. 2. *Perotrochus eocenicus* KURODA et URATA, n. sp., Paratype, ×1. a, apertural view; b, apical view.

Fig. 3. Portion of surface of the Paratype showing the characteristic ornament above and below the cicatrix. ca. ×2.5.

Fig. 4. Portion of surface of the external mould of the Holotype showing the characteristic ornament. ca. ×1.7.

Fig. 5. Portion of basal surface of the external mould of the Holotype showing the ornamentation of base. ca. ×1.5.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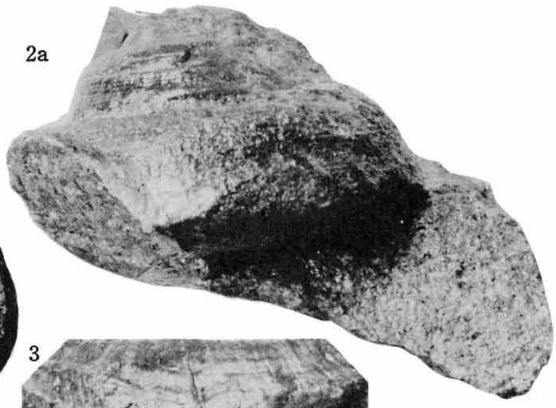
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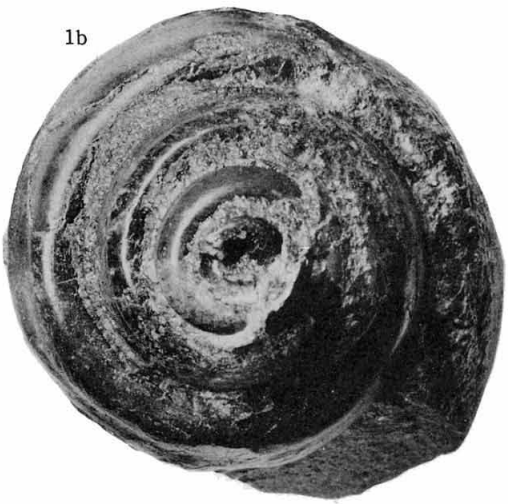
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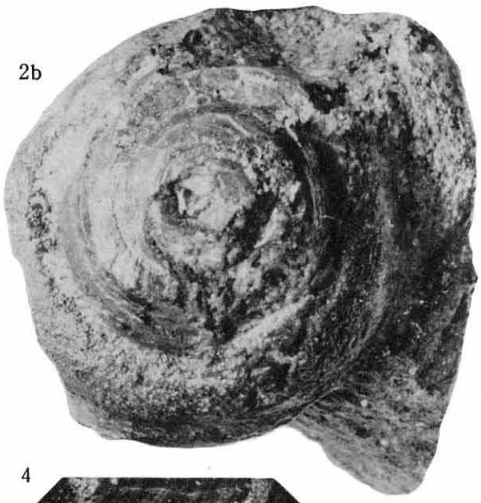
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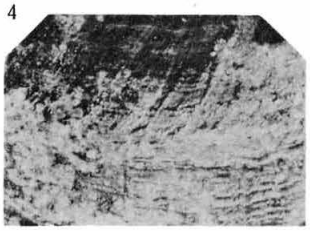
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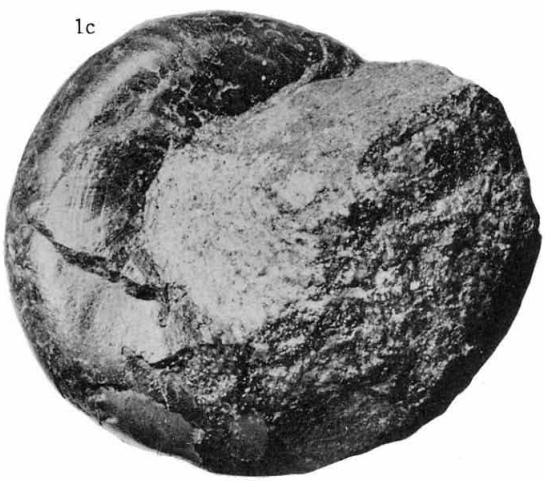
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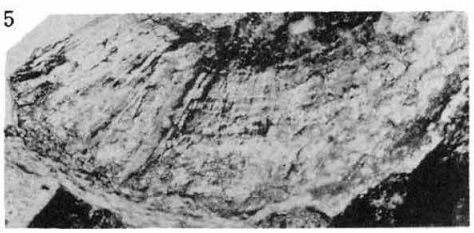
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Trans. Proc. Palaeont. Soc. Japan, N.S., No. 55, pp. 271-280, pls. 39-41, Sept. 20, 1964

475. A FIND OF SPONGIOMORPHOIDS FROM THE CRETACEOUS SYSTEM OF REBUN ISLAND AND THE ESASHI GROUP OF THE ESASHI MOUNTAINS, HOKKAIDO*

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北海道礼文島白亜系および枝幸山地の枝幸層群から Spongiomorphoids の発見：礼文島の基盤をつくる地層から、秋葉力・大森保によって、下部白亜紀バレム世を示す菊石の産出が報告されたが、その分布は菊石産出層準を中心とし、極狭い範囲と考えられた。しかし、1962年、筆者等は礼文島の地質の予察を行ったところ、菊石産出層準より、さらに上位にあたるところからも中生代化石を発見した。そして、基盤の層序については、古い佐藤文男のものが、多少の修正を加えるだけで使用出来得ることを知った。

採集した化石は、*Zamiophyllum*? を除き、いづれも珪岩質噴出物の中に含まれる石灰岩塊中に発見されたもので、いわゆる島の巣型生物群といえよう。そうしたものの中に2種類の Spongiomorphoids が発見された。この仲間は白亜紀層に産することはむしろ稀で、江口元起が岩手県宮古の *Orbitolina* 砂岩層から一種記載しているにすぎない。礼文島ではバレム世の菊石産出層準の上位からこの仲間が発見された事、その内の一種はいわゆる島の巣石灰岩産の種に同定され、他の一種も、新種ではあるが極めて近い種がある。そこでそれ等を記載すると共に、あわせて枝幸山地産のこの仲間についても記した。また、こうした化石に関連して、北海道からの記録をしらべ、産出層準について言及した　　橋本　亘・長尾捨一

Introduction

Nearly a decade ago, when the senior writer compiled the geologic map of Hokkaido on the scale of 1 : 600,000, he treated the basement complex of Rebun island as being of the Cretaceous period according either to its stratigraphic relation to the Tertiary system or to the litho-facies described by F. SATO (1936, MS.). However in 1957, upon the occasion of compilation of the 1 : 200,000 geologic map of Hokkaido, the senior writer treated the same depositions as pyroclastic facies of the Sorachi series of the Jurasso-Cretaceous age according to the junior writer's observation on it.

The senior writer had been thus in two mind, due to the following points, namely, 1) the basement complex of Rebun island consists of heavy effusive rocks of porphyrite origin, 2) no fossil had been recognized from it until that

* Received June. 23, 1964; read Nov. 19, 1961.

time, 3) on the other hand in south Saghalien to the north of this island, there develops a well known fossiliferous porphyrite pyroclastic formation, the Ryugase, of Upper Senonian age (T. MATSUMOTO, 1942-1943), while in the central meridional geotectonic zone of Hokkaido there develops a thick effusive facies of porphyrite in the lower and the middle parts of the Shuyubari formation of the Sorachi group. The latter is considered to be of Jurasso-Cretaceous age as judged by the presence of calcareous algae found within it. (W. HASHIMOTO, 1958a and 1960a).

Very recently, C. AKIBA and T. OMORI (1959) discovered *Crioceras* sp. from the Jizoiwa formation of F. SATO. Moreover T. MATSUMOTO of Kyushu University stated that, he has been presented a fairly good specimen of *Pulchellia* obtained by T. OMORI from the same locality through the courtesy of K. TANAKA of the Geological Survey of Japan who examined the fossil locality together with T. OMORI. Thus the Barremian age of the Jizoiwa, the lowermost formation of the basement complex of the island has been recognized.

Judging from the report of AKIBA and OMORI, it seems to the present writers that they considered the Cretaceous deposits of Rebun island to be limitted to a small area covered by the Jizoiwa formation while nearly all of the remaining area consists of various kind of Miocene deposits, such as so-called "green tuffs" etc. In other words, they seemed to consider the remaining part of SATO's basement complex consisting mostly of porphyrite pyroclastics to be of Miocene age, including SATO's Tertiary green tuff.

It is a very interesting problem in speculating upon the development of the geologic structure of Hokkaido that the "lower Miocene green tuff" formation which hitherto has been regarded as the most characteristic member of the geotectonic zone of southwest Hokkaido and circum-Okhotsk region, overlies a basement complex of peculiar facies compared with that of the above mentioned areas. Therefore the senior writer has been much interested in the stratigraphy of the island and had tried to visit the island for geological survey. In 1962, he got a chance to follow the junior writer who has been engaged in field works for the publication of the geologic map of the island for the Geological Survey of Hokkaido with cooperation of Messrs C. AKIBA, T. OMORI, H. OSANAI and K. MATSUSHITA.

The present writers' geological excurtion was successful for observation of the stratigraphy of the basement complex of the island. They obtained a plenty of individual Mesozoic fossils from the horizon of much upper than the Jizoiwa formation where Barremian ammonites were obtained. Herein the findings are described.

Before proceeding further, the writers express their cordial thanks to Prof. M. EGUCHI of Tohoku University for his kind advice on the fossil spreactinids and to T. MATSUMOTO of Kyushu University for his kind information on ammonites from the island. Present writers are also much indebted to Dr. H. OSANAI and Mr. K. MATSUSHITA of the Geological Survey of Hokkaido, to Dr. C. AKIBA of Hokkaido Gakugei Daigaku and to Mr. T. OMORI of Utanobori Primary School for information on the stratigraphic relation of the Nairo formation described below.

Brief Notes on the Geology of Rebun Island

F. SATO (1936 MS.) established the following stratigraphic order for the basement complex of the island, in descending order.

Nairo formation
Anama formation
Uennai upper formation
„ lower „
Jizoiwa formation

According both to the present writers' observations and to information given by Messrs. C. AKIBA, T. OMORI, H. OSANAI and K. MATSUSHITA, SATO's succession seems to be almost acceptable with the slight modification described bellow. Namely, the revised Jizoiwa formation is restricted to the part which consists of agglomeratic rocks intercalating thin bedded greenish, tuffaceous mudstone and sandstone layers from which, as above mentioned two kinds of Barremian ammonites have been obtained. Therefore, the upper part of SATO's Jizoiwa formation illustrated in his geological map must be transferred to the Uennai lower formation of revised meaning. The thickness of the Jizoiwa attains 200 m.

The revised Uennai formation consists mostly of pyroclastic sediment of porphyrite eruption; it overlies the Jizoiwa and conformably underlies the Anama. The typical exposure is observed along the west coast of Rebun island from Uennai southwards to just north of Jizoiwa. This formation is subdivided into two parts: the lower consists of greenish tuffaceous sandstone intercalating tuff-breccia and agglomerate and attains 400 m in thickness; the upper consists of an alternation of tuff-breccia and agglomerate which is characterized by small pieces of calcareous remains of organisms or calcareous mud scattered in the matrices of rock and attains also ca. 400 m in thickness.

The Anama formation consists of tuff-breccia and intercalates fossil-plant-bearing sandstone and slate; thickness ca. 400 m. The type locality of this formation is on the Anamaiwa coast situated at nearly 1 kilometer north of Uennai. The Nairo formation of ca. 600 m thickness widely crops out along the east coast of the island; it consists mostly of agglomerate, porphyrite blocks which display characteristic onion weathering surface, intercalating some sheets of porphyrite lava flow.

According to H. OSANAI, the Nairo conformably overlies the Anama in the central part of the island. The Nairo forms a broad and gentle folded synclinorium with an axis almost parallel to the direction of the island which embraces the Rebundake formation at its central part and includes the remaining formation described above on its western flank.

According to C. AKIBA and T. OMORI, the Rebundake formation consists mainly of tuffaceous sandstone and tuff-breccia in alternation and certain amount of lava flow of basaltic andesite, a part of which, sometimes, grades into agglomerate. The present writers propose a new name "the Rebun Group" for the above described six formations, namely the Jizoiwa, Uennai lower, Uennai upper, Anama, Nairo and Rebundake formations in ascending order.

Notes on Biota and Age Consideration

The present writers obtained many Mesozoic fossils from the Rebun group

exposed along the west coast of Rebun island, those are: *Zamiophyllum* ? sp., *Stromatomorpha rebunensis* n. sp., *Spongiomorpha asiatica* YABE and SUGIYAMA, *Thamnasteria* sp., *Stylina* sp., *Latomeandra* ? sp., *Polyphylloseris* ? sp. cf. *P. iwatensis* EGUCHI, *Placocoenia* ? sp., besides calcareous algae, stromatoporoids and others.

The first mentioned one was obtained from the Anama formation and the rest from the Uennai upper formation. The impression determined as *Zamiophyllum* ? sp. is not in sufficiently good preservation for determination of distinguishing point of this genus. However, its general figure closely resembles the certain part near the apex of this Bennettitales.

Zamiophyllum Buccianum (ETTINGSHAUSEN) NATHORST, the only one species of this genus, is the typical Wealden indicator in Europe and North America, however, in Japan, it ranges from Upper Jurassic to Upper Cretaceous. Although, *Zamites Yabei* OISHI of lower Jurassic is another allied form in Japan, the form of pinnule base and the manner of its attachment to the middle rachis of the present specimen is quite distinguishable from that of *Z. Yabei*.

A spongiomorphoid is a typical Mesozoic organism which flourished mostly in the Triassic seas in foreign countries; therefore, it was the first record of this organism from the Upper Jurassic when YABE and SUGIYAMA (1931) described *Stromatomorpha yokoyamai*, *Spongiomorpha asiatica* and *Spongiomorpha globosa* from the Torinosu limestone of Japan.

Among many localities of the Spongiomorphoid-bearing limestone of Honshu reported by YABE and SUGIYAMA, the Torinosu limestone of "Sanchu graben" in the Kwanto Mountains was considered by M. EGUCHI (1951) to be Cretaceous in age due to the inclusion of the Cretaceous coral *Eugyra*. However, no further argument on the geologic age of the limestone was carried on and the editors of the 1 : 200,000 geologic map of Nagano Prefecture regarded the Naranokidaira formation which includes the limestone under question to be Upper Jurassic in age. In 1948, M. EGUCHI reported *Spongiomorpha miyakoense* EGUCHI from the "*Orbitolina* sandstone" of Miyako, Iwate Prefecture.

This is the first description of a Cretaceous spongiomorphoid. Prior to that, the first report of a Cretaceous spongiomorphoid was made by YABE and SUGIYAMA (1939b) on the existence of a species allied to *Spongiomorpha asiatica* from the *Orbitolina* limestone of Hokkaido, but neither description nor illustration was attached to their statement. They also reported the discovery of *Spongiomorpha asiatica* from Iwachishi, Hidaka Province, Hokkaido, which was said to be identical with the type specimen from the "Sanchu graben". According to T. NEMOTO, M. SANBONSUGI and B. MIZUGUCHI (1942), the Iwachishi sample was probably obtained from the Sarugawa series which was correlated by the senior writer (1959) to the Yamabe formation, the lower half of the Sorachi Series; both of these, especially their upper part, are considered to be of Upper Jurassic.

Microsolena sp. reported by YABE and SUGIYAMA (1939b) from the Pepeshuru River in Iburi Province, Hokkaido presents feature closely resembling spongiomorphoid. The present writers, after their studies on the Rebun specimen described bellow, and some specimens of

Microsolena from Honshu, are rather inclined to consider that the Iburi specimen is hardly distinguishable from *Spongiomorpha* and probably is conspecific with *asiatica*. Iburi specimen was obtained from the river floor of the Pepeshuru River and is considered to have been washed out from the "schalstein group" of the Sarugawa Series.

Stromatomorpha rebunensis closely allies to *Stromatomorpha yokoyamai*, with which the writers once misidentified it (W. HASHIMOTO and S. NAGAO, 1962). This new species was found from the formation conformably superposing on the ammonite-bearing Jizoiwa formation of Barremian age together with *Thamnasteria* sp., *Polyphylloseris*? sp., cf. *P. iwatensis* and other corals besides above mentioned *Spongiomorpha*.

Recently, Y. TERAOKA obtained *Stromatomorpha yokoyamai* from the Nikoro group (W. HASHIMOTO and Y. TERAOKA, 1962 MS.) in Kitami Province together with Stromatoporoids of the Torinosu and Ainonai elements (W. HASHIMOTO, 1960c).

The Nikoro group intercalates the Ainonai limestone in its southern extention and is considered to be equivalent to the Yamabe formation to both its lithic character and fossil evidence.

As already mentioned above, the so-called "Torinosu fossil elements" occur not only in the Yamabe formation and its equivalents but also in such a higher horizone as the Uennai upper formation conformably superposing on the Barremian Jizoiwa.

Two forms of *Thamnasteria* were observed in thin section. This genus ranges from Middle Triassic to Middle Cretaceous. *Stylina* ranges Upper Triassic to Lower Cretaceous. A specimen resemblant to *Latomeandra* was obtained, which ranges from Middle Jurassic to Lower Cretaceous.

Many individuals of *Polyphylloseris* were collected from several places, but no one preserves its external feature which provides the distinguishable character of this genus. The general features observed in the thin section of the Rebun specimens, however, seem to the writers quite similar to those of *P. iwatensis*. The latter was described by M. EGUCHI (1951) from the Hiraiga sandstone of Miyako, which is, according to S. SHIMIZU (1931), Aptian in age. Genus *Polyphylloseris* ranges from Upper Jurassic to Cretaceous. Two individuals of *Placocoenia* are at hand. Their state of preservation is not very good. This is a Cretaceous genus.

Lithocodium was established G. F. ELLIOT in 1956 on specimens obtained from the lower Cretaceous of Iraq. R. ENDO (1961) added two new species from the Torinosu limestone of Soma, Fukushima Prefecture and of Kochi district.

Judging from the above mentioned palaeontological and stratigraphical data, the geologic age of the Uennai upper formation may be considered to be of Lower Cretaceous, Barremian or slightly younger.

Notes on Specimens from Nakatombetsu-machi, Eshashi County, Kitami Province

Three specimens are at hand: one small piece of coenosteum from Garo of the Peichan River (Pl. 41, figs. 1, 2 and 3) and two fragmental sections (Pl. 41, figs. 5 and 6) from a railroad cutting at about 1 kilometer to the west of Shotom-

betsu station.

When he described the problems on the stratigraphy of the Esashi Mountains, the senior writer (1960a) reported the discovery of those fossils.

The Garo limestone runs nearly N-S and upright within a thick pyroclastic formation with pillow lavas; gray in color, apparently barren of fossils excepting for only one which is identical with *Spongiomorpha asiatica* (Reg. No. 30416). R. ENDO (1960) described *Pycnoporidium lobatum* collected by S. IMANISHI from a limestone lense exposed at the Nakanokawa valley, a tributary of the Peichan River. This limestone is considered by the present writers to be of nearly the same horizon as the Garo limestone.

The Shotombetsu specimens were found in a thin section (Reg. No. 30409) together with *Yezoactinia shotombetsuensis* (W. HASHIMOTO, 1960b). They probably belong to the genus *Spongiomorpha*, however, further study is impossible due to failure to make sections of different orientation.

The geologic age of the formations intercalating above mentioned limestone is assumed to be Upper Jurassic according chiefly to the lithic character, though there is little palaeontological evidence (W. HASHIMOTO, 1960b; R. ENDO, 1960).

Description of Spongiomorphoid

Order SPONGIOMORPHIDA, ALLOITEAU, 1952

Family SPONGIOMORPHIDAE, FRECH, 1890

Genus *Stromatomorpha*, FRECH, 1890

Type of Genus *Spongiomorpha stylifera* FRECH

Stromatomorpha rebunensis HASHIMOTO and NAGAO, n. sp.

Pl. 39, figs. 1-6; Pl. 40, fig. 1.

1962. *Stromatomorpha yokoyamai*, HASHIMOTO and NAGAO, p. 235.

Coenosteum massive, subsphaerical; diameter of the holotype attains 5×7×5 cm; mode of attachment probably encrusting according to paratype; consists of ramified skeleton as if of sponge at a glance at the well weathered surface of holotype; however, it is not skeletal elements, but skeletal interspaces full up with silicate derived from rock matrices enclosing the fossil which are important. After careful examination, it is observed, that the coenosteum consists of two kinds of skeletal elements

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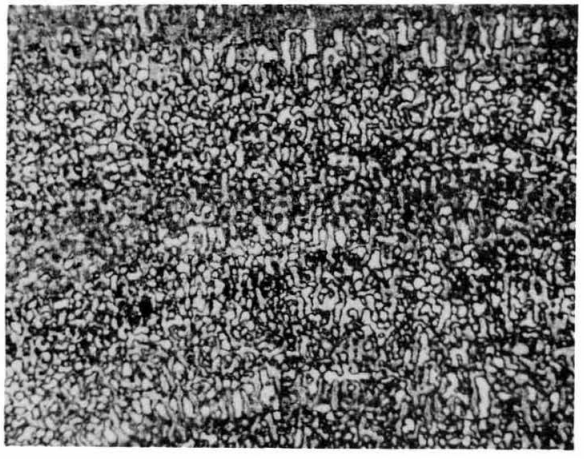
Explanation of Plate 39

Figs. 1-5. *Stromatomorpha rebunensis*, n. sp. (Reg. No. 30411).
Fig. 1. Cross section. ×3.
Fig. 2. Vertical section. ×3.
Fig. 3. Partial enlargement of fig. 2. ×8.
Fig. 4. Partial enlargement of fig. 1. ×8.
Fig. 5. Partial enlargement of fig. 5. ×20.
Fig. 6. *Stromatomorpha rebunensis*, n. sp. (Reg. No. 30414).



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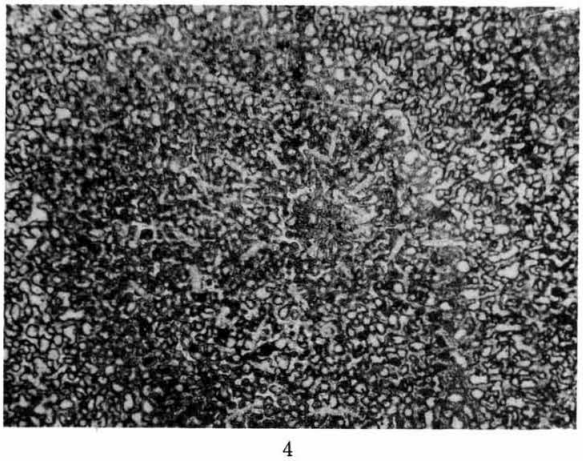

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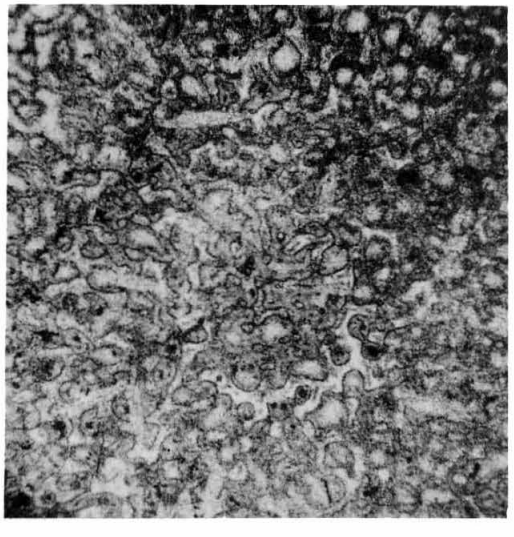

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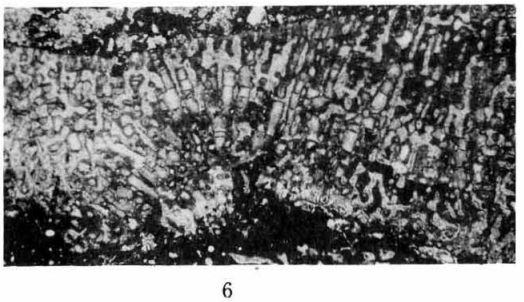


6

S. AOKI photo.

arranged vertical and in concentric order.

Vertical elements relatively more prominent than the concentric or horizontal ones; short, very thin walled, slightly sinuated trabeculae, thickned ring-wisely with somewhat regular intervals; arranged nearly parallel and perpendicular to the base or encrusting surface. Diameter of trabeculae ca. 0.1 mm. commonly and 0.23 mm at maximum at the thickened part; thickness of thin wall of skeleton about 0.03 mm.

Therefore, vertical elements appear in the cross section as rounded or somewhat irregular shaped figures of various diameter up to 0.23 mm; often neighbouring ones connected at their thickened parts or by short horizontal elements show constricted lamellar skeleton as if a short, sinuated rosario in the cross section. In the vertical section, however, they appear as slightly sinuated and gently waved moniliform, short trabeculae in parallel direction; sometimes, neighbouring ones united with each other at their thickened part or by short horizontal bars, therefore they show a wide skeletal element with slightly constricted outline corresponding to longitudinal low of a few or several small rounded or narrow longitudinally elongated pores occuring at the central part of the wide vertical element. Very thin, streight or slightly curved partitions occur at various levels within the vertical skeletal elements; some of them are traceable horizontally one by one in the vertical section of vertical elements, for a considerable distance. This evidence probably means the older upper surface of coenosteum. Partition interval varies from 0.175 to 0.21 mm commonly, attains 0.46 mm or more not seldem.

Horizontal elements rather short, connecting neighbouring vertical elements as short bars, therefore, they display their cut ends and tangential figures in the vertical section of coenosteum as rounded or sub-rounded spots with thin wall or horizontal bars of short ladder with different lengthened side flame consisting of vertical elements; sometimes, a horizontal bar connects to the neighbouring vertical element with or without interruption by the neighbouring one according to the grade of development of the two elements. A horizontal element, however, does not continue very far horizontally, being limited within the space including three or four vertical elements even in the largest specimen. In the coenosteum cross section, horizontal elements appear as short, moniriform bars connecting cut ends of vertical elements, or form a moniriform ring which in turn, sometimes concentrates in a small area to form lamellae with several rounded pores. No partition occurs between horizontal elements.

Horizontal and vertical interspaces are nearly the same in width. Vertical elements counted 10-12 in 2 mm and horizontal ones 10-14 in the same distance.

Microstructure of skeleton is fibrous excepting for the expanded part of skeleton where thin fibrous wall enclosing the transparent part consisted of carbonate crystal without any sharp boundary line.

No tabulae or dissepiment is observed in the interspaces of skeletons. Stellate structure, none observed which matched typical one.

Remarks:—Stromatomorpha yokoyamai YABE and SUGIYAMA is a closely resembling species so the writers misidentified the present species as a dwarf variation of the former. However, the present species is distinguishable from the former by its less development and

short intervals of horizontal elements, though their interspaces are narrower; no tabulae and finess of skeleton as a whole.

Repository:—Tokyo Kyoiku Daigaku, Reg. No. 30411, the holotype; No. 30413, the paratype, No. 30414 and No. 30412.

Localities and Geologic Horizon:—Locality No. R-11 of G. S. HOK., about 2 kilometers south of Uennai on the southern part of the west coast of Rebun Island, Hokkaido. Uennai upper formation; probably Barremian or slightly younger in age.

Genus *Spongiomorpha*, FRECH, 1890

Type of Genus *Spongiomorpha acyclina* FRECH

Spongiomorpha asiatica YABE and SUGIYAMA

Pl. 40, figs. 3, 4 and 5; Pl. 41, figs. 1, 2, 3 and 4.

1931. *Spongiomorpha asiatica*, YABE and SUGIYAMA, p. 104, Pl. 34, figs. 1-8 and Pl. 35, fig. 6.

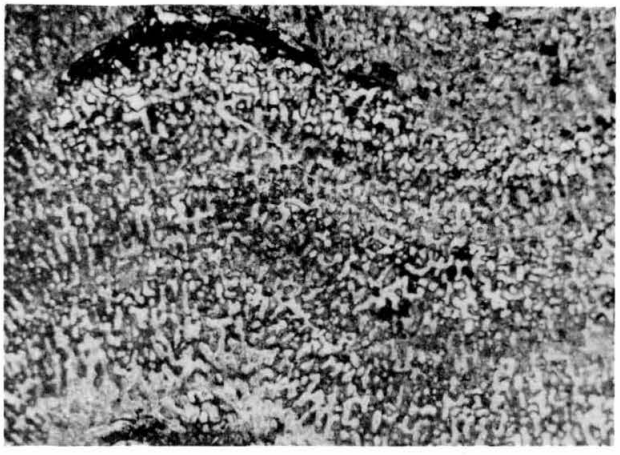
1939. ? *Microsolena* ? sp., YABE and SUGIYAMA, p. 87, figs. 1-3.

A few fragmental pieces of coenosteum conspecific with this species are at hand from Rebun Island and one specimen from Garo of the Peichan River, Nakatombetsu-machi, Esashi-gun, Kitami Province. The largest one of them, from Loc. No. R-11 of Rebun island is about 4 cm long, 2×1 cm in diameter at one end and about 0.5 cm at the other end. This is probably a part of a cylindrical body, attached to another organism, Bryozoa? judging from its weathered surface (Reg. No. 30416). Another specimen shows lamellar nature in its vertical section as if it was an encrusting form. Mode of attachment of the Garo specimen is not known.

Coenosteum is composed of vertical and horizontal elements. Both are nearly the same in diameter, about 0.05 mm. Vertical one prominent, trabecullar in its form, arranged almost in parallel with regular interspaces of about 0.12-0.14 mm. Horizontal elements connect the neighbouring vertical elements with regular intervals, about 0.1 mm or little larger. Connecting parts of both elements slightly increase in diameter towards the connecting point according as they approach each other, form four ridges with low and round tops around horizontal base and trabeculae and show roundness to the every corner of the lattice work, form a round or elongated pore by an arrangement of two each horizontal and vertical elements. Thus the lattice structure with elongate round space appears in the thin sections. According to the orientation of the thin section, there appear trabeculae furnish-

Explanation of Plate 40

Fig. 1. *Stromatomorpha rebunensis*, n. sp. (Reg. No. 30413). ×8.
Fig. 2. *Polyphylloseris* ? sp. cf. *P. iwatensis* EGUCHI (Reg. No. 30420). Cross section. ×8.
Figs. 3, 4 and 5. *Spongiomorpha asiatica* YABE and SUGIYAMA. (Reg. No. 30416).
Fig. 3. Vertical section. Partial enlargement of fig. 5. ×8.
Fig. 4. Cross section. Partial enlargement of fig. 5. ×8.
Fig. 5. ×3.



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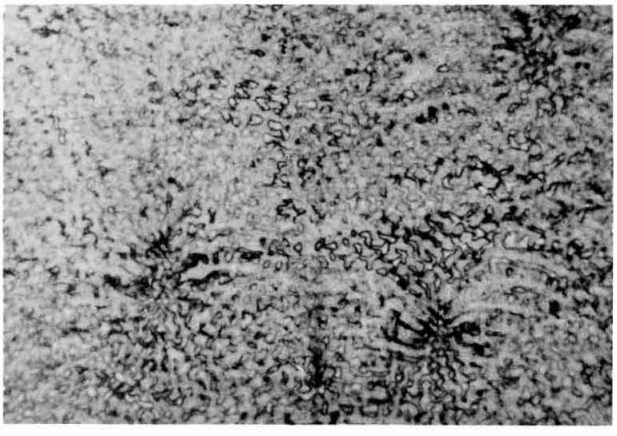

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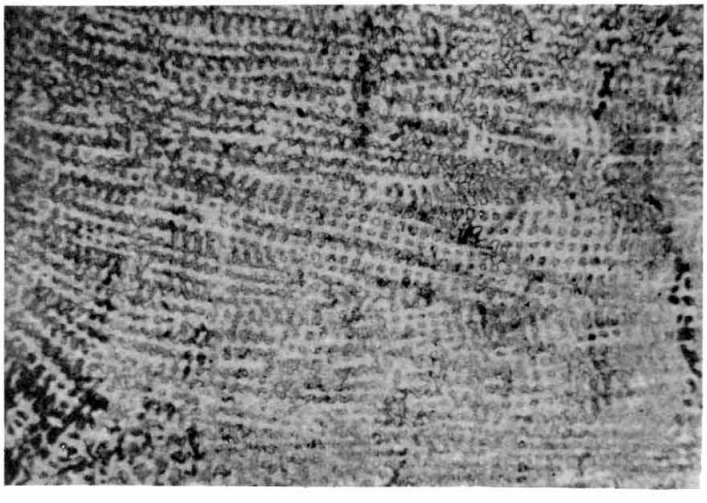

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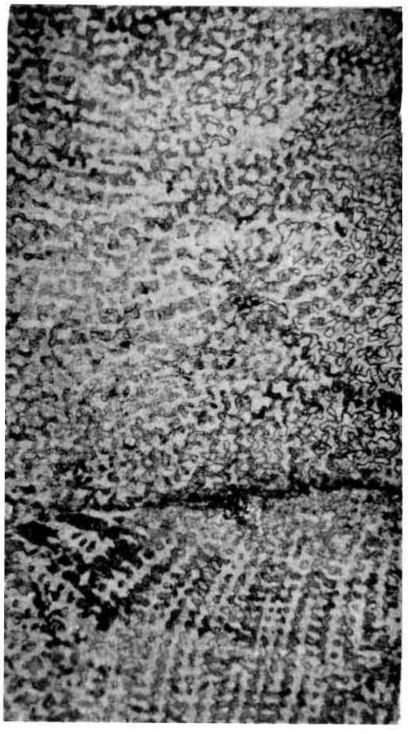

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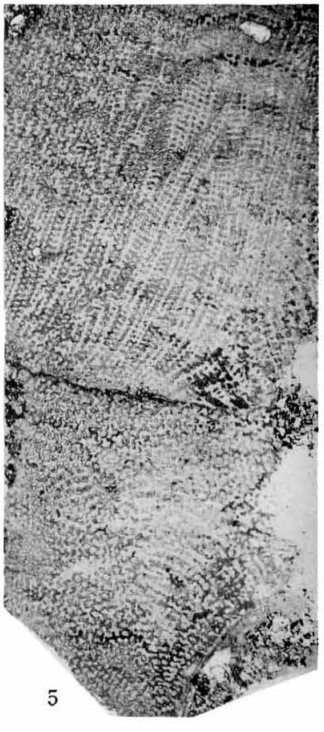

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S. AOKI photo.

ed with rhomboidal expanding parts having a regular interval or rhomboidal or rounded cut ends in a row.

Stellate astroheather-like structure occurs here and there, but not so often; cross section of it shows such a structure that one vertical trabeculae in center and 12 lamellae radiate from 6 points surrounding the central one in hexagonal arrangement (Pl. 40, figs. 4 and 5, Pl. 41, figs. 1, 2 and 3).

Remarks:— Although *Polyphylloseris* has some similar characters, the present specimens are distinguishable from it by the characteristic stellate structure. One of the Rebun specimens of *Polyphylloseris* (Reg. No. 30420) is illustrated for comparison (Pl. 40, fig. 2). Sample shown in Pl. 40, figs. 3, 4 and 5 closely resembles the figure of *Microsolena*? sp. illustrated by YABE and SUGIYAMA, in both skeletal structure and size.

Repository:—Tokyo Kyoiku Daigaku, Reg. No. 30416, the Rebun specimen; Reg. No. 30410, the Garo specimen.

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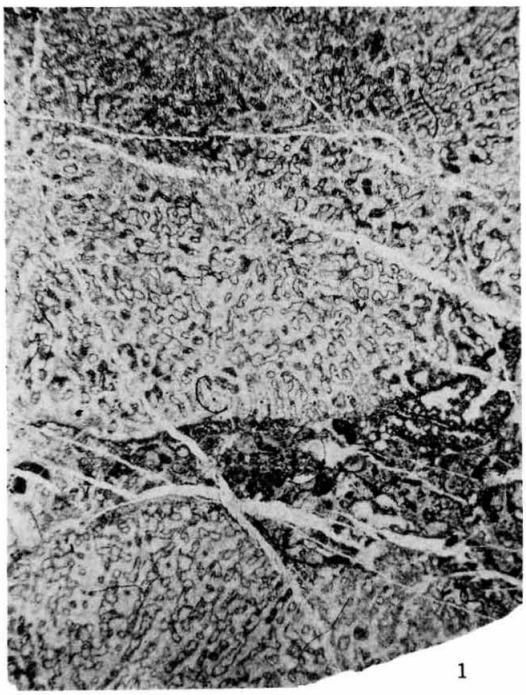
P.S. Explanatory Text and Geological Sheet Map "Rebun Island" by S. NAGAO, C. AKIBA and T. OMORI was published in 1963 prior to contribution of this manuscript.

Anamaiwa	アナマ岩	Nakatombetsu-machi	中頓別町
Garo	ガ ロ	Peichan River	兵知安川
Iwachishi	岩知志	Rebun island	礼文島
Jizoiwa	地蔵岩	Shotombetsu	小頓別
Nakanokawa	中ノ川	Uennai	宇遠内

Explanation of Plate 41

Figs. 1, 2, 3 and 4. *Spongiomorpha asiatica* YABE and SUGIYAMA. ×10. (Reg. No. 30416). Loc. Garo of the Peichan River, Nakatombetsu-machi, Esashi-gun, Kitami.
Fig. 1. *Lithocodium*-bearing specimen.

Figs. 5 and 6. *Spongiomorpha* sp. ×10. (Reg. No. 30409). Loc. About 1 kilometer west to the Shotombetsu station, Nakatombetsu-machi, Esashi-gun, Kitami.



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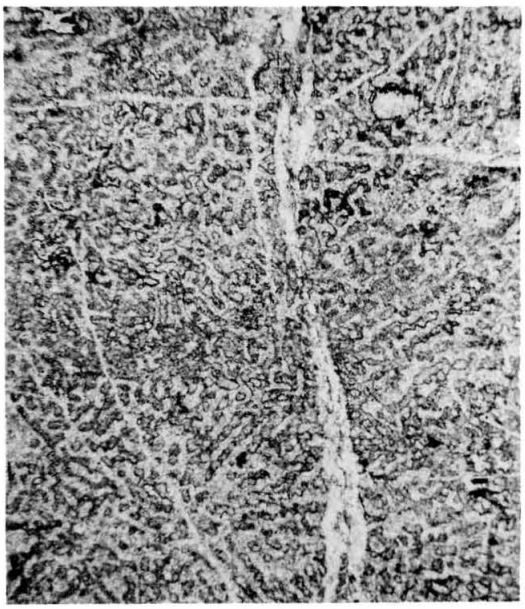

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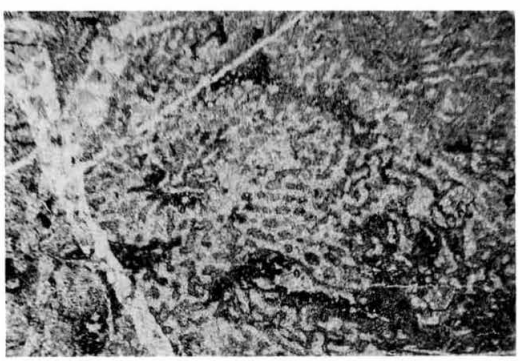

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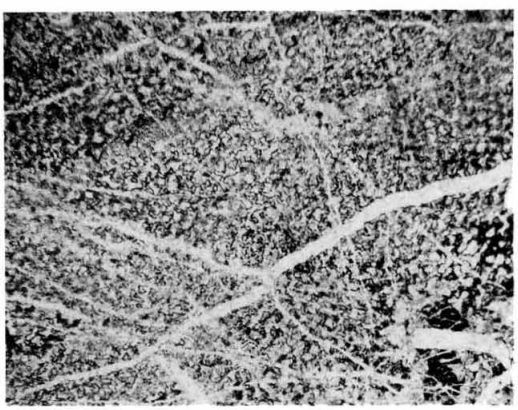

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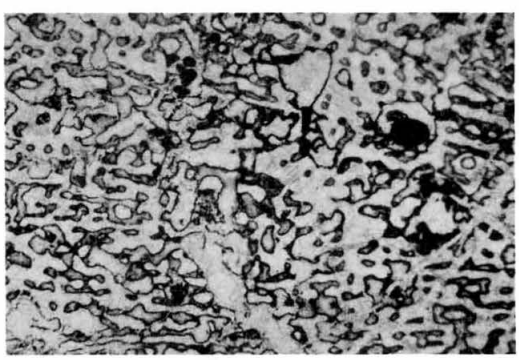

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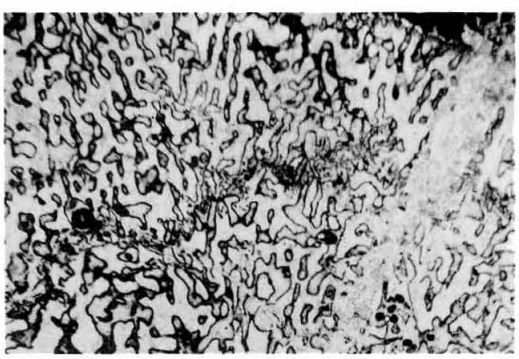

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S. AOKI photo.

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 55, pp. 281-293, pls. 42, 43, Sept. 20, 1964

476. NATICID GASTROPODS FROM THE MIYAZAKI GROUP (PALAEONTOLOGICAL STUDY OF THE MIYAZAKI GROUP—X)

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宮崎層群産タマガイ類：宮崎層群産化石軟体動物の研究の一部として腹足綱 Naticidae 科の4属，9種，うち2種は新種，の記載をする。また従来の慣用に従う一，二の既知種の分類について，問題があるのでそれについて私見を述べる。 首藤次男

Here are the descriptions of nine species of Naticidae from several horizons of the Miyazaki group. Of nine species six are known in our country, two are new to science, and one is possibly new species.

I am greatly indebted to Professor Tatsuro MATSUMOTO of Kyushu University for his kind suggestions and advices during the field survey and laboratory work. I wish to express my cordial thanks to Professor Ryuzo TORIYAMA of the same university for his valuable advices and thorough criticisms on the subject at the type script.

I also appreciate Drs. Tadashige HABE of National Science Museum of Tokyo and Katura OYAMA of the Geological Survey of Japan for their valuable advices and discussions at the field of the molluscan taxonomy. This study was partly financed by the aid of the science research expenditure fund by the Ministry of Education.

Systematic Description

Received June 20, 1964; read Jan. 19, 1964 at Fukuoka.

Superfamily Naticacea

Family Naticidae

Subfamily Polinicinae

Genus *Polinices* MONTFORT, 1810

(type-species: *Polinices albus* MONTFORT =*Nerita mamilla* LINNÉ by original designation)

Subgenus *Neverita* RISSO, 1926

(type-species: *Neverita josephina* RISSO by monotypy)

Polinices (*Neverita*) *sagamiensis* PILSBRY

Pl. 42, Figs. 2, 8 and 14.

1904. *Polinices sagamiensis* PILSBRY, *Proc. Acad. Nat. Sci. Philad., Vol. 56*, p. 23, pl. 4, fs. 37, 37a.

1922. *Polinices powisianus*, YOKOYAMA, *Jour. Coll. Sci., Imp. Univ. Tokyo, Vol. 44, Art. 1*, p. 83, pl. 14, f. 12 (not of RECLUZ).

1935. *Polinices sagamiensis*, OTUKA, *Bull. Earthq. Res. Inst., Vol. 13*, p. 866, pl. 53, f. 26.

1951. *Polinices sagamiensis*, (HIRASE) TAKI, *Handb. Illust. Shells*, pl. 91, f. 8.

1954. *Polinices (Mammillaria) sagamiensis*, TAKI and OYAMA, *Palaeont. Soc. Japan, Spec. Pap., No. 2*, p. 17, pl. 21, f. 12.

1954. *Polinices sagamiensis*, KIRA, *Colored Illust. Shells Japan, I*, p. 35, pl. 17, f. 15.

1961. *Polinices sagamiensis*, HAYASAKA, *Sci. Rep., Tohoku Univ., 2nd Ser., Vol. 33, no. 1*, p. 75, pl. 9, fs. 12a, 12b.

Material:—GK-L 7987 (loc. Nihonmatsu), 7988-7990 (loc. Tôriyama). All the specimens were collected by myself.

Measurements:—

specimen GK-L	max D (mm)	min D (mm)	H (mm)	H/max D (%)	numb. whorls	loc.
7987	20.0	24.9	ca. 23.0	115.0	5.4	Nihonmatsu
7989	40.6	33.9	32.3	79.9	6.0	Tôriyama

Remarks:—The specimens from Tôriyama are quite identical to the living species, but that from Nihonmatsu slightly differs from others in being provided with an obsoletely and shallowly grooved band close to the upper suture. This band starts at the one-third of the third whorl. It is minutely and spirally striated and bordered below by rather a distinct step-like ridge. The early two and one-third whorls are separated from the succeeding whorl by oblique and weak ridge which is more distinct than the normal growth-lines. This character is not observed on ordinary specimens of *P. sagamiensis*, both living and fossil, and suggestsa possible specific discrepancy between this and others. I am, however, inclined to treat this specimen as an abnormal variety of *P. sagamiensis*, because subsutural grooved band is examined only at a single specimen.

The present species, although it has been described by many authors as *Polinices* MONTFORT, 1810, is quite similar to the type species of *Neverita* RISSO, 1826, in general characters, especially in the outline and umbilical feature. *Polinices mamilla* (LINNÉ), the type species of *Polinices*, has tall shell with almost filled umbilicus, while *Neverita josephina* RISSO, the type-species of *Neverita*, has depressed shell with crescent umbilical furrow. The difference in the outline of the shells between these two type-species is very distinct in reality, but they are reasonably congeneric on the basis of the several intermediate species.

Horizon:—The fifth and sixth fossil horizon of the Miyazaki group (Lower Pliocene).

Localities:—1) Road side small cutting at Nihonmatsu, Takanabe machi, Koyu gun; 2) Railroad cutting at the entrance of a gorge near Tôriyama, Kawaminami machi, Koyu gun, Miyazaki Prefecture.

Subgenus *Glossaulax* PILSBRY, 1929

(type-species: *Natica reclusiana* DESHAYES by original designation)

Polinices (Glossaulax) hyugensis n. sp.

Pl. 42, Figs. 3, 5, 13 and 15;
Pl. 43, Figs. 9, 10 and 12,
Text-figs. 1 and 2.

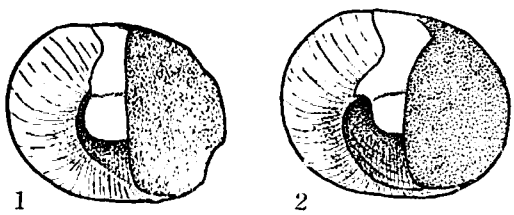
Material:—Holotype: GK-L 8009 (loc. Hagenoshita, coll. T. SHUTO); paratypes: GK-L 8001, 8002, 8008 (loc. Hagenoshita,

coll. T. MATSUMOTO et al.). 8010 (loc. Hagenoshita, coll. T. SHUTO), 8005, 8006 (loc. Nihonmatsu, coll. T. SHUTO), 8011 (loc. Kugino, coll. T. SHUTO), 8012 (loc. Nakabyu, coll. T. SHUTO), and 8035 to 8040 (loc. Yamaji, coll. T. SHUTO). Many other specimens from Tôriyama are imperfectly preserved and not registered.

Measurements:—

specimen GK-L	max D (mm)	min D (mm)	H (mm)	H/max D (%)	number of whorls	∠A (degrees)	∠P
8002	15.1	11.8	12.4	82.1	5.25	129	142
8005	14.8	11.7	11.7	79.0	5.0(2.5)*	128	140
8008	15.8	13.5	13.8	87.4	5.5	124	133
8009	20.7	17.5	17.7	85.5	5.3	129	144
8010	15.5	12.9	12.6	81.3	5.1	131	139
8012	18.0	14.6	13.9	77.2	5.25(2.5)*	134	144

* Number of the protoconch whorls



1 2

Fig. 1. Umbilical region of (1) *Polinices (Glossaulax) hagenoshitensis* n. sp. (GK-L 8004) and (2) *P. (G.) hyugensis* n. sp.

The umbilicus is bordered by rather the sharp edge and devoid of the inner spiral furrow in both species. While they are quite distinguishable each other in the feature of the callus.

Diagnosis:—The shell is moderate in size, obliquely hemispherical, smooth, and rather solid. The spire is very low, small, and depressed-conical. The body whorl is large, hemispherical, very gently sloped below the suture showing an extraconical profile with the pleural angle larger than the apical one. The suture is slightly depressed. The surface of the shell is ornamented by the close lines of growth which are distinct below the suture and at the base. The base is oblique, roundly convexed, and deeply umbilicate. The umbilicus is narrowed by a distinct umbilical cord and partly covered by the strong parietal callus. The parietal callus extends backward at its lower part along the edge of the umbilical furrow and is fused with the umbilical cord but bordered by a shallow groove between them. The umbilical furrow is separated from the basal surface by rather a sharp ridge, which terminates at the anterior extremity of the aperture. There is no spiral inner furrow on the wall of the umbilical furrow, although many spiral striae are observed. The aperture is semicircular with narrowly rounded anterior end. The inner lip is almost straight and slightly oblique. The outer lip is simple, sharp, slightly sinuate, and antecurrently oblique. The whorls are about five of which early two and a half volutions are perfectly smooth and shining protoconch (text-fig. 2). The protoconch consists of more convexed volutions separated by deeper suture than in the conch whorls and bordered by more or less distinct groove between the first conch-whorl.

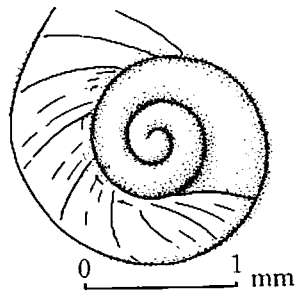


Fig. 2. Protoconch and early teleoconch of *Polinices (Glossaulax) hyugensis* n. sp.

Comparison:—The present species is closely allied to *P.* (*G.*) *vesicalis* (PHILIPPI) in general characters, but is distinguished from the latter in having the distinct ridge separating the basal surface and the umbilical furrow, white umbilical callus, and more triangularly pointed lowest part of the parietal callus along the ridge of the furrow. Furthermore the anteriorly elongated columella of the present species gives a wider appearance to the aperture than in *P. vesicalis*.

The present species also closely resembles *P.* (*G.*) *didyma* (RÖDING), flourishing in Japanese waters, in general, but the former shows some critical differences from the latter. That is to say, the former is (1) much smaller than the latter; (2) the present species has not inner spiral furrow inside the umbilical furrow, which is evidently observed on the adolescent and younger specimens of the latter.

Horizon:—The first, second, (third), fourth, and fifth fossil horizons of the Miyazaki group (Middle Miocene to Lowest Pliocene).

Localities:—1) Small cutting along the national highway No. 10 at Hagenoshita, Uwaye mura; 2) small cutting along the national highway No. 10 at Nihonmatsu, Takanabe machi; 3) road side small cliff north of Yamaji, Mino mura, Koyu gun; 4) river shore at Nakabyu, Yatsushiro mura; 5) 300 m south of Kugino, Aya machi; Higashi-morogata gun, Miyazaki Prefecture.

Polinices (*Glossaulax*) *hagenoshitensis* n. sp.

Pl. 42, Fig. 10, Text-fig. 1.

Material:—Holotype: GK-L 8003, paratypes: GK-L 7993, 8004, and 8007.

Measurements:—

specimen GK-L	max D (mm)	min D (mm)	H (mm)	H/max D (%)	numb. whorls (N)	(PN)	∠A (degrees)	∠P
8003	14.1	11.4	ca. 11.6	82.2	2.5	2.4	127	139
8004	12.3	10.6	10.4	84.5	2.6	2.3	135	142

Diagnosis:—The shell is moderate in size, oblique, hemispherical, round, smooth, and solid. The spire is small, very low, and depressed-conical. The body whorl is large, occupying more than 90 percent of the total height of the shell, and very gently sloped just below the suture with slightly concave part. The suture is impressed and distinct. The surface of the shell is ornamented with dense growth-lines, which are distinct below the suture and at the base and subobsolete at the periphery. The protoconch is much smoother and more roundly convex between sutures than the conch and consists of more than two and a half volutions, of which the first is a minute dome and the

others are minute and round tube. The end of the protoconch is marked by a recurrently oblique line. The umbilicus is separated by moderately sharp edge from the basal surface of the body whorl and narrowed by a large umbilical cord, which is provided with the larger callus at the outer end than cord itself. The parietal callus is thick and moderately wide and somewhat extends backward at its lower part along the edge of the umbilical furrow. It is, however, not pointed as is seen in the preceeding species beyond the limit of the umbilical callus, but slightly narrower than the umbilical callus. There is a shallow groove on the surface between the parietal and the umbilical callus almost perpendicular to the columellar lip.

Comparison:—The present new species is quite similar in size and outline of the shell to the preceeding species, but differs in the features of the protoconch and the umbilicus. I examined the specimens in hand to check whether the characteristics in question are mere fluctuating variation or distinct features. The result shows that these two species are sharply separated and there is no intermediate form concerning with the mentioned characteristics.

Horizon:—The fourth fossil horizon of the Miyazaki group (Lowest Pliocene).

Locality:—Cutting along the national highway No. 10 at Hagenoshita, Uwaye mura, Koyu gun, Miyazaki Prefecture.

Polinices (*Glossaulax*) aff. *reiniana* (DUNKER)

Pl. 42, Fig. 1, Text-fig. 3.

1877. *Neverita reiniana*, DUNKER, *Malak. Blätt., Vol., 24*, p. 71.
1882. *Neverita reiniana*, DUNKER, *Index Moll. Mar. Japon*, p. 62, pl. 4, fs. 15, 16.
1886. *Natica reiniana*, TRYON, *Man. Conch., Vol. 8*, p. 35, pl. 13, f. 12.
1920. *Polinices* (*Neverita*) *ampla*, YOKOYAMA, *Jour. Coll. Sci., Imp. Univ. Tokyo, Vol. 39, Art. 6*, p. 77, pl. 5, f. 6.
1954. *Polinices* (*Glossaulax*) *reiniana* var., TAKI and OYAMA, *Palaeont. Soc. Japan Spec. Pap., No. 2*, p. 17, pl. 6, f. 6.
1958. *Neverita reiniana*, OZAKI, *Bull. Nat. Sci. Mus. (Tokyo), Vol. 4, No. 1*, p. 143, 2 text-fs.
1961. *Neverita* (*Glossaulax*) *reiniana*, HABE, *Colored Illust. Shells Japan, II*, p. 38, pl. 17, f. 11.
1961. *Neverita* (*Glossaulax*) *reiniana*, HAYASAKA, *Sci. Rep. Tohoku Univ., 2nd Ser. Vol. 33, No. 1*, p. 76, pl. 9, fs. 18a, 18b.

Material:—GK-L 7991 and 7992 (coll. T. SHUTO).

Measurements:—

specimen GK-L	max D (mm)	min D (mm)	H (mm)	H/max D (%)	numb. whorls
7991	24.6	20.5	ca. 22.5	91	ca. 5.5
7992	ca. 19.5	15.9	ca. 16.3	83	5.1

Remarks:—The present specimens are provided with a groove separating the parietal and the umbilical callus and readily identified to *Glossaulax*. Among the species of *Glossaulax* it closely resembles *P.* (*G.*) *reiniana* (DUNKER) with rather tall spire, roundly convexed whorls, and solid test. It, however,

slightly differs from the living specimens of the species in having larger umbilical cord and callus and in being devoid of the spiral groove inside the umbilical furrow (text-fig. 3).

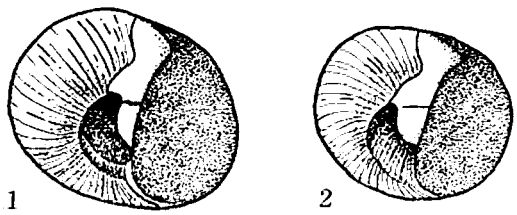


Fig. 3. Umbilical region of (1) *Polinices (Glossaulax) reiniana* (DUNKER) (recent) and (2) *P. (G.)* aff. *reiniana* (DUNKER) (GK-L 8992).

Note the similar callus and different umbilicus. Recent specimens has the distinct inner furrow within the umbilicus.

The characteristics of the umbilical region of these specimens closely resemble those of *P. hyugensis* n. sp., although their spires are generally more elevated and the tests are much heavier than the latter. There are three possibilities concerning with the taxonomic position of these specimens. They may represent a varietal group in *P. reiniana*; they may be a stout form in *P. hyugensis*; or they may be a off-shoot of *P. hyugensis* and the ancestor of *P. reiniana*. Considering that the elevation of the spire is rather variable and the specimen GK-L 7992 is hardly distinguished from *P. hyugensis* in its outline though the test is much more solid. I perfer to the second possibility.

Horizon:—The fourth fossil horizon of the Miyazaki group (Lowest Pliocene).

Locality:—Small cutting along the national highway No. 10 at Hagenoshita. Uwaye mura, Koyu gun, Miyazaki Prefecture.

Genus *Mammilla* SCHUMACHER, 1817

(type-species: *Mammilla fasciata* SCHUMACHER=*Nerita melanostoma* GMELIN by monotypy)

Mammilla melanostoma (GMELIN)

Pl. 42, Figs. 4 and 6.

1791. *Nerita melanostoma*, GMELIN, *Systema naturae*, ed. 13, p. 3674.
1852. *Natica melanostoma*, PHILIPPI (in MARTINI-CHEMNITZ) *Conch. Cab., Vol. 2, Natica*, p. 30, pl. 4, fs. 5, 6, 15, 16.
1956. *Natica melanostoma*, REEVE, *Conch. Icon., Vol. 9, Natica*, pl. 18, sp. 78.
1886. *Natica melanostoma*, TRYON, *Man. Conch., Vol. 8*, p. 50, pl. 21, fs. 13, 14; pl. 22, f. 21.
1925. *Natica (Mammilla) melanostoma*, COSSMANN, *Essais de Paléoconch. Comp., Vol. 13*, p. 129, pl. 1, fs. 36, 37; pl. 2, fs. 3, 4.
1934. *Polinices (Polinices) melanostoma*, LADD, *Bernice P. Bishop Mus., Bull. No. 119*, p. 211.
1935. *Polinices (Polinices) melanostoma*, NOMURA, *Sci. Rep., Tohoku Imp. Univ., 2nd Ser., Vol. 18, No. 2*, p. 203, pl. 9, f. 32.
1941. *Polinices (Mammilla) melanostoma*, ALTENA, *Leidse Geol. Meded., Vol. 12*, p. 67.
1951. *Polynices opacus*, (HIRASE) TAKI, *Handb. Illust. Shells*, pl. 91, f. 1.
1954. *Polinices opacus*, KIRA, *Colored Illust. Shells Japan, I*, p. 35, pl. 17, f. 13.
1960. *Mammilla melanostoma*, MACNEIL, *U.S. Geol. Surv., Prof. Pap., No. 339*, p. 54, pl. 8, f. 1; pl. 12, f. 19.

Material:—GK-L 8033 (coll. T. SHUTO).

Measurements:—

specimen GK-L	max D (mm)	min D (mm)	H (mm)	H/max D (%)	numb. whorls
8033	9.1	5.9	10.8	118	4.5

Remarks:—The present *Mammilla* specimen is featured by depressedly pear-shaped tall outline, slit-like very narrow umbilicus, and almost smooth surface except for minute growth lines and safely identified to *M. melanostoma* (GMELIN). Its shell is slightly taller and its umbilicus is much narrower than those of *M. maura* BRUGUIÈRE, which is a close ally to it. *M. kurodai* TAKI (=*Natica macrostoma* PHILIPPI in MARTINI and CHEMNITZ, 1852, p. 55, pl. 9, f. 1, TAKI, 1943, p. 111, text-fs. 1, 2) is closely allied to the present species, but the former has wider umbilicus, stronger growth-lines, and somewhat wider shell than the latter.

Comparing with *M. simiae* (DESHAYES) (1842, p. 652), living in south Japan, the present specimen has much heavier callus.

Horizon:—The secondfossil horizon of the Miyazaki group (Middle Miocene).

Locality:—Road side cutting north of Yamaji, Mino mura, Koyu gun, Miyazaki Prefecture.

Mammila maura (BRUGUIÈRE)

Pl. 42, Figs. 7 and 9.

1792. *Natica maura*, BRUGUIÈRE, *Encyclopédie methodique* pl. 453, fs. 4a, b.
1852. *Natica maura*, PHILIPPI (in MARTINI-CHEMNITZ). *Conch. Cab., Vol. 2, Natica*, p. 58, pl. 9, f. 6.
1856. *Natica maura*, REEVE, *Conch. Icon., Vol. 9, Natica*, pl. 7, f. 25.
1886. *Natica maura*, TRYON, *Man. Conch., Vol. 8*, p. 51, pl. 22, f. 24.
1951. *Polinices maurus*, (HIRASE) TAKI, *Handb. Illust. Shells*, pl. 91, f. 3.
1954. *Polinices (Mammilla) maurus*, KIRA, *Colored Illust. Shells Japan, I*, p. 35, pl. 17, f. 12.

Material:—GK-L 8034 (loc. Yamaji, MI-5070, coll. T. SHUTO) and 8045 (loc. Hagenoshita, coll. T. SHUTO). The specimen GK-L 8034 is slightly broken at the labrum and 8045 lost the apical part of the protoconch.

Measurements:—

specimen GK-L	max D (mm)	min D (mm)	H (mm)	H/max D (%)	numb. whorls
8034	5.4	4.3	7.2	133	4.0
8045	8.5	5.8	9.8	115	5.1

Remarks:—The present specimens are featured by the broad shell, deep and distinct umbilicus, moderately distinct growth-lines, and dark brown uniform coloration. On the basis of these characteristics they are identified to *M. maura* (BRUGUIÈRE), although the former is much smaller than the living specimens.

Horizon:—The second and fourth fossil horizon of the Miyazaki group (Middle Miocene to Lowest Pliocene).

Localities:—Small cutting along the national highway No. 10 at Hagenoshita, Uwaye mura; road side 600 m north of Yamaji, Mino mura, Koyu-gun, Miyazaki Prefecture.

Genus *Lunatia* GRAY, 1847

(type-species: *Natica ampularia* SOWERBY by original designation)

Lunatia pallida BRODERIP and SOWERBY

Pl. 43, Figs. 4, 6, 7, 8, 11 and 13.

1829. ? *Natica pallida*, BRODERIP and SOWERBY, *Zool. Jour., Vol. 4*, p. 372 (in DALL, 1921).

1886. ? *Natica pallida*, TRYON, *Man. Conch., Vol. 8*, p. 37, pl. 14, fs. 26 to 28.

1921. ? *Euspira pallida*, DALL, *U.S. Nat. Mus., Bull., Vol. 112*, p. 164, pl. 14, f. 5.

1945. ? *Lunatia pallida*, ABBOTT, *American Sea shells.*, p. 190, f. 43c.

1960. *Euspira* cf. *pallida*, MACNEIL, *U.S. Geol. Surv., Prof. Pap., No. 339*, p. 57, pl. 2, fs. 20, 26.

Material:—GK-L 8018 to 8023, 8025, 8026, 8029 (loc. Nihonmatsu, coll. T. SHUTO), 8013 to 8017, 8027, 8028 (loc. Hagenoshita, coll. T. MATSUMOTO et al.), and 8032 (loc. Hagenoshita, coll. T. SHUTO).

Measurements:—

specimen GK-L	max D (mm)	min D (mm)	H (mm)	H/max D (%)	numb. whorls
8013	7.8	6.2	8.1	104	4.0
8018	9.5	7.6	10.1	106	4.25
8025	12.5	10.6	13.4	107	ca. 4.8
8027	12.6	10.6	13.6	108	5.0
8028	14.7	12.9	ca. 15.7	107	5.0

Remarks:—The present thick-shelled specimens are featured at first by moderately shouldered outline with the maximum convexity at higher part of the whorls. In other words the whorls are narrowly rounded just below the horizontal or gently sloped subsutural part (shoulder). Secondly the umbilicus is moderately narrow but very deep, and not separated from the basal surface by a sharp angulation. The parietal callus is thick, solid, wide, and partly truncated at the margin of the umbilicus, where it merges partly to the narrower columellar callus. The eversion is also thickly deposited with the callous material. There is no funicle in the umbilicus. Thirdly the suture is impressed. On the basis of these characteristics they are identified to "?*Natica pallida* BRODERIP and SOWERBY".

They are very closely similar to *Euspira* AGASSIZ, 1838, and *Lunatia* GRAY, 1847. I, however, consider they are reasonably included in *Lunatia*, because they have solid shell, being devoid of the shallow groove between the parietal and umbilical callus which are the important characteristics of *Euspira*. New Zealand genus, *Uberella* FINLAY, 1928, with the type-species, *Natica vitrea* HUTTON, is also closely allied to these genera, especially to *Lunatia* and it seems there is no critical distinction between them as far as the descriptions and figures are concerned.

"*Uberella yokoyamai* (KURODA and HABE)" (TAKI and OYAMA, 1954, p. 17, pl. 5, f. 1), which is originally reported as *Gennaeosinum* (?) (KURODA and HABE, 1952, p. 59), is distinguished from the present specimens in having the maximum convexity at lower position than the latter. Although this difference

looks very slight, it is markedly persistent to serve as the criterion for interspecific separation.

The present specimens are very closely allied to "*Natica gendinganensis* MARTIN" (1899, p. 262, pl. 29, fs. 627, 627a) in general feature. The only difference is that the latter has more produced anterior end of the aperture and eversion and somewhat smaller ratio of the diameter of the whorl to the diameter of the whorl-tube of the same whorl. I prefer to deal with it as a subspecies of *L. pallida*.

Horizon:—The fourth and fifth fossil horizon of the Miyazaki group (Lower Pliocene).

Localities:—1) Small cutting along the national highway No. 10 at Hagenoshita, Uwaye mura; 2) cutting along the national highway No. 10 at Nihonmatsu, Takanabe machi, Koyu gun, Miyazaki Prefecture.

Genus *Tectonatica* SACCO, 1890

(type-species: *Natica tectula* BONELLI by monotypy)

Tectonatica janthostomoides KURODA and HABE

Pl. 42, Fig. 11; Pl. 43, Figs. 1, 2, 3 and 5.

1920. *Natica janthostoma*, YOKOYAMA, *Jour. Coll. Sci., Imp. Univ., Tokyo, Vol. 39, Art. 6*, p. 76, pl. 5, fs. 3 and 4 (not of DESHAYES).
1934. *Natica (Tectonatica) janthostoma*, KINOSHITA and ISAHAYA, *Rep. Fish. Surv., Hokkaido Fish. Experim. Stat., No. 33*, p. 7, pl. 4, f. 27.
1935. *Natica (Tectonatica) janthostoma*, NOMURA, *Saito Ho-on Kai Mus. Res. Bull. No. 5*, p. 122, pl. 7, fs. 4 to 6.
1935. *Natica (Tectonatica) janthostoma*, NOMURA and HATAI, *ibid., No. 6*, p. 128, pl. 9, f. 4.
1949. *Tectonatica janthostomoides*, KURODA and HABE, *Venus, Vol. 15, Nos. 5-8*, p. 7, text-fs. 1a to d.
1954. *Natica (Tectonatica) serera*, KIRA, *Colored Illust. Shells Japan, I*, p. 35, pl. 17, f. 18.
1958. *Natica janthostomoides*, OZAKI, *Bull. Nat. Sci. Mus., (Tokyo), Vol. 4, No. 1*, p. 144, pl. 19, fs. 1 and 2.
1961. *Tectonatica janthostomoides*, HAYASAKA, *Sci. Rep. Tohoku Univ., 2nd Ser., Vol. 33, No. 1*, p. 77, pl. 9, fs. 20a and b.

Material:—GK-L 7994 to 7996, coll. T. MATSUMOTO et al., 7997 to 8000 and 8031, coll. T. SHUTO. All the specimens came from a single locality.

Measurements:—

specimen GK-L	max D (mm)	H (mm)	H/max D (%)	numb. whorls
7995	16.8	16.8	100	5.5
7997	14.9	15.4	103	5.2
7998	11.0	11.5	104	5.0
8031	12.2	12.9	106	5.5

The largest specimen, GK-L 7994, attains about 20 mm in maximum diameter.

Remarks:—The present specimens generally have much smaller shell with more closed umbilicus than the living ones which are provided with narrow but apparently open umbilical furrow around the umbilical callus and cord. Of course the degree of closure at the

umbilicus is not invariably fixed but somewhat variable and some specimens, as GK-L 7995, show typical umbilicus of *T. janthostomoides*. The present specimens may represent a group which is biased but not so different from the typical one as to be separated specifically.

Horizon:—The fourth fossil horizon of the Miyazaki group (Lowest Pliocene).

Locality:—Small cutting along the national highway No. 10 at Hagenoshita, Uwaye mura, Koyu gun, Miyazaki Prefecture.

Tectonatica sp.

Text-fig. 4.

Material:—GK-L 8030, coll. T. SHUTO.

Measurement:—H=13.6 mm, number of the whorls=5.0.

Description:—The shell is moderately small, moderately thick, and globose. The spire is moderately elevated. The whorls are about five in number, and round. The body whorl is large, roundly convex at the side slightly above the middle, round at the base, and not umbilicate. The aperture is semicircular. The outer lip is not observed because of fracturing. The labrum profile is moderately oblique judging from the growth lines. The inner lip is moderately curved and covered by the distinct callus. The parietal callus is wide, thick, and perfectly fused with the umbilical one which entirely closes the umbilicus. The callus of the lower part of the columellar lip is also thick and continued to the produced eversion.

Remarks and comparison:—The glo-

Explanation of Plate 42

Fig. 1. *Polinices (Glossaulax)* aff. *reiniana* (DUNKER)
GK-L 7991 (×1.6), loc. Hagenoshita.

Figs. 2, 8, 14. *P. (Neverita) sagamiensis* PILSBRY
2...GK-L 7987 (×2.2), loc. Nihonmatsu,
8...GK-L 7988 (×1.3), loc. Tôriyama,
14...GK-L 7989 (×0.9), loc. Tôriyama.

Figs. 3, 5, 13 and 15. *P. (Glossaulax) hyugensis* n. sp.
3...paratype: GK-L 8008 (×2.3), loc. Hagenoshita,
5...holotype: GK-L 8009 (×2), loc. Hagenoshita,
13...paratype: GK-L 8012 (×2.3), loc. Nakabyu,
15...(×2.3), same specimen as fig. 13.

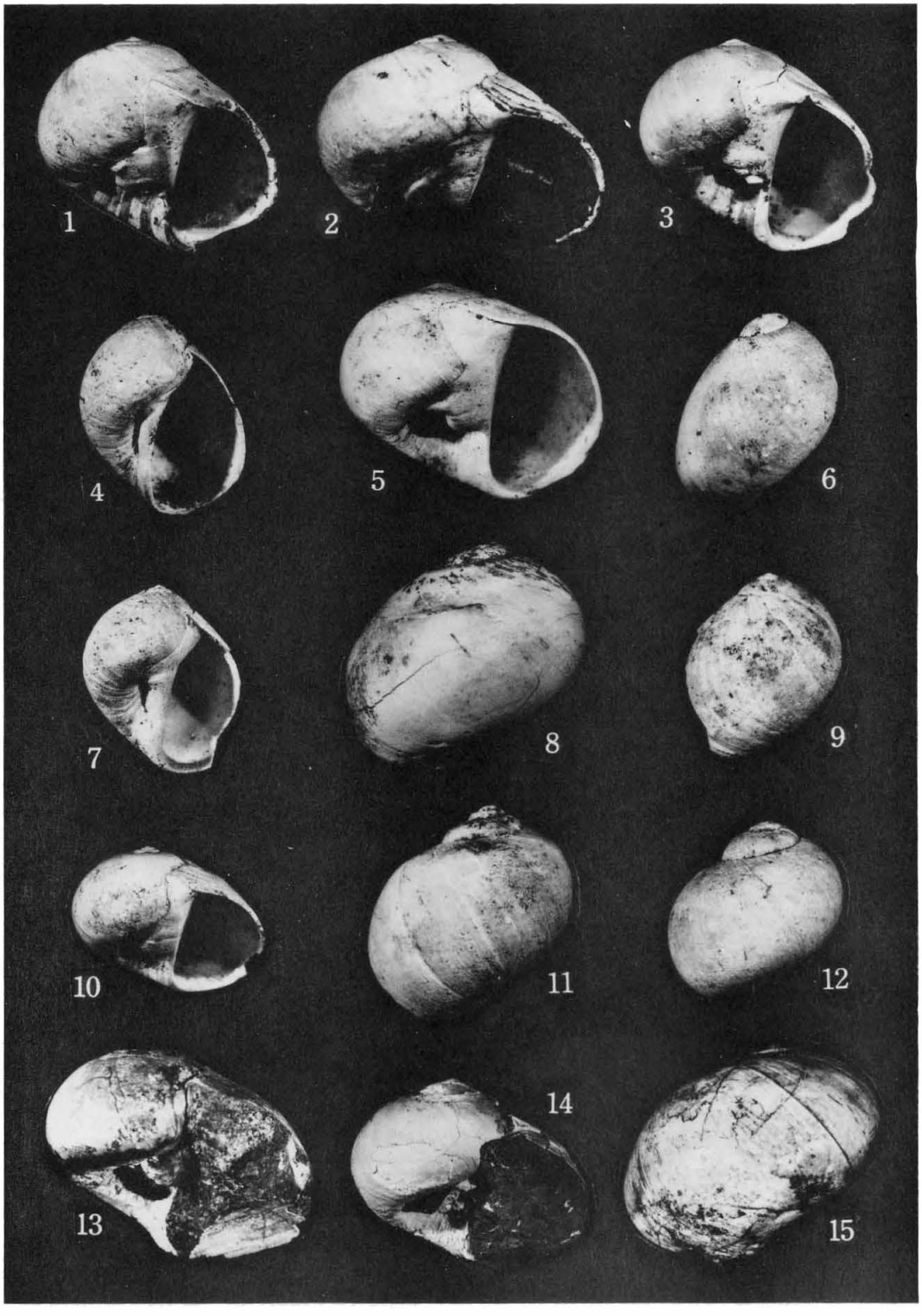
Figs. 4 and 6. *Mammilla melanostoma* (GMELIN)
4...GK-L 8003 (×3), loc. Yamaji,
6...(×3), same specimen as fig. 4.

Figs. 7 and 9. *M. maura* (BRUGUIÈRE)
7...GK-L 8045 (×3), loc. Hagenoshita,
9...(×3), same specimen as fig. 7.

Fig. 10. *Polinices (Glossaulax) hagenoshitensis* n. sp.
paratype: GK-L 8004 (×2.5), loc. Hagenoshita.

Fig. 11. *Tectonatica janthostomoides* KURODA and HABE
GK-L 7998 (×3), loc. Hagenoshita.

Fig. 12. *Lunatia pallida* (BRODERIP and SOWERBY)
GK-L 8018 (×3), loc. Nihonmatsu.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bose shell with moderately elevated spire and utterly closed umbilicus indicates that the specimen belongs to *Tectonatica*. Although whole species of *Tectonatica* known in our country have the umbilical callus fused with the parietal callus, their umbilical callus is apparently separated from the parietal one by the remarkably contracted part between them. While in the present specimen, they are perfectly fused together and not separated each other. This peculiarity together with the occurrence of the specimen from the higher horizon than the preceeding species supports the idea that the specimen may not be included in the range of variation of *T. janthostomoides* and may be a new species. The establishment of the new species is, however, suspended untill plenty specimens are examined.

Horizon:—The fourth fossil horizon of the Miyazaki group (Lowest Pliocene).

Locality:—Cutting along the national highway No. 10 at Nihonmatsu, Takanabe machi, Koyu gun, Miyazaki Prefecture.

Concluding Remarks

Some revisions of the systematic position of certain common Japanese naticid gastropods are given in this report.

Polinices sagamiensis PILSBRY was usually classified into *Polinices* s.s. by Japanese authors, but the former is readily distinguished from the latter in depressed shell and is better to be included in *Neverita* RISSO, 1926.

Glossaulax is usually included in *Neverita* also by Japanese authors, but the latter is devoid of the shallow groove separating the parietal and the umbilical callus which is the typical feature of the former. *Glossaulax* should be separated from *Neverita*.

Natica pallida BRODERIP and SOWERBY is considered to be included in *Lunatia* GRAY, 1847, on the basis of the shell character. The species seems to be a characteristic to the Lower Pliocene of Indo-southwest Pacific region. That is to say, besides in Japan it also occurs in the Lower Pliocene of Okinawa Island and its close ally, *L. gendinganensis* (MARTIN) (1905, p. 262) in the Lower Pliocene Bantam bed of Java.

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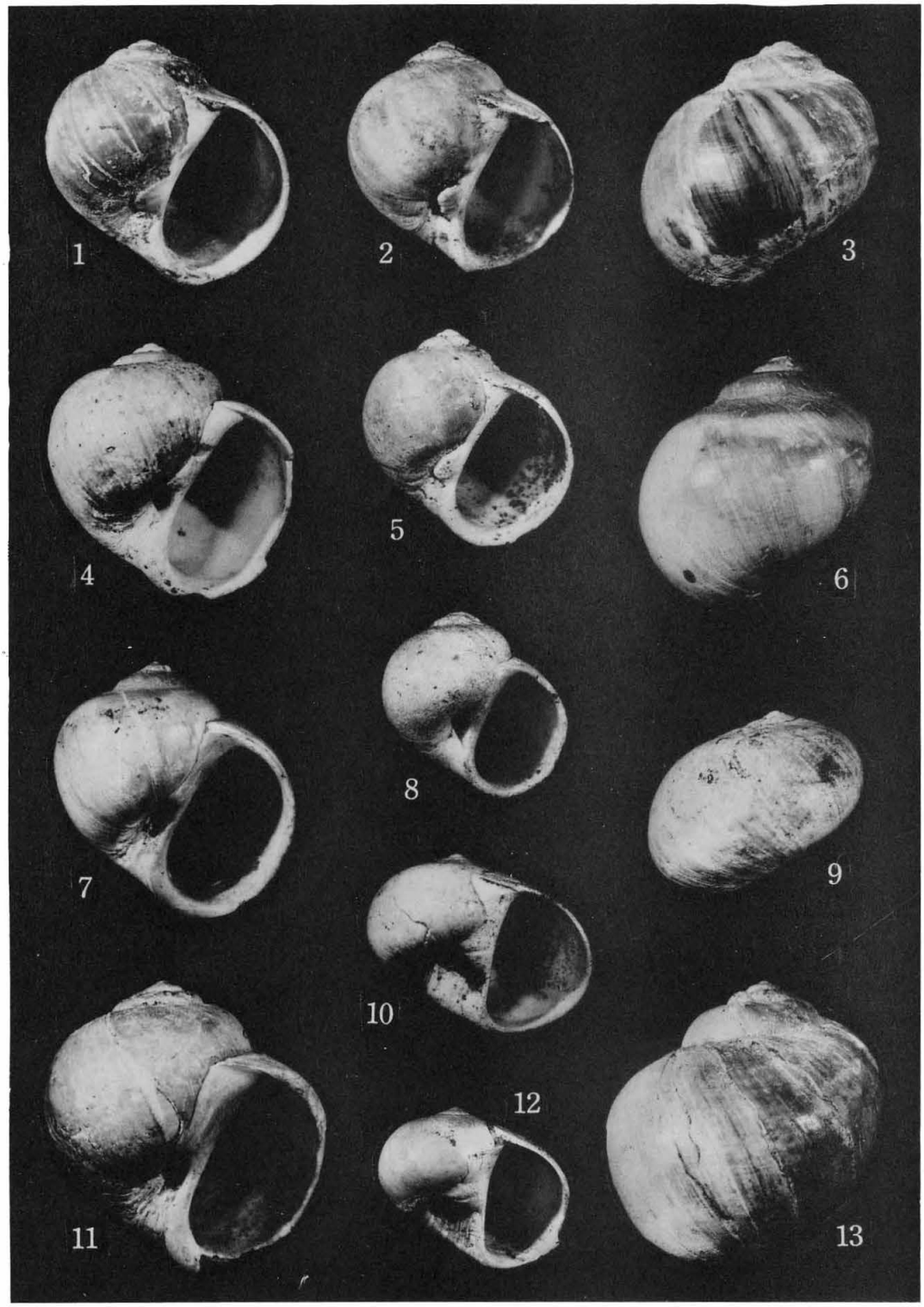
Explanation of Plate 43

Figs. 1, 2, 3 and 5. *Tectonatica janthostomoides* KURODA and HABE
1...GK-L 8031 (×3), loc. Hagenoshita,
2...GK-L 7997 (×2.5), loc. Hagenoshita,
3...(×3), same specimen as fig. 1,
5...GK-L 7998 (×3), loc. Hagenoshita.

Figs. 4, 6, 7, 8, 11 and 13. *Lunatia pallida* (BRODERIP and SOWERBY)
4...GK-L 8027 (×3), loc. Hagenoshita,
6...GK-L 8026 (×3), loc. Nihonmatsu,
7...(×3), same specimen as fig. 6,
8...GK-K 8012 (×3), loc. Nihonmatsu,
11...GK-L 8028 (×3), loc. Hagenoshita,
13...(×3), same specimen as Fig. 11.

Figs. 9, 10 and 12. *Polinices (Glossaulax) hyugensis* n. sp.
9...paratype: GK-L 8005 (×2.5), loc. Nihonmatsu,
10...(×2.5), same specimen as Fig. 9.
12...paratype: GK-L 8002 (×2), loc. Hagenoshita.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Aya machi	綾 町	Nakabyu	中別府
Hagenoshita	元の下	Nihonmatsu	二本松
Higashi-morogato gun	東諸県郡	Takanabe machi	高鍋町
Kawaminami machi	川南町	Tôriyama	通 山
Koyu gun	児湯郡	Uwaye mura	上江村
Kugino	久木野	Yamaji	山 路
Mino mura	三納村	Yatsushiro mura	八代村

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 55, p. 294, Sept. 20, 1964

SHORT NOTE

12. DISCOVERY OF CONODONTS AND HOROTHURIAN SCLERITES IN JAPAN

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In connection with demonstrations on etching techniques at the University of Tokyo and various other universities I had the opportunity to dissolve some limestones of the Japanese Paleozoic and Triassic in 15% acetic acid, in order to to find conodonts and other microfossils.

Well preserved and fairly abundant conodont faunas have been secured from:

1) Lower Triassic limestone, Kamura formation, Kamura; Takachiho-cho, Miyazaki Prefecture, Kyushu. (leg. KAMBE).
2) Lower Triassic limestone with *Anasibirites*. Taho formation, Taho; Shirokawa-machi, Ehime Prefecture Shikoku. (leg. K. ICHIKAWA). Similar material was also etched from the collection of the Tohoku University.

The Taho formation also has yielded excellently preserved early ontogenetic stages of Ceratitina, with exposed the pro- and the primary sutures, and shall be studied by Prof. SATO.

Holothurian sclerites have been secured from the Lower Carboniferous Omi limestone, containing Productids. Locality: Omi, Niigata Prefecture (leg. T. HAMADA) and from material of the University of Tokyo (Pal. 330, Omi-mura, Echigo).

Furthermore, silicifications have been observed at various places, *e.g.* in the Permian limestones of Kuzuu, Tochigi Prefecture.

The studies are not completed as yet, and a more detailed account will be published in the Transactions and Proceedings of the Palaeontological Society of Japan.

* Received Sept. 28, 1962

shall call a Special Meeting at the written request of more than one-third of the members. The request shall be granted only if the written statement fully explains the reasons for assembly and items for discussion.

Article 19. Members unable to attend the General Meeting may give an attending member a written statement signed by himself trusting the bearer with the decision of business matters. Only one attending member may represent one absentee.

Article 20. The decison of the General Meeting shall be by majority vote. When the number of votes is equal, the President shall cast the deciding vote.

Article 21. The President and Councillors shall compose the Council. The dicision of the General Meeting concerning administration shall be considered and implemented by the Council.

Article 22. The Executive Council shall carry out the decisions of the Council.

Article 23. The fiscal year of the Society shall begin on the first of January each year and end on the thirtyfirst of December of the same year.

Article 24. The amendments to the Constitution of the Society shall be decided at the General Meeting and must be approved by more than two-thirds of those members who are in attendance.

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

会　員　消　息

◎ 会員岡田博有君は英国文化振興会奨学金により，英国 Reading 大学の堆積学研究所に留学のため7月中旬出発した。

学　会　紀　事

日本古生物学会長期計画委員会委員には選挙の結果次の諸君が当選した。

石島　渉・市川　渡・内尾高保・大森昌衛・大山　桂・金谷太郎・菅野三郎・鹿間時夫・高橋　清
高柳洋吉・島山隆三・中野光雄・花井哲郎・早坂一郎・速水　格・藤岡一男・藤本治義・松本達郎
湊　正雄・森下　晶

尚，委員会第一回会合は東京数寄屋橋際，成蹊クラブで開かれ席上早坂一郎君が委員長に推薦され，又討議は選挙の際会員各位に配布された資料を中心に行なわれた。第二回会合は9月19日（土）広島大学で行なわれた。

例　会・年　会　通　知

	開　催　地	開　催　日	講演申込締切日
第89回例会	北海道大学	1964年11月24日	1964年10月10日
1965年総会・年会	国立科学博物館	1965年1月23,24日	1964年12月20日

第89回例会（北海道大学）：シンポジウム・Sub-micropaleontology の進歩　（世話人 本庄　丕）
1965年々会（国立科学博物館）：脊椎動物に関する講演会　（世話人 尾崎　博）

購読御希望の方は本会宛御申込下さい

1964年9月15日　印　刷
1964年9月20日　発　行

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CONSTITUTION
of the
PALAEONTOLOGICAL SOCIETY OF JAPAN

Article 1. The Society shall be known as the Palaeontological Society of Japan.

Article 2. The object of the Society is to promote the study and popularization of palaeontology and related sciences.

Article 3. The Society, to execute Article 2, shall undertake the following business:

1. Issue the Society journal and other publications.
2. Hold or sponsor scientific le6tures and meetings.
3. Popularize the science by field trips, scientific lectures and other projects.
4. Aid and encourage research work; award outstanding contributions to the Society; carry out the objectives stated in Article 2.

Article 4. To attain the object of the Society, the Society may, by decision of the General Meeting, establish within it research committees.

Article 5. The society shall be composed of members who are active or interested in palaeontology or related sciences.

Article 6. The members shall be known as Regular Members, Fellows, Patron and Honorary Members.

Article 7. Persons desiring membership in the Society are requested to fill out the necessary application forms and receive the approval of the Council.

Article 8. Fellows are persons who have held Regular Membership in the Society for more that ten years, have contributed to the science of palaeontology, have been nominated by five Fellows and approved by the Council.

Article 9. Patrons are organizations supporting Article 2 and recommended by the Council.

Article 10. Honorary Members are persons of distinguished achievement in palaeontology. They shall be recommended by the Council and approved by the General Meeting.

Article 11. The members of the Society shall be obliged to pay the annual dues stated in Article 12. Members shall enjoy the privilege of receiving the Society journal and participating in the activities stated under Article 3.

Article 12. The rates for annual dues shall be decided by the General Meeting. Rates for annual dues are: Regular Members, Yen 1,000; Fellows, Yen 1,500; and Foreign Members, $ 4.00. Patrons are organizations donating more than Yen 10,000 annually; Honorary Members are free from obligations.

Article 13. The budget of the Society shall be from membership dues, donations and bestowals.

Article 14. The Society, by decision of the Council, may expel from membership persons who have failed to pay the annual dues or those who have disgraced the Society.

Article 15. The officers of the Society shall be composed of one President and fifteen Councillors, among whom several shall be Executive Councillors. The term of office is two years and they may be eligible for re-election without limitation. The President may appoint several persons who shall be Secretaries and Assistant Secretaries. An Executive Council shall be nominated and approved by the Council. Councillors shall be elected from Fellows by vote of returned mail unsigned ballot.

Article 16. The President shall be a Fellow nominated and approved by the Council. The President shall represent the Society and supervise the business affairs. The President may appoint a Vice-President when he is unable to perform his duties.

Article 17. The Society may have the honarary President. The honorary President shall be recommended by the council and approved by the General Meeting. The honorary President may participate in the Council.

Article 18. The Society shall hold regularly one General Meeting a year. The President shall be Chairman and preside over the administrative affairs. The program for the General Meeting shall be decided by the Council. The President may call a special meeting when he deems it necessary. The General Meeting requires the attendance of more than one-tenth of the members. The President