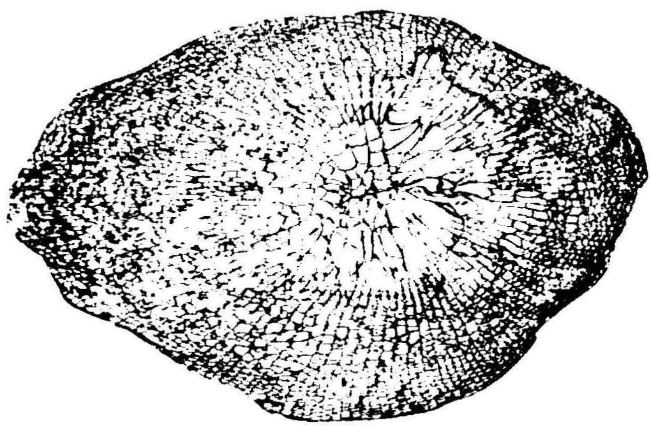
日本古生物学會
報告・紀事

Transactions and Proceedings
of the
Palaeontological Society of Japan

New Series No. 65



日本古生物学会

Palaeontological Society of Japan
April 10th, 1967

CONTENTS

The fossil on the front page is *Kueichouphyllum yahagiense* MINATO 1955.

All Communications relating to this Journal should be addressed to the
PALAEONTOLOGICAL SOCIETY OF JAPAN
Geological Institute, Faculty of Science, University of Tokyo, Japan

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 65, pp. 1-18, pls. 1, 2, Apr. 10, 1967

516. MOLLUSCAN FAUNA OF THE HIGASHI-INNAI FORMATION OF NOTO PENINSULA, JAPAN-III ; DESCRIPTION OF NEW SPECIES AND REMARKS ON SOME SPECIES*

KÔICHIRÔ MASUDA

Department of Geology, Miyagi University of Education, Sendai

能登半島東印内層の軟体動物化石群—III；新種の記載および若干の既知種の考察：本編では巻貝16新種を記載した他，既知種4種の巻貝について再検討を行なった。 増田孝一郎

Family Potamididae

Genus *Cerithidea* SWAINSON, 1840

Cerithidea ohiroi MASUDA, n. sp.

Pl. 1. figs. 5a-b, 6a-b

Holotype:—DGS, Reg. No. 4577.

Description:—Shell small, moderately thick, turreted, with nine whorls, two to three younger whorls lacking; spiral angle about 30°. Whorls moderately inflated, separated by rather distinct, impressed sutures; surface with elevated, rounded, granulated longitudinal ribs and numerous, rather distinct spiral threads; longitudinal ribs subvertical, nearly equal to their interspaces, about 14 on penultimate whorl and 16 on body whorl, sculptured with spiral threads; spiral threads of distinct, fine threads and fine intercalary threads broader than their interspaces. Base of whorl with two rather distinct sutural bands and fine, unequal revolving threads. Aperture subovate; outer lip notched posteriorly; inner lip indistinctly defined; columella subvertical; canal short.

Dimensions (in mm):—

Height	11.0*	ca. 7.6	ca. 6.0	ca. 4.0
Diameter	4.1	2.6	2.8	2.0

*—holotype

Remarks:—*Cerithidea tokunariensis* MASUDA (1956, p. 162, pl. 26, figs. 6, 7) from the Higashi-Innai Formation at Loc. No. 12 resembles the present new species, but is distinguishable from the present one by its low, narrow, fewer longitudinal ribs, fewer and faint spiral threads and less rounded whorls.

Type locality:—Loc. No. 30.

Occurrence:—Type loc.—C; Loc. No. 3—R; Loc. No. 24—F; Loc. No. 32—R; Loc. No. 39—F.

Genus *Vicaryella* YABE and HATAI, 1938

Vicaryella ishiiana (YOKOYAMA), 1926

Pl. 1. figs. 1a-b, 2a-b

1925. *Cerithium baculum* YOKOYAMA, *Jour. Coll. Sci., Imp. Univ. Tokyo*, Vol. 45, Art. 5, p. 12, pl. 2, fig. 6 (non YOKOYAMA, 1924).
1926. *Cerithium ishiianum* YOKOYAMA, *Jour. Fac. Sci., Imp. Univ. Tokyo, Sec. 2,*

* Received February 23, 1966; read September 25, 1965 at Nagasaki.

Vol. 1, Pt. 7, p. 218, pl. 28, figs. 11, 12.
1935. *Cerithium (Proclava) otukai* NOMURA, *Saito Ho-on Kai Mus., Res. Bull.*, No. 6, p. 227, pl. 17, fig. 17.
1938. "*Vicaryella*" *ishiiana* (YOKOYAMA), YABE and HATAI, *Sci. Rep., Tohoku Imp. Univ., Ser. 2*, Vol. 19, No. 2, p. 169.
1944. *Vicaryella ishiiana* (YOKOYAMA). OYAMA and SAKA, *Shigenkagaku Kenkyusho, Bull.*, Vol. 1, No. 2, p. 139, pl. 14, figs. 5, 6a, b, 7a, b, 8a, b.
1960. *Vicaryella ishiiana* (YOKOYAMA), KAMADA. *Sci. Rep., Tohoku Univ., Ser. 2, Spec. Vol.* No. 4, p. 284, pl. 31, figs. 4a, b, 8, 9.
1962. *Vicaryella ishiiana* (YOKOYAMA), KAMADA, *Palaeont. Soc. Japan, Spec. Papers*, No. 8, p. 152, pl. 18, figs. 15, 16.

Syntype:—Geological Survey of Japan.

Remarks:—*Vicaryella ishiiana* (YOKOYAMA) was described from the Miocene Mizunami Group, Gifu Prefecture under the genus *Cerithium*. Subsequently it was reported from the Miocene Nakayama Formation, Fukushima Prefecture in association with *Vicarya yokoyamai* TAKEYAMA and also from the Miocene Ajiri Formation, Miyagi Prefecture together with *Vicarya yokoyamai* TAKEYAMA (KAMADA, 1960).

On the other hand, *Vicaryella notoensis* MASUDA was first described from the Higashi-Innai Formation at Loc. No. 12 (MASUDA, 1956). It was subsequently recorded from the Kunimi Formation, Fukui Prefecture (KASENO, 1956), Orito Formation, Niigata Prefecture (KAMADA, 1960) and Kurosedani Formation, Toyama Prefecture (TSUDA, 1960). In 1960 KAMADA pointed out the associated occurrence of this species with *Vicarya callosa japonica* YABE and HATAI, *Vicarya yatuoensis* YABE and HATAI or *Vicarya yokoyamai* TAKEYAMA in the Hokuriku District.

From the occurrence of *Vicaryella* in the present field it is inferred that the species of the genus when associated with *Vicarya callosa japonica* YABE and HATAI always is *Vicaryella notoensis* MASUDA, but the species when not associated with *Vicarya* is *Vicaryella ishiiana* (YOKOYAMA). From the different occurrences of *Vicaryella notoensis* MASUDA and *Vicaryella ishiiana* (YOKOYAMA) it is suggested that they lived in different environmental conditions, that is to say, *Vicaryella notoensis* MASUDA and *Vicaryella ishiiana* (YOKOYAMA) are very closely related with each other and they are probably allopatric forms of the same stock. This consideration is supported by that the younger stage of *ishiiana* is indistinguishable from that of *notoensis* but with growth they can be easily distinguished from each other.

Type locality:—Matsubora, Hitoichiba, Mizunami City, Gifu Prefecture.

Occurrence:—Loc. No. 23—A; Loc No. 39—C.

Genus *Batillaria* BENSON, 1842

Batillaria toshioi MASUDA, n. sp.

Pl. 1. figs. 7a-b, 8a-b, 9

Holotype:—DGS, Reg. No. 4580.

Description:—Shell of medium size, rather thick, turreted, with about 12 whorls, two younger whorls lacking; spiral angle a little less than 30°. Whorls separated by distinct, impressed, uneven sutures; surface with elevated, broad, nodose longitudinal ribs and numerous distinct spiral threads; longitudinal ribs subvertical, nine on body whorl, narrower than their interspaces, sculptured with distinct spiral threads; spiral threads of three conspicuous spiral threads and subordinate, fine but distinct, unequal spiral threads among main spiral threads; subordinate spirals tend to decrease their number upwards. Base of body whorl with three conspicuous revolving threads and several, fine subequal threads among main threads. Aperture subovate; outer lip thin; inner lip with thin callus; colmella somewhat curved; canal short, nearly straight.

Dimensions (in mm):—

Height	30.0*	ca. 38.0	ca. 36.0	ca. 34	29.0
Diameter	11.0	14.0	12.0	11.5	10.0

*—holotype

Remarks:—*Batillaria yamanarii* MAKIYAMA (1926, p. 148, pl. 13, fig. 4) from the Miocene Heirokudô Formation, North Korea resembles the present species but is distinguishable from *toshioi* by its subcentrally angulated whorls and subequal, fine spiral threads. *Batillaria minoensis* ITOIGAWA (1960, p. 280 pl. 4, figs. 4a-b) from the Miocene Mizunami Group, Gifu Prefecture and *Batillaria s-itoi* NOMURA and ZINBO (1936, p. 343, pl. 20, fig. 5) from the Yanagawa Miocene of Fukushima Prefecture resemble the present species. But the present species is distinguishable from the former in having larger shell, fewer longitudinal ribs which are narrower than their interspaces and unequal spiral threads, and from the latter by the larger shell, larger spiral angle, strong, elevated longitudinal ribs and unequal spiral threads.

The present new name is given to the name of my son, Toshio MASUDA.

Type locality:—Loc. No. 23.

Occurrence:—Type loc.—A; Loc. No. 24—C; Loc. No. 39—A.

Family Cerithiidae

Genus *Cerithium* BRUGUIÈRE, 1792

Subgenus *Proclava* THIELE, 1929

Cerithium (*Proclava*) *ancisum* (YOKOYAMA), 1929

Pl. 1. figs. 10a-b, 11a-b, 12a-b, 13a-b, 17a-b

1929. *Potamides ancisus* YOKOYAMA, *Jour. Fac. Sci., Imp. Univ. Tokyo, Sec. 2*, Vol. 2, Pt. 8, p. 367, pl. 70, fig. 2.

1956. *Cerithium ancisum* (YOKOYAMA), ITOIGAWA, *Mem. Coll. Sci., Univ. Kyoto, Ser. B*, Vol. 22, Art. 2, pl. 2, fig. 7.

Holotype:—GT, Reg. No. 4895.

Remarks:—The following description is based upon abundant specimens newly collected: Shell of medium size, moderately thick, turreted; ten whorls preserved; spiral angle 25°-30°. Whorls slightly rounded, shouldered, separated by distinctly impressed sutures; shoulders with numerous, somewhat elevated tubercles; surface with three, unequal, rather distinct, somewhat granulated spiral threads and two, subordinate, fine spiral threads. Base of body whorl with several, unequal, fine revolving threads. Aperture subovate, somewhat angulated posteriorly; outer lip rather thick, denticulated within; inner lip sharply defined by very thick, somewhat protruded callus; columella subvertical, smooth; canal short, rather deep, narrow, somewhat bent back.

This species was first described by YOKOYAMA (1929) as *Potamides* from the Miocene Tôgane Formation, Shimane Prefecture based upon a single specimen of the last two whorls. Subsequently it was illustrated by OTUKA (1938, p. 42, pl. 4, fig. 36) from the Miocene Shôbara Formation, Okayama Prefecture as *Cerithium*. At that time OTUKA considered *Batillaria atukoae* OTUKA once described by him (1934, p. 623, pl. 49, figs. 69, 70) from the Miocene Shiratori Member of the Kadonosawa Formation, Iwate Prefecture to be a synonym of *ancisa*, and that *Batillaria atukoae* OTUKA illustrated by NOMURA (1935, p. 282, pl. 17, fig. 23) from the Miocene Ajiri Formation, Miyagi Prefecture is conspecific with the present species. Further, OTUKA stated that since the specimen collected from the Lower Kadonosawa Series has a columellar fold in the whorls it may belong to *Proclava*. OYAMA and SAKA (1944) presented a key to the species of the genus *Vicaryella* and included into it the present species. Lately KAMADA (1959) reported on *Vicarya* and *Vicaryella* in Japan and referred the present species to *Vicaryella* as done previously by OYAMA and SAKA.

To clarify the characters of this species and its relationship with related species, observations were made on YOKOYAMA's and OTUKA's type specimens (Reg. No. 10024) preserved in the Geological Institute of the Tokyo University. As the result, it was found that YOKOYAMA'S holotype specimen has no columellar fold but OTUKA'S specimens have. Thus OTUKA's *ancisum* from the Shôbara and Shiratori Miocene are different from YOKOYAMA's *ancisus*, though their surface characters are similar to one another. Therefore OTUKA's *ancisum* should be referred to another species. Consequently, OTUKA's *ancisum* from the Shôbara and Shiratori Miocene and NOMURA's *atukoae* from the Ajiri can be referred to *Cerithidea sirakii* (MAKIYAMA) (1936, p. 221, pl. 5, figs. 10,15) from the Lower Bankôdô Miocene, North Korea.

Cerithium (*Proclava*) *meisense* MAKIYAMA (1936, p. 220, pl. 5, fig. 20) from the Miocene Heirokudô Formation, North Korea also resembles the present species. *Cerithium* (*Proclava*) *meisense* differs from *ancisum* in having a larger spiral angle, more prominent beaded spiral threads and a columellar fold. *Meisense* is distinguishable from *Cerithidea sirakii* (MAKIYAMA) by its larger spiral angle and more conspicuous beaded spiral threads.

Dimensions (in mm) :—

Height	33.0	ca. 33.0	ca. 31.0	27.5	27.0
Diameter	13.4	14.5	10.5	10.0	10.0

Type locality:—Senjyôjiki, Tôgane-ura, Kokubu-mura, Naga-gun, Shimane Prefecture.

Occurrence:—Loc. No. 3—F; Loc. No. 10—C; Loc. No. 23—C; Loc. No. 24—C; Loc. No. 30—C; Loc. No. 32—F.

Family Epitoniidae

Genus *Nodiscala* BOURY, 1890

Nodiscala suzuensis MASUDA, n. sp.

Pl. 1, figs. 19a–b

Holotype:—DGS, Reg. No. 4588.

Description:—Shell very small, moderately thick, turreted, rounded at base; five whorls preserved; spiral angle about 20°. Whorls rounded, separated by distinct, impressed sutures; surface with conspicuous, rounded, rather smooth longitudinal ribs and fine spiral threads; longitudinal ribs somewat oblique, nearly equal to their interspaces, about 15 on body whorl, sculptured with fine spiral threads; a few longitudinal ribs especially thick, elevated like varices; spiral threads rather faint, nearly equal, rather regularly spaced. Aperture subcircular; outer lip makes thick, rounded varix sculptured with faint, fine spiral threads; inner lip sharply defined by callus; not umbilicated.

Dimensions (in mm):—Height 5.0, diameter 2.0 (holotype).

Remarks:—This species is distinguished from *Nodiscala rissoinaeformis* (YOKOYAMA) (1927, p. 418, pl. 47, fig. 4) from the Pleistocene Tokyo Formation, Tokyo Metropolis by its small shell and more conspicuous longitudinal ribs which are nearly equal to their interspaces.

Type locality:—Loc. No. 30.

Occurrence:—Type loc.—R.

Family Eulimidae

Genus *Eulima* RISSO, 1826

Eulima hataii MASUDA, n. sp.

Pl. 1, figs. 21a–b

Holotype:—DGS, Reg. No. 4590.

Description:—Shell very small, thin, subulate, with about eight whorls, one and half whorls are nuclear whorls; spiral angle about 25°. Whorls smooth, polished, very slightly inflated, separated by rather indistinct sutures; nuclear whorls smooth. Aperture elongated, posteriorly angulated, more or less rounded at base; outer lip thin, simple; inner lip rather sharply defined.

Dimensions (in mm):—Height 6.5, diameter 2.0 (holotype).

Remarks:—This species is distinguished from *Eulima osawanoensis* TSUDA (1959, p. 85, pl. 4, fig. 5) from the Kurosedani Miocene of Toyama Prefecture by its small shell, indistinct sutures and larger aperture which is angulated above and rounded below.

Type locality:—Loc. No. 35.

Occurrence:—Type loc.—R.

Family Naticidae

Genus *Neverita* RISSO, 1826

Neverita coticazae (MAKIYAMA), 1926

Pl. 1, figs. 25a–b, 26a–b

1926. *Polinices* (*Neverita*) *coticazae* MAKIYAMA, *Mem. Coll. Sci., Kyôto Imp. Univ., Ser. B*, Vol. 2, No. 3, Art. 8, p. 150, pl. 12, fig. 8.

1939. *Polinices* (*Neverita*) *coticazae* MAKIYAMA, NOMURA, *Jour. Geol. Soc. Japan*, Vol. 46, No. 548, p. 255, pl. 3, figs. 13a–b, 14a–b.

Holotype:—Geological Survey of Korea, Reg. No. 75.

Remarks:—This species was first described by MAKIYAMA from the Miocene Bankôdô Formation at Kinshodô, North Korea, illustrated by NOMURA from the Miocene Kozai Formation, Miyagi Prefecture, reported from the Mizunami Miocene of Gifu Prefecture (ITOIGAWA, 1960) and also from the Kurosadani Miocene of Toyama Prefecture (TSUDA, 1960).

The present species was described to be characterized by its slightly elevated spire, wide umbilicus and very thick callus filling the posterior angle of the aperture. The longitudinal profile shown in fig. 25b of Plate 1, is the morphological character by which it can be easily distinguished from its related ones.

That the specimens from the Higashi-Innai Formation are generally small in size compared with the holotype and topotype specimens from the Bankôdô

Formation of North Korea suggests that they may be young or dwarfted shells. In other words, the environmental conditions may not have been favourable to them. This view is supported by that the fauna with small sized shells of *coticazae* in this field includes some brackish water species.

Dimensions (in mm):—

Height	12.5	12.0	10.0	10.0	10.0
Diameter	14.5	13.0	11.5	11.0	10.0

Type locality:—Kinshôdô, Meisen District, North Korea.

Occurrence:—Loc. No. 1—R; Loc. No. 3—C; Loc. No. 4—F; Loc. No. 7—R; Loc. No. 23—C; Loc. No. 24—C; Loc. No. 32—F; Loc. No. 35—F; Loc. No. 39—F.

Family Cypraeidae

Genus *Cypraea* LINNAEUS, 1758

Cypraea ohiroi MASUDA, n. sp.

Pl. 1, figs. 28a-b, 29

Holotype:—DGS, Reg. No. 4598.

Description:—Shell of medium size, moderate in thickness, swollen, cypraeiform, narrowed towards both ends. Whorls smooth, polished. Aperture long, narrow; outer lip with about 25, rather distinct, fine transverse teeth; inner lip a little swollen, finely denticulated at inner margin; canal short.

Dimensions (in mm):—

Height	26.4*	32	—	24.5**
Lateral diameter	17.0	22.0	18.0	16.4
Dorso-ventral diam.	13.8	17.0	15.0	13.5

*—holotype; **—specimen from Iwaki, Osawano-machi, Toyama Prefecture (Kurosedani Miocene)

Remarks:—The present species resembles *Cypraea nomurai* HATAI and NISIYAMA (1952, p. 197) which was illustrated by NOMURA (1940, p. 38, pl. 3, figs. 4-6) as *Cypraea* sp. from the Moniwa Miocene, Miyagi Prefecture. But *ohiroi* is distinguished from *nomurai* by its rather long shell, larger number of distinct, fine teeth at the outer lip and rather swollen shell. *Ponda carneola* (LINNAEUS) (REEVE, 1846, pl. 6, fig. 19), a Recent, Pleistocene and Pliocene species of Southern Japan, resembles the present one but differs by its larger shell and transverse teeth on the inner part of outer lip.

Cypraea sp. illustrated by KANNO (1960, p. 359, pl. 47, fig. 20) from the Miocene Hiranita Formation, Saitama Prefecture may probably be the present species, but further materials are necessary to settle this problem.

A single specimen preserved in the Department of Geology, Faculty of Education, Tohoku University, collected from the Kurosedani Miocene of Toyama Prefecture, can be identified with the present species. The specimen from Toyama shows faint longitudinal striations on the surface.

Type locality:—Loc. No. 30.

Occurrence:—Type loc.—F.

Family Pyrenidae

Genus *Mitrella* Risso, 1825

Mitrella notoensis Masuda, n. sp.

Pl. 2, figs. 3a-b, 4a-b, 5a-b

Holotype:—DGS, Reg. No. 4603.

Description:—Shell small, rather thick, fusiform, with about seven whorls, one or two nuclear whorls lacking; spiral angle about 35°. Whorls somewhat rounded, gradually growing below, separated by distinct, slightly impressed sutures; surface smooth except for a few, faint spiral threads on basal part of body whorl. Aperture elongate oval, narrow, with acute posterior angle; outer lip thin, very feebly denticulated within; inner lip with thin callus; columella a little curved; canal short and open.

Dimensions (in mm):—

Height	6.8*	ca. 10.0	7.0	7.0	5.0	4.5
Diameter	3.0	3.9	3.1	3.0	2.4	2.0

*—holotype

Remarks:— *Mitrella minoensis* Itoigawa (1960, p. 286, pl. 5, figs. 7a-b) from the Mizunami Miocene of Gifu Prefecture can be distinguished from the present one by its shorter shell, spiral striae on surface, wide aperture and expanded body whorl. *Mitrella varians* Dunker (1860, p. 231, sp. 7), a common Recent species of Japan, also can be distinguished from *notoensis* by its larger and inflated shell and larger aperture.

Type locality:—Loc. No. 30.

Occurrence:—Type loc.—C; Loc. No. 1—C; Loc. No. 3—R; Loc. No. 10—F; Loc. No. 23—C; Loc. No. 24—C; Loc. No. 35—C.

Family Buccinidae

Genus *Phos* Montfort, 1810

Phos notoensis Masuda, n. sp.

Pl. 2, figs. 6a-b

Holotype:—DGS, Reg. No. 4605.

Description:—Shell of medium size, moderate in thickness, fusiform, with seven whorls, of which two are nuclear, spiral angle about 45°. Whorls moderately rounded, separated by distinct, impressed sutures; nuclear whorls smooth, rounded; surface with conspicuous, rounded, longitudinal ribs and low, regular, smooth spiral threads; longitudinal ribs narrower than their interspaces, about 18 on penultimate whorl, sculptured with spiral threads; interspaces with spiral threads broader than their interspaces. Aperture oblongly ovate, angulated posteriorly; outer lip thin, finely denticulated within; inner lip sharply defined by thin callus, concave; canal short.

Dimensions (in mm):—

Height	ca. 13.5*	ca. 14.5	ca. 11.5	ca. 10.5	9.0
Diameter	6.5	7.0	5.5	5.0	4.2

*—holotype

Remarks:—This species is distinguished from *Phos minoensis* ITOIGAWA (1960, p. 289, pl. 6, figs. 2a-b, 3) from the Mizunami Miocene of Gifu Prefecture by its low spire, moderately rounded whorls, fewer longitudinal ribs and low, regular, smooth spiral threads.

Type locality:—Loc. No. 23.

Occurrence:—Type loc.—C; Loc. No. 4—F; Loc. No. 7—R.

Family Nassariidae

Genus *Nassarius* DUMÉRILL, 1806

Subgenus *Zeuxis* H. and A. ADAMS, 1853

Nassarius (Zeuxis) minoensis ITOIGAWA, 1960

Pl. 2, figs. 7a-b, 8a-b

1960. *Nassarius (Zeuxis) minoensis* ITOIGAWA, *Jour. Earth Sci., Nagoya Univ.*, Vol. 8, No. 2, p. 289, pl. 6, figs. 1a-c.

Holotype:—Institute of Earth Science, Nagoya University, Reg. No. 20079.

Remarks:—*Nassarius (Zeuxis) minoensis* ITOIGAWA was described from the Miocene Mizunami Group, Gifu Prefecture. It is characterized by its small shell and flat-topped longitudinal ribs slightly wider than interspaces.

Nassarius simizui OTUKA (1934, p. 631, pl. 50, figs. 85-87) from the Shiratori Miocene of Iwate Prefecture is related to the present species and *Nassarius notoensis* MASUDA from the Higashi-Innai Formation (MASUDA, 1956, p. 164, pl. 26, figs. 13, 14). But *minoensis* and *notoensis* can be distinguished from *simizui* by their small shell and fewer longitudinal ribs.

Nassarius notoensis MASUDA was collected at Loc. Nos. 10, 12, 23 and 24, whereas *Nassarius minoensis* ITOIGAWA was found at Loc. Nos. 1, 3, 24, 30 and 32. The specimens from the upper part of Loc. No. 24 consist of a well preserved *minoensis* and some, small, fragmental individuals of *notoensis*. *Notoensis* is found in associated with *Vicarya*, *Vicaryella*, etc. but *minoensis* does not occur with such an association. The different geographical distribution of the species mentioned probably depends upon the environmental conditions and the co-occurrence of *minoensis* and *notoensis* in the upper part of Loc. No. 24 is probably that the small, fragmental individuals of *notoensis* were transported from another area. However, they may be allopatric forms.

Type locality:—Shukubora, Mizunami City, Gifu Prefecture.

Occurrence:—Loc. No. 1—R; Loc. No. 3—F; Loc. No. 4—R; Loc. No. 10—R; Loc. No. 24—F; Loc. No. 30—F; Loc. No. 32—F.

Family Mitridae

Genus *Mitra* MARTYN, 1784

Mitra ishidae MASUDA, n. sp.

Pl. 2, figs. 11, 12a-b

Holotype:—DGS, Reg. No. 4609.

Description:—Shell small, moderately thick, fusiform, with seven whorls; spiral angle about 40°. Whorls slightly rounded, separated by shallow, uneven, rather distinct sutures; two younger whorls smooth, rounded; surface rather smooth but sculptured with four, unequal, fine, more or less channeled spiral threads on upper part and very fine incremental lines; spiral threads unequally spaced, much less than their interspaces in breadth, middle two more distinct than others. Body whorl rounded, slightly contracted below, sculptured with two, fine spiral threads on upper part, with several, rather distinct revolving threads at extreme end. Aperture rather narrow, elongated, with acute posterior angle; outer lip simple; columellar folds three, upper one stronger than others and middle one stronger than lower; canal short.

Dimensions (in mm):—Height 9.6, diameter 4.3 (holotype); height ca. 7.0, diameter 3.6; height 15.0, diameter 6.5 (paratype).

Remarks:—This species resembles *Mitra hukusimana* NOMURA and ZINBO (1936, p. 174, pl. 15, figs. 29, 29b) from the Yanagawa Miocene of Fukushima Prefecture, but differs by its longer shell, smaller spiral angle, smooth surface and four columellar folds.

Type locality:—Loc. No. 30.

Occurrence:—Type loc.—F; Loc. No. 24—R.

Genus *Vexillum* RÖDING, 1798

Vexillum setsukoae MASUDA, n. sp.

Pl. 2, figs. 21a-b, 22a-b

Holotype:—DGS, Reg. No. 4617.

Description:—Shell small, rather thick, elongated fusiform, with six whorls, one or two nuclear whorls lacking; spiral angle about 30°. Whorls moderately rounded, separated by rather distinct, impressed sutures, sculptured with conspicuous, fine longitudinal ribs and fine spiral threads; longitudinal ribs subvertical, rather low, about 12 on body whorl, broader than their interspaces and tend to become obsolete below; spiral threads numerous but become fewer upwards. Body whorl contracted below, with rather distinct revolving threads near base. Aperture narrow, elongated, angulated posteriorly; outer lip thick, simple; inner lip thin, rather faint; columellar folds four, upper three rather distinct, lower one very faint; canal long, wide and open.

Dimensions (in mm):—

Height	8.8*	8.9	7.8	6.5
Diameter	3.5	3.3	2.9	2.6

*—holotype

Remarks:—*Vexillum sanguisuga* (LINNAEUS) (TRYON, 1882, p. 165, pl. 48, figs. 393-397), a Recent species of Southern Japan, can be distinguished from the present new species by its larger shell and longitudinal ribs which are narrower than their interspaces.

The new name is given to the name of my wife, Setsuko MASUDA who helped me in various ways.

Type locality:—Loc. No. 30.

Occurrence:—Type loc.—F; Loc. No. 24—R.

Genus *Strigatella* SWAINSON, 1840

Strigatella notoensis MASUDA, n. sp.

Pl. 2, figs. 20a-b

Holotype:—DGS, Reg. No. 4616.

Description:—Shell rather large, thick, fusiform, with six whorls, two to three younger whorls lacking; spiral angle about 40°. Whorls slightly rounded, separated by distinct, channeled sutures; surface smooth, with one or two, very faint, fine spiral threads and fine incremental lines. Body whorl smooth, slightly contracted below, with several, faint, fine revolving threads near base. Aperture rather narrow, long, subvertical, angulated above, truncated below; outer lip vertical, simple, subparallel with columella; inner lip thin, rather narrow, rather distinctly defined; columellar folds four, decreasing in size and strength below; upper three folds prominent, lowest one very faint and fine; canal short.

Dimensions (in mm):—Height 32.0, diameter 12.2 (holotype); height 17.0, diameter 7.0 (paratype).

Remarks:—This new species is distinguished from *Strigatella dainitiensis* MAKIYAMA (1927, p. 114, pl. 5, figs. 15, 16) from the Pliocene Dainichi Formation, Shizuoka Prefecture by its distinct sutures, long aperture and surface sculpture.

Type locality:—Loc. No. 24.

Occurrence:—Type loc.—F.

Family Cancellariidae

Genus *Sydaphera* IREDALE, 1929

Sydaphera horii MASUDA, n. sp.

Pl. 2, figs. 16a-b, 17a-b, 18a-b, 19

Holotype:—DGS, Reg. No. 4613.

Description:—Shell rather small, rather thin, ovate-fusiform, with seven whorls, two and a half nuclear whorls; spiral angle about 40°. Whorls shouldered, moderately convex, separated by distinct sutures; nuclear whorls low, smooth, rounded; surface sculptured with distinct, elevated, spirally sculptured longitudinal threads and numerous, distinct, round-topped spiral threads and fine intercalary threads; longitudinal ribs somewhat narrower than their interspaces, about 13 on penultimate whorl; interspaces with distinct spiral threads and intercalary threads. Aperture obliquely ovate, rounded above; outer lip rather thick, denticulated within; inner lip defined by thin callus; columella nearly straight, with three distinct folds, upper two much stronger than lower one; canal short.

Dimensions (in mm):—

Height	11.0*	ca. 15.0	12.0	7.0
Diameter	5.5	8.0	6.5	4.2

*—holotype

Remarks:—The present species resembles *Cancellaria hukusimana* NOMURA and HATAI (1936b, p. 134, pl. 17, figs. 6a-b) from the Tanagura Miocene, Fukushima Prefecture, but *horii* is distinguishable therefrom by its oblong shell, more longitudinal ribs and spiral threads. *Sydaphera* sp. illustrated by ITOIGAWA (1960, p. 290, pl. 6, fig. 4) from the Mizunami Miocene of Gifu Prefecture may be included into the present species, but the naming is withheld until better materials accumulate.

This species is named in honor of Mr. Hisanao HORI of the Kanazawa Technical High School who was my former teacher during the Middle School days and who helped me in various ways.

Type locality:—Loc. No. 32.

Occurrence:—Type loc.—R; Loc. No. 4—R; Loc. No. 7—R; Loc. No. 35—R.

Family Turridae

Genus *Inquisitor* HEDLEY, 1918

Inquisitor shibanoi MASUDA, n. sp.

Pl. 2, figs. 23a-b, 24a-b, 25a-b, 26a-b

Holotype:—DGS, Reg. No. 4619.

Description:—Shell of medium size, rather thick, turreted, with about ten whorls, two to three nuclear whorls; spiral angle about 40°. Whorls separated by rather distinct, uneven sutures; surface with elevated, smooth longitudinal ribs and somewhat granulated subsutural cords; longitudinal ribs oblique, 13 on penultimate whorl and 15 on body whorl, somewhat narrower than their interspaces, angulated at uppermost part; nuclear whorls smooth, rounded. Base of body whorl somewhat contracted, with a few, faint, fine revolving threads. Aperture oblique, rather narrow, elongated, narrowly channeled posteriorly; outer lip thin, with rather deep sinus; inner lip sharply defined, with thin callus; canal short and open.

Dimensions (in mm):—Height 14.0, diameter 5.0 (holotype); height ca. 13.0, diameter 4.0; height 6.4, diameter 2.9 (paratype).

Remarks:—The present new species can be distinguished from *Inquisitor mizunamiensis* ITOIGAWA (1960, p. 291, pl. 6, figs. 8a-b) from the Mizunami Miocene of Gifu Prefecture by its larger number of longitudinal ribs and angulated subsutural bands, and from *Inquisitor osawanoensis* TSUDA (1960, p. 97, pl. 6, figs. 4, 5) from the Kurosedani Miocene of Toyama Prefecture by its larger spiral angle and more longitudinal ribs.

This species is named in honor of Mr. Shôichi SHIBANO of the Yanaida Agricultural High School who helped me in the field.

Type locality:—Loc. No. 30.

Occurrence:—Type loc.—R; Loc. No. 4—R; Loc. No. 23—R; Loc. No. 24—F; Loc. No. 35—R.

Family Pyramidellidae

Genus *Syrnola* A. ADAMS, 1860

Syrnola notoensis MASUDA, n. sp.

Pl. 2, figs. 31a, b

Holotype:—DGS, Reg. No. 4627.

Description:—Shell rather large, thin, turreted, rounded at base, six whorls preserved; spiral angle about 20°. Whorls flattish to slightly rounded, separated by distinct, shallowly channeled sutures; surface smooth but with narrow, colored band a little above sutures, very faint, fine spiral threads and very faint, fine incremental lines. Aperture subovate, posteriorly angulated but anteriorly rounded; outer lip thin, smooth; columella short, with a fold.

Dimensions (in mm):—Height 7.2, diameter 3.0 (holotype); height ca. 8.5, diameter 3.6 (paratype).

Remarks:—The present species was described based upon a well preserved specimen lacking the upper whorls and some unfavourably preserved specimens.

This new species can be distinguished from *Syrnola cinctella* A. ADAMS (NOMURA, 1937, p. 47, pl. 9, figs. 47a-b), a Recent and Pleistocene species of Japan, by its larger shell and rather weak fold.

Type locality:—Loc. No. 23.

Occurrence:—Type loc.—R; Loc. No. 39—F.

Genus *Turbonilla* RISSO, 1827

Turbonilla ishidae MASUDA, n. sp.

Pl. 2, figs. 34a, b, 35

Holotype:—DGS, Reg. No. 4632.

Description:—Shell small, thin, elongate-conical, with six whorls, nuclear whorls lacking; spiral angle about 35°. Whorls somewhat rounded, separated by constricted sutures; surface with elevated, slightly oblique, fine longitudinal ribs much narrower than their interspaces, about 18 on body whorl. Base of body whorl somewhat contracted.

slightly concave, with three, faint, fine spiral threads. Aperture subquadrate, with acute posterior angle; outer lip thick; columella nearly straight.

Dimensions (in mm):—Height 4.3, diameter 2,2 (holotype); height 2.2, diameter 1.3 (paratype).

Remarks:—This new species distinguishable from *Turbonilla tayaensis* NOMURA and HATAI (1938b, p. 61, figs. 5a-b) from the Miocene Taya Formation, Akita Prefecture by its rather small, low shell, larger number of whorls and rounded base.

Type locality:—Loc. No. 24.

Occurrence:—Type loc.—R; Loc. No. 10—R.

Genus *Tiberia* MONTEROSATO, 1875

Tiberia konamiensis MASUDA, n. sp.

Pl. 2, figs. 32a, b

Holotype:—DGS, Reg. No. 4630.

Description:—Shell small, thin, umbilicated, regularly turreted, with nine whorls, younger two to three whorls lacking; spiral angle about 30°. Whorls flattish, gradually growing, separated by rather distinct sutures; surface smooth but with very faint, fine incremental lines. Body whorl flattish above, rounded at periphery, convex at base. Aperture subovate, with acute posterior angle; outer lip thin, simple; inner lip with thin callus; columella straight, with three unequal folds, upper fold strong, conspicuous and lower two much less conspicuous.

Dimensions (in mm):—Height 9.0, diameter 4.5 (holotype).

Remarks:—The present new species can be distinguished from *Pyramidella hataii* MASUDA (1956, p. 164, pl. 26, figs. 15a-b) from the Higashi-Innai Formation at Loc. No. 12 by its larger spiral angle, not channeled sutures and upper conspicuous columellar fold and two, lower weak columellar folds.

Type locality:—Loc. No. 35.

Occurrence:—Type loc.—R.

Family Scaphanderidae

Genus *Adamnestia* IREDALE, 1936

Adamnestia onukii MASUDA, n. sp.

Pl. 2, figs. 36a, b

Holotype:—DGS, Reg. No. 4634.

Description:—Shell small, solid, elongated, cylindrical, rounded at lower end; convolute; vertex shallowly depressed, with a small pit at bottom. Body whorl equal to length of shell; surface smooth but with very faint, fine growth lines and a few, very faint, fine spiral threads at uppermost part. Aperture linear, narrow, dilated at lower part; outer lip thin, nearly straight; inner lip covered by callus; umbilicus very shallow, slit-like.

Dimensions (in mm)—Height 7.2, diameter 3.0 (holotype); height 5.7, diameter 2.4 (paratype).

Remarks:—*Adamnestia japonica* (A. ADAMS) (HABE, 1961, p. 91, pl. 43, fig. 15), a Recent species of Japan, can be distinguised from the present one by its smaller shell and surface sculpture.

This new species is named in honor of Professor Yoshio ONUKI of the Department of Geology, Faculty of Education, Tohoku University.

Type locality:—Loc. No. 24.

Occurrence:—Type loc.—R; Loc. No. 23—R.

References

ARAKI, Y. (1961): Geology, Paleontology and Sedimentary Structures (including Problematica) of the Tertiary Formations Developed in the Environs of Tsu City, Mie Prefecture, Japan. *Bull. Lib. Arts, Mie Univ., Spec. Vol.*, No. 1, pp. 1-118, 6 tables, 3 maps, 1 chart, pls. 1-11.

ASANO, K. (1953): Miocene Foraminifera from Noto Peninsula, Ishikawa Prefecture. *Short Papers, Inst. Geol. Paleont., Tohoku Univ.*, No. 5, pp. 1-21, 2 tables, pls. 1-3.

DUNKER, W. (1860): Neue japanische Mollusken. *Mal. Bl.*, Vol. 6, pp. 221-240.

HABE, T. (1950): Myochamidae in Japan. *Illust. Cat. Jap. Shells by* T. KURODA, No. 4, pp. 25-30, pl. 4.

—— (1961): Coloured Illustrations of the Shells of Japan (II). pp. 1-183, pp. 1-66, Hoikusha, Osaka, Japan (in Japanese).

HATAI, K. (1960): Japanese Miocene Reconsidered. *Sci. Rep., Tohoku Univ., 2nd Ser., Spec. Vol.*, No. 4, pp. 127-153.

—— and KOTAKA, T. (1952): On Some Lower Miocene Shells. *Short Papers, Inst. Geol. Paleont., Tohoku Univ.*, No. 4, pp. 70-86, 1 table, pl. 7.

—— and MASUDA, K. (1966): A New Miocene *Myadora* from Sendai, Miyagi Prefecture, Northeast Honshu, Japan. *Saito Ho-on Kai Mus., Res. Bull.*, No. 29, pp. 32-34, text-figs. 1-2.

—— and NISIYAMA, S. (1928): Remarks on Certain Fossils from the Borderland of the Japan Sea. *Japan. Jour. Geol. Geogr.*, Vol. 16, Nos. 1-2, pp. 123-154, pl. 9.

—— and —— (1949): New Tertiary Mollusca from Japan. *Jour. Paleont.*, Vol. 23, No. 1, pp. 87-94, pls. 23-24.

—— and —— (1952): Check List of Japanese Tertiary Marine Molluscs. *Sci. Rep., Tohoku Univ., 2nd Ser., Spec. Vol.*, No. 3, pp. 1-464.

HUZIOKA, K. (1949): Two Daijimaian Floral Types in the Inner Zone of Northern Japan. *Jour. Geol. Soc. Japan*, Vol. 55, Nos. 648-649, p. 177 (in Japanese).

IKEBE, N. (1941): On *Katelysia (Nipponomarcia) nakamurai*, subgen. et sp. nov., from the Togarian Miocene of Japan. *Japan. Jour. Mal.*, Vol. 11, Nos. 2-3, pp. 49-54, pl. 2.

—— (1942): Trochid Mollusca *Calliostoma* of Japan, Fossil and Recent. *Japan. Jour. Geol. Geogr.*, Vol. 18, No. 4, pp. 249-282, text-figs. 1-7, pls. 26-28.

IMAIZUMI, R. (1958): Miocene Crab from the Noto Peninsula and Tsuyama Basin. —A Revision of *Carcinoplax antiqua*—. *Jour. Geol. Soc. Japan*, Vol. 64, No. 753, p. 308 (in Japanese).

INO, T. and KAMETAKA, Y. (1943): Feeding Intensity and Changes of the Shell of the Top-shell, *Turbo cornutus* SOLANDER, due to Environments. *Jour. Fish Soc. Japan*, Vol. 12, No. 3, pp. 113-118, text-figs. 1-2, 5 tables (in Japanese).

ISHIDA, S. (1959): Cenozoic Strata of Noto, Japan. *Mem. Coll. Sci., Kyoto Univ., Ser, B.* Vol. 27, No. 2, pp. 83-101, text-figs. 1-8, 1 table, pl. 2.

—— (1964): Orito Flora of Noto, Japan. *Mem. Coll. Sci., Kyoto Univ.* (in press).

—— and MASUDA, K. (1956): Geology of the Northeastern Region of Noto Peninsula, Japan. *Jour. Geol. Soc. Japan*, Vol. 62, No. 735, pp. 703-716, 1 table, text-figs. 1-3 (in Japanese).

ITOIGAWA, J. (1955): Molluscan Fauna of the Mizunami Group in the Iwamura Basin. *Mem. Coll. Sci., Kyoto Univ., Ser., B*, Vol. 22, No. 2, pp. 127-143, 1 text-fig., pls. 5-6.

—— (1956): Molluscan Fauna of the Tsuzuki Group in Kyoto Prefecture, Japan. *Ibid.*, Vol. 23, No. 2, pp. 179-192, text-figs. 1-2, pls. 1-3.

—— (1957): On the Miocene Lucinidae from the Mizunami Group, Japan. *Trans. Proc. Palaeont. Soc. Japan. N. S.*, No. 25, pp. 1-6, pl. 1.

—— (1958): On Some Cephalaspid Opisthobranchia from the Japanese Miocene. *Ibid.*, No. 29, pp. 175-183, pl. 26.

—— (1960): Paleoecological Studies of the Miocene Mizunami Group, Central Japan. *Jour. Earth Sci., Nagoya Univ.*, Vol. 8, No. 2, pp. 246-300, text-figs. 1-5, 2 tables, pls. 1-6.

IWAI, T. (1961): The Miocene Molluscan Fossils from the Area southwest of Hirosaki City, Aomori Prefecture, Japan. *Trans. Proc. Palaeont. Soc. Japan, N.S.*, No. 41, pp. 1-8, 1 text-fig., 1 table, pl. 1.

KAMADA, Y. (1952): On Some Species of *Cyclina* from Japan and Korea. *Trans. Proc. Palaeont. Soc. Japan, N.S.*, No. 6, pp. 167-173, pl. 15.

—— (1960): On the Associated Occurrence of *Vicarya* and *Vicaryella* in Japanese Tertiary with first Description of a Paleogene Species of *Vicarya* from Japan. *Sci. Rep., Tohoku Univ., 2nd Ser., Spec. Vol.*, No. 4, pp. 281-295, pls. 30-31.

—— (1962): Tertiary Marine Mollusca from the Joban Coal-field, Japan. *Palaeont. Soc. Japan, Spec. Papers*, No. 8, pp. 1-187, text-figs. 1-3, 2 tables, pls. 1-21.

KANEHARA, K. (1936): Neogene Shells from South Chôsen (Korea). *Japan. Jour. Geol. Geogr.*, Vol. 13, Nos. 1-2, pp. 31-37, pl. 10.

KANNO, S. (1960): Tertiary System of the Chichibu Basin, Saitama Prefecture, Central Japan. Part II, Palaeontology. *Japan Soc. Promot. Sci.*, pp. 123-396, text-figs. 21-26, 15 tables, 5 maps, pls. 31-51.

KASENO, Y. (1956): Illustrations of Fossils from Fukui. Pt. 1, The Vicinity of Ayukawa. pp. 1-16, pls. 1-4, *Sci. Comm., Fukui City and Fukui City Mus.* (in Japanese).

—— (1963): Geology of Southern Noto Peninsula, Central Japan, with Reference to the Cenozoic History. *Sci. Rep., Kanazawa Univ.*, Vol. 8, No. 2, pp. 541-568, text-figs. 1-11, 1 table, pls. 1-4.

——, SAKAMOTO, T. and ISHIDA, S. (1961): A Contribution to the Neogene History of the Eastern Hokuriku District, Central Japan. *Mem. Vol., Prof. Jiro MAKIYAMA*, pp. 83-95, text-figs. 1-10, 2 tables (in Japanese).

KIRA, T. (1960): Coloured Illustrations of Japan. pp. 1-239, pls. 1-71, Hoikusha, Osaka, Japan (in Japanese).

KOBAYASHI, T. and HORIKOSHI, M. (1958): Indigeneous *Aturia* and Some Tropical Gastropods from the Miocene of Wakasa in West Japan. *Japan. Jour. Geol. Geogr.*, Vol. 29, Nos. 1-3, pp. 45-54, text-figs. a-c, pls. 4-5.

KOTAKA, T. (1958): Faunal Consideration of the Neogene Invertebrates of Northern Honshu, Japan. *Saito Ho-on Kai Mus., Res. Bull.*, No. 27, pp. 28-44, 1 text-fig., 3 tables.

MAKIYAMA, J. (1926): Tertiary Fossils from North Kankyô-dô, Korea. *Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B*, Vol. 2, No. 3, pp. 143-160, pls. 12-13.

—— (1927): Molluscan Fauna of the Lower Part of the Kakegawa Series in the Province of Tôtômi, Japan. *Ibid.*, Vol. 3, No. 1, pp. 1-147, pls. 1-6.

—— (1936): The Meisen Miocene of North Korea. *Ibid.*, Vol. 11, No. 4, pp. 193-228, text-figs. 1-2, pls. 4-5.

MASUDA, K. (1954): On the Geology of Machino-machi, Najimi-mura and Yanaida-mura, Fugeshi-gun, Ishikawa Prefecture. *Jour. Geol. Soc. Japan*, Vol. 60, No. 703, pp. 145-152, pl. 4 (in Japanese).

—— (1955): Miocene Mollusca from Noto Peninsula, Japan. Part I(1). *Trans. Proc. Palaeont. Soc. Japan, N.S.*, No. 20, pp. 119-127, pl. 19.

—— (1956): Miocene Mollusca from Noto Peninsula, Japan. Part I(II). *Ibid.*, No. 21, pp. 161-167, pl. 26.

—— (1962a): Tertiary Pectinidae of Japan. *Sci. Rep., Tohoku Univ., 2nd Ser.*, Vol. 33, No. 2, pp. 117-238, text-figs. 1-11, pls. 18-27.

—— (1962b): Notes on the Tertiary Pectinidae of Japan. *Ibid., Spec. Vol.*, No. 5, pp. 159-193, text-figs. 1-9, 9 tables.

—— (1963): Biostratigraphy of the Japanese Neogene based upon the Molluscan Fauna with Special Reference to the Pectinidae and Turritellidae. *Fossils, Palaeont. Soc. Japan*, No. 5, pp. 25-38, text-figs. 1-2, 1 table (in Japanese).

NAGAO, T. (1938): Palaeogene Fossils of the Islands of Kyushu, Japan. Part 1. *Sci. Rep., Tohoku Imp. Univ., 2nd Ser.*, Vol. 9, No. 3, pp. 97-128, pls. 18-22.

NOMURA, S. (1935a): Miocene Mollusca from the Nisi-Tugaru District, Aomori-ken, Northeast Honsyû, Japan. *Saito Ho-on Kai Mus., Res. Bull.*, No. 6, pp. 19-74, 1 text-fig., pls. 2-8.

—— (1935b): Miocene Mollusca from Siogama, Northeast Honsyû, Japan. *Ibid.*, No. 6, pp. 193–234, pls. 15–16.

—— (1937): Additional Pyramidellidae from Siogama Bay, with Remarks on the Molluscan Fauna, especially Pyramidellidae from Sagami Bay; being a Comparative Study. *Ibid.*, No. 13, pp. 11–107, pls. 4–14.

—— (1938): Molluscan Fossils from the Tatunokuti Shell Bed Exposed at Gôroku Cliff in the Western Border of Sendai. *Sci. Rep., Tohoku Imp. Univ., 2nd Ser.*, Vol. 19, No. 2, pp. 235–275, pls. 33–36.

—— (1939): Miocene Mollusca from Yamaguti, Kozai-mura, Igu-gun, Miyagi-ken, Northeast Honsyû, Japan. *Jour. Geol. Soc. Japan*, Vol. 46, No. 548, pp. 253–257, pl. 13.

—— (1940): Molluscan Fauna of the Moniwa Shell Beds Exposed along the Natori-gawa in the Vicinity of Sendai, Miyagi Prefecture. *Sci. Rep., Tohoku Imp. Univ., 2nd Ser.*, Vol. 21, No. 1, pp. 1–46, pls. 1–3.

—— and HATAI, K. (1936): Fossils from the Tanagura Beds in the Vicinity of the Town Tanagura, Hukusima-ken, Northeast Honsyû, Japan. *Saito Ho-on Kai Mus., Res. Bull.*, No. 10, pp. 109–155, pls. 13–17.

—— and —— (1938a): Fossil Mollusca from the Neogene of Izumo. *Japan. Jour. Geol. Geogr.*, Vol. 16, Nos. 1–2, pp. 1–9, pl. 1.

—— and —— (1938b): On Some Fossils from Akita Prefecture, Northeast Honsyû, Japan. *Ibid.*, Vol. 16, Nos. 1–2, pp. 39–64, text-figs. 1–5.

—— and ZINBO, N. (1935): Mollusca from the Yanagawa Shell-Beds in the Hukusima Basin, Northeast Honsyû, Japan. *Saito Ho-on Kai Mus., Res. Bull.*, No. 6, pp. 151–192, pl. 15.

OINOMIKADO, T. (1938): Neogene Shells from the Vicinity of the City of Takasaki, Gumma-ken, Japan. *Jour. Geol. Soc. Japan*, Vol. 45, No. 539, pp. 671–676, pl. 20.

OTUKA, Y. (1934): Tertiary Structure of the Northwestern End of the Kitakami Mountainland, Iwate Prefecture, Japan. *Bull., Earthq. Res. Inst., Imp. Univ. Tokyo*, Vol. 12, Pt. 3, pp. 566–638, 1 map, pls. 44–51.

—— (1937): The Geologic Age of the Tertiary Formation near Hamada, Simane Prefecture, Japan. *Japan. Jour. Geol. Geogr.*, Vol. 14, Nos. 1–2, pp. 23–32, 1 text-fig., 1 table, pl. 33.

—— (1938a): Neogene Fossils of the Ihara District, Sizuoka Prefecture, Japan. *Jour. Fac. Sci., Imp. Univ. Tokyo, Sec. 2*, Vol. 5, Pt. 1, pp. 1–19, text-figs. 1–2, 3 tables, pls. 1–2.

—— (1938b): Mollusca from the Miocene of Tyûgoku, Japan. *Ibid.*, Vol. 5, Pt. 2, pp. 21–45, text-figs. 1–4, pls. 1–4.

—— (1941): Fossil Mollusca from Tazima, Hyôgo Prefecture, Japan. *Japan. Jour. Geol. Geogr.*, Vol. 18, Nos. 1–2, pp. 21–45.

OYAMA, K. (1950): Studies of Fossil Molluscan Biocoenosis, No. 1. Biocoenological Studies on the Mangrove Swamps, with Descriptions of New Species from Yatuo Group. *Geol. Surv. Japan, Rep.*, No. 132, pp. 1–15, 1 text-fig., pls. 1–3.

—— (1961): Revision of Cenozoic Fossil Mollusca from Japan (1). *Ibid., Bull.*, Vol. 21, No. 5, pp. 75–85 (in Japanese).

—— (1953): Fossil Communities of the Oceanic Water (No. 1). *Misc. Rep., Res. Inst. Nat. Res.*, No. 32, pp. 23–29 (in Japanese).

—— (1954): Fossil Communities of the Oceanic Water (No. 2). *Ibid.*, No. 34, pp. 89–100 (in Japanese).

—— and SAKA, K. (1944): Fossilienmollusken der Tukiyosi-Formation (1). *Bull., Sigenkagaku Kenkyusho*, Vol. 1, No. 2, pp. 137–144, pls. 14–15 (in Japanese).

PHILIPPI, R. A. (1845): Abbildungen und Beschreibungen neuer order wenig gekannter Conchylien, unter Mithülfe mehrerer deutscher Conchyliologen. Vol. 1, pp. 1–204.

PILSBRY, H. A. (1904): New Japanese Marine Mollusca; Pelecypoda. *Proc. Acad. Nat. Sci. Phila.*, Vol. 56, pp. 550–561, pls. 39–41.

REEVE, L. A. (1843–1887): Conchologia Iconica, figures and descriptions of the shells of molluscs; with remarks on their affinities, synonymy, and geographical distribution. Vols. 1–17, 18–20 (continued by G. B. SOWERBY).

SHUTO, T. (1957): Fossil *Paphia* from the Miyazaki Group. *Japan. Jour. Geol. Geogr.*, Vol. 28, Nos. 1-3, pp. 139-160, text-figs. 1-9, 6 tables, pl. 12.
—— (1961): Palaeontological Study of the Miyazaki Group.—A General Account of the Faunas. *Mem. Fac. Sci., Kyushu Univ., Ser. D*, Vol. 10, No. 2, pp. 73-206, text-figs. 1-23, 5 tables, pls. 11-13.
SOWERBY, G. B., (1842-1887): Thesaurus Conchyliorum. Vols. 1-5.
TRYON, G. W., (1878-1898): Manual of Conchology. Vols. 1-9; 10-16 (continued by H. A. PILSBRY); 17 (by H. A. PILSBY and B. SHARP).
TSUDA, K., (1955): On the Sedimentary Environments of the Yatsuo Group.—A Study of the Sedimentary Environment of the Miocene Deposits in the so-called "Green Tuff" Region—(Part 1). *Jour. Geol. Soc. Japan*, Vol. 61, No. 722, pp. 532-542, text-figs. 1-4, 2 tables (in Japanese).
—— (1956): Faunas and Facies of Some Middle Miocene Deposits in Japan. *Jour. Paleont.*, Vol. 30, No. 4, pp. 974-980, text-

Explanation of Plate 1

(All figures in natural size, unless otherwise stated)

Figs. 1a-b, 2a-b. *Vicaryella ishiiana* (YOKOYAMA). 1a-b, DGS, Reg. No. 4573; Loc. No. 23. 2a-b, DGS, Reg. No. 4574; Loc. No. 39. .... p. 1

Fig. 3. *Vicaryella notoensis* MASUDA. DGS, Reg. No. 4575; Loc. No. 24.

Fig. 4. *Cerithidea kanpokuensis* MAKIYAMA. DGS, Reg. No. 4576; Loc. No. 24.

Figs. 5a-b, 6a-b. *Cerithidea ohiroi* MASUDA, n. sp. 5a-b, paratype, DGS, Reg. No. 4578; Loc. No. 30. ×5. 6a-b, holotype, DGS, Reg. No. 4577; Loc. No. 24. ×2. .... p. 1

Figs. 7a-b, 8a-b, 9. *Batillaria toshioi* MASUDA, n. sp. 7a-b, holotype, DGS, Reg. No. 4580; Loc. No. 23. 8a-b, paratype, DGS, Reg. No. 4582; Loc. No. 38. 9, paratype, DGS, Reg. No. 4581; Loc. No. 23. .... p. 2

Figs. 10a-b, 11a-b, 12a-b, 13a-b, 17a-b. *Cerithium* (*Proclava*) *ancisum* (YOKOYAMA). 10a-b, 12a-b, DGS, Reg. No. 4583; Loc. No. 30. 11a-b, DGS, Reg. No. 4579; Loc. No. 24. ×2. 13a-b, 17a-b, DGS, Reg. No. 4584; Loc. No. 23. .... p. 3

Figs. 14a-b, 15a-b. *Cerithidea sirakii* (MAKIYAMA). 14a-b, DGS, Reg. No. 4585; Loc. No. 35. 15a-b, DGS, Reg. No. 4646; Loc. No. 35.

Figs. 16a-b. *Cerithium meisense* MAKIYAMA. DGS, Reg. No. 4586; Loc. No. 7.

Figs. 18a-b. *Bittium* sp. DGS, Reg. No. 4587; Loc. No. 24. ×5.

Figs. 19a-b. *Nodiscala suzuensis* MASUDA, n. sp. Holotype, DGS, Reg. No. 4588; Loc. No. 30. ×5. .... p. 4

Figs. 20a-b. *Turriscala* sp. DGS, Reg. No. 4589; Loc. No. 3. ×2.

Figs. 21a-b. *Eulima hataii* MASUDA, n. sp. Holotype, DGS, Reg. No. 4590; Loc. No. 35. ×2. .... p. 5

Figs. 22a-b. *Pachycrommium japonicum* KANNO. DGS, Reg. No. 4593; Loc. No. 24.

Figs. 23a-b. *Sinum ineptum* (YOKOYAMA). DGS, Reg. No. 4594; Loc. No. 23.

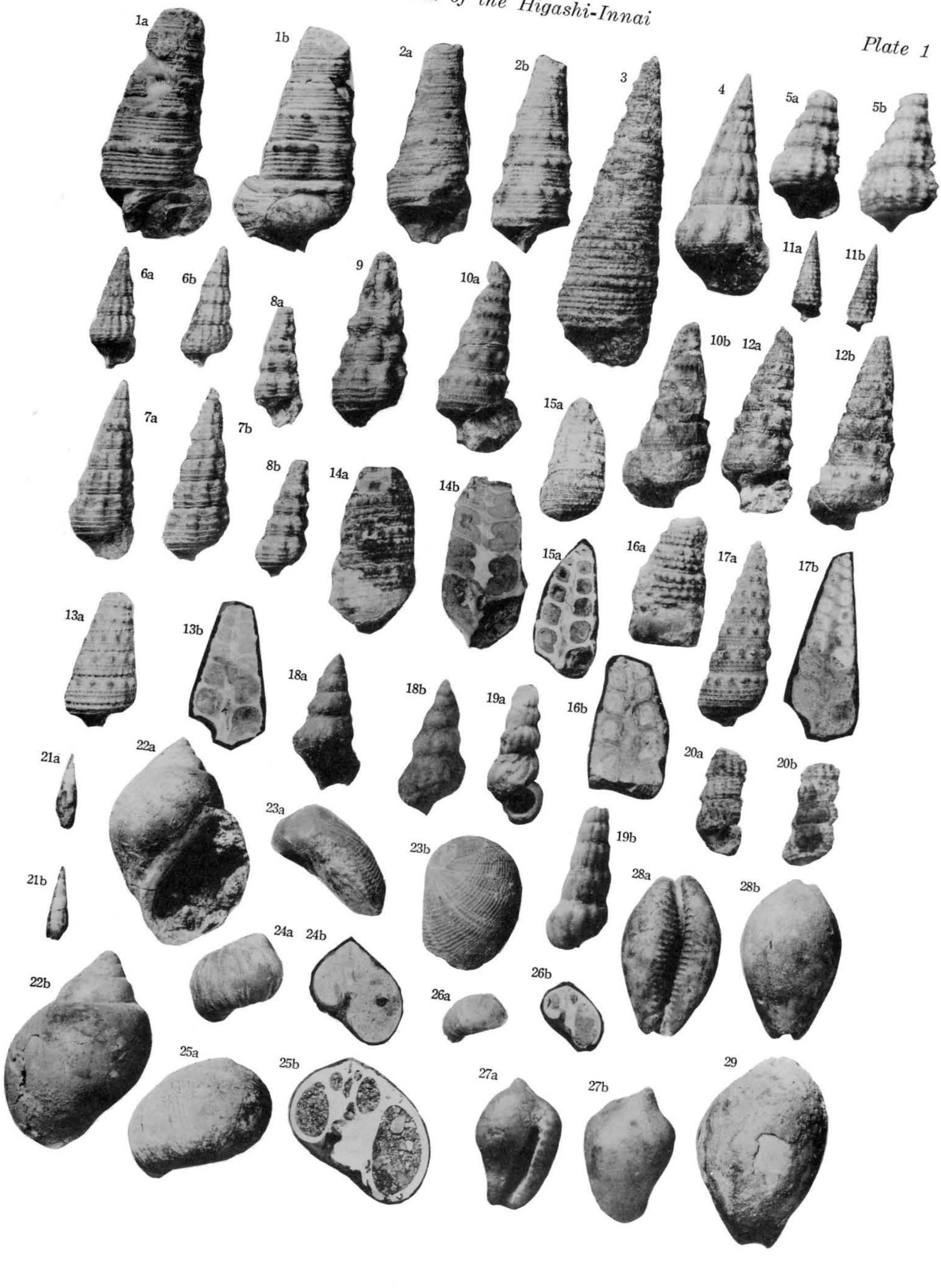
Figs. 24a-b. *Polinics meisensis* MAKIYAMA. DGS, Reg. No. 4595; Loc. No. 23.

Figs. 25a-b, 26a-b. *Neverita coticazae* (MAKIYAMA). 25a-b, topotype, IGPS, coll. cat. no. 64773; Loc. Kinshôdô, Meisen District, North Korea (Bankôdô Formation). 26a-b, DGS, Reg. No. 4596; Loc. No. 24. .... p. 5

Figs. 27a-b. *Proterato* (*Sulcerato*) *minoensis* ITOIGAWA. DGS, Reg. No. 4597; Loc. No. 30. ×5.

Figs. 28a-b, 29. *Cypraea ohiroi* MASUDA, n. sp. 28a-b, holotype, DGS, Reg. No. 4598; Loc. No. 30. 29, paratype, DGS, Reg. No. 4599; Loc. No. 30. .... p. 6

Plate 1


1a
1b
2a
2b
3
4
5a
5b
6a
6b
7a
7b
8a
8b
9
10a
10b
11a
11b
12a
12b
13a
13b
14a
14b
15a
15a
16a
16b
17a
17b
18a
18b
19a
19b
20a
20b
21a
21b
22a
22b
23a
23b
24a
24b
25a
25b
26a
26b
27a
27b
28a
28b
29

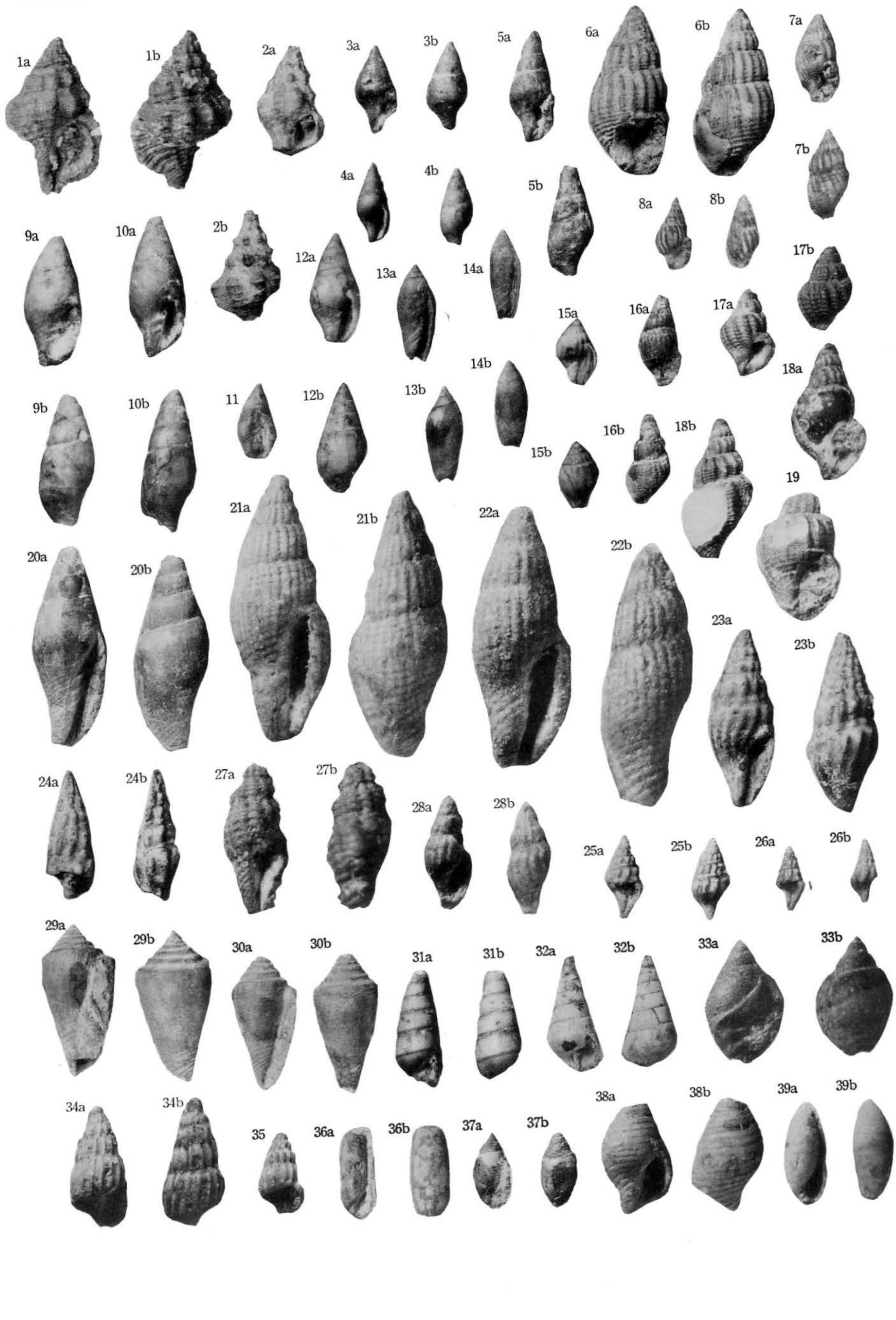
figs. 1–6.
—— (1959): New Miocene Molluscs from the Kurosedani Formation in Toyama Prefecture, Japan. *Jour. Fac. Sci., Niigata Univ., Ser. 2*, Vol. 3, No. 2, pp. 67–110, 1 text-fig., 1–7.
—— (1960): Paleo-Ecology of the Kurosedani Fauna. *Ibid.*, Vol. 3, No. 4, pp. 171–203, text-figs. 1–27, 1 table.
UOZUMI, S., (1962): Neogene Molluscan Faunas in Hokkaido (Part 1). Sequence and Distribution of Neogene Molluscan Faunas). *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, Vol. 11, No. 3, pp. 507–544, text-figs. 1–11, 3 tables.
VREDENBURG, E., (1928): Descriptions of Mollusca from the Post-Eocene Tertiary Formation of Northwestern India. *Mem. Geol. Surv. India*, Vol. 50, Pt. 2, pp. 351–462, pls. 14–33.
YABA, H. and HATAI, K., (1938): On the Japanese Species of *Vicarya*. *Sci. Rep., Tohoku Imp. Univ., 2nd Ser.*, Vol. 19, No. 2, pp. 149–172, pl. 12.
—— and —— (1941): The Cenozoic Formations and Fossils of Northeast Honsyû, Japan. *Ibid.*, Vol. 22, No. 1, pp. 1–86, pls. 1–4.
YOKOYAMA, M., (1920): Fossils from the Miura Peninsula and Its Immediate North. *Jour. Coll. Sci., Imp. Univ. Tokyo*, Vol. 39, Art. 6, pp. 1–193, pls. 1–20.
—— (1923): Tertiary Fossils from Kii. *Japan. Jour. Geol. Geogr.*, Vol. 2, No. 3, pp. 47–58, pls. 6–7.
—— (1925): Molluscan Remains from the Uppermost Part of the Jo-Ban Coal-Field. *Jour. Coll. Sci., Imp. Univ. Tokyo*, Vol. 45, Art. 5, pp. 1–35, pls. 1–6.
—— (1926a): Molluscan Fossils from the Tertiary of Mino. *Jour. Fac. Sci., Imp. Univ. Tokyo, Sec. 2*, Vol. 1, Pt. 7, pp. 213–227, pl. 28.
—— (1926b): Fossil Shells from the Atsumi Peninsula, Mikawa. *Ibid.*, Vol. 1, Pt. 9, pp. 369–375, pl. 43.
—— (1927): Mollusca from the Upper Musashino of Tokyo and its Suburbs. *Ibid.*, Vol. 1, Pt. 10, pp. 391–437, pls. 46–50.
—— (1929): Neogene Shells from Some Provinces of Chugoku. *Ibid.*, Vol. 2, Pt. 8, pp. 363–368, pl. 70.

Akagami	赤 神	Awagura	粟 蔵
Doguchi	土 口	Fugeshi-gun	鳳 至 郡
Fujio	藤 尾	Higashi-Innai	東 印 内
Hizumewaki	日 詰 脇	Iizuka	飯 塚
Inomote	井 面	Kakuma	角 間
Kanagura	金 蔵	Kendaradake	見 平 岳
Kobunayama	小 鮒 山	Kônami	高 波
Kônosuyama	高 洲 山	Kûden	久 田
Matsunagi	馬 緤	Maura	真 浦
Mukaiyama	向 山	Munehiro	宗 広
Najimi	南 志 見	Nekogatake	猫 ヶ 岳
Nishi-Innai	西 院 内	Orito	折 戸
Sakaishiyama	坂 石 山	Sarugaba	猿 ヶ 場
Suzu City	珠 洲 市	Tannoji	谷 野 地
Tokunari	徳 成	Wajima City	輪 島 市
Wanizaki	鰐 崎	Wasumi	和 住
Yanaida-mura	柳 田 村	Yoshiro	吉 路

Explanation of Plate 2

(All figures in natural size, unless otherwise stated)

Figs. 1a-b. *Apollon osawanoensis* TSUDA. DGS, Reg. No. 4601; Loc. No. 24.
Figs. 2a-b. *Siphonalia nisiyamai* HATAI and KOTAKA. DGS, Reg. No. 4602; Loc. No. 30.
Figs. 3a-b, 4a-b, 5a-b. *Mitrella notoensis* MASUDA, n. sp. 3a-b, holotype, DGS, Reg. No. 4603; Loc. No. 30. ×2. 4a-b, 5a-b, paratype, DGS, Reg. No. 4604; Loc. No. 24. ×2. ....p. 7
Figs. 6a-b. *Phos notoensis* MASUDA, n. sp. Holotype, DGS, Reg. No. 4605; Loc. No. 23. ×2. ....p. 7
Figs. 7a-b, 8a-b. *Nassarius (Zeuxis) minoensis* ITOIGAWA. 7a-b, DGS, Reg. No. 4606; Loc. No. 32. 8a-b, DGS, Reg. No. 4607; Loc. No. 3. ....p. 8
Figs. 9a-b, 10a-b. *Mitra hukusimana* NOMURA and ZINBO. DGS, Reg. No. 4608; Loc. No. 30. ×2.
Figs. 11, 12a-b. *Mitra ishidae* MASUDA, n. sp. 11, paratype, DGS, Reg. No. 4601; Loc. No. 30. ×2. 12a-b, holotype, DGS, Reg. No. 4609; Loc. No. 30. ×2. ....p. 8
Figs. 13a-b, 14a-b. *Oliva osawanoensis* TSUDA. DGS, Reg. No. 4611; Loc. No. 24.
Figs. 15a-b. *Pusia* sp. DGS, Reg. No. 4612; Loc. No. 35. ×2.
Figs. 16a-b, 17a-b, 18a-b, 19. *Sydaphera horii* MASUDA, n, sp. 16a-b, 19, paratype, DGS, Reg. No. 4614; Loc. No. 23. ×2. 17a-b, holotype, DGS, Reg. No. 4613; Loc. No. 32. ×2. 18a-b, paratype, DGS, Reg. No. 4615; Loc. No. 7. ×2. ....p. 10
Figs. 20a-b. *Strigatella notoensis* MASUDA, n. sp. Holotype, DGS, Reg. No. 4616; Loc. No. 24. ....p. 9
Figs. 21a-b, 22a-b. *Vexillum setsukoae* MASUDA, n. sp. 21a-b, holotype, DGS, Reg. No. 4617; Loc. No. 30. ×5. 22a-b, paratype, DGS, Reg. No. 4618; Loc. No. 24. ×5. ....p. 9
Figs. 23a-b, 24a-b, 25a-b, 26a-b. *Inquisitor shibanoi* MASUDA, n. sp. 23a-b, holotype, DGS, Reg. No. 4619; Loc. No. 30. ×2. 24a-b, 25a-b, 26a-b, paratype, DGS, Reg. No. 4620; Loc. No. 24. ×2. ....p. 10
Figs. 27a-b. *Philbertia* sp. DGS, Reg. No. 4622; Loc. No. 30. ×5.
Figs. 28a-b. *Cythara* sp. DGS, Reg. No. 4624; Loc. No. 30. ×5.
Figs. 29a-b, 30a-b. *Conus tokunagai* OTUKA. DGS, Reg. No. 4626; Loc. No. 23.
Figs. 31a-b. *Syrnola notoensis* MASUDA, n. sp. Holotype, DGS, Reg. No. 4627; Loc. No. 23. ×2. ....p. 11
Figs. 32a-b. *Tiberia konamiensis* MASUDA, n. sp. Holotype, DGS, Reg. No. 4630; Loc. No. 35. ×2. ....p. 12
Figs. 33a-b. *Ringicula minoensis* TAKEYAMA. DGS, Reg. No. 4631; Loc. No. 23. ×5.
Figs. 34a-b, 35. *Turbonilla ishidae* MASUDA, n. sp. 34a-b, holotype, DGS, Reg. No. 4632; Loc. No. 24. ×5. 35, paratype, DGS, Reg. No. 4633; Loc. No. 10. ×5. ....p. 11
Figs. 36a-b. *Adamnestia onukii* MASUDA, n. sp. Holotype, DGS, Reg. No. 4634; Loc. No. 24. ×2. ....p. 12
Figs. 37a-b. *Acteon osawanoensis* TSUDA. DGS, Reg. No. 4635; Loc. No. 23.
Figs. 38a-b. *Menestho* sp. DGS, Reg. No. 4636; Loc. No. 30. ×5.
Figs. 39a-b. *Volvulella tokiensis* ITOIGAWA. DGS, Reg. No. 4637; Loc. No. 30. ×5.


1a
1b
2a
3a
3b
5a
6a
6b
7a
7b
4a
4b
5b
8a
8b
9a
10a
2b
12a
13a
14a
17b
15a
16a
17a
18a
14b
9b
10b
11
12b
13b
15b
16b
18b
19
21a
21b
22a
22b
20a
20b
23a
23b
24a
24b
27a
27b
28a
28b
25a
25b
26a
26b
29a
29b
30a
30b
31a
31b
32a
32b
33a
33b
34a
34b
35
36a
36b
37a
37b
38a
38b
39a
39b

Trans. Proc. Palaeont. Soc. Japan. N.S., No. 65, pp. 19-25, pls. 3, 4, Apr. 10, 1967

517. THREE NEW TERTIARY FORAMINIFERAL GENERA FROM FLORIDA, SAIPAN AND GUAM*

SHOSHIRO HANZAWA

Institute of Geology and Paleontology, Tohoku University, Sendai

北米フロリダ・サイパン島・グアム島産の第三紀有孔虫の新属：フロリダ下部始新期産 *Borelis gunteri* COLE, 1941 は multi-tiered chambers 及び continuous septa を有し，中新～現生期の *Alveolinella* DOUVILLÉ に近似し single storied chambers の *Borelis* EHRENBERG から区別しなければならないので新属 *Quasiborelis* を提議した。サイパン島 Aquitanian 統産 *Gypsina marianensis* HANZAWA, 1957 は構造的に3層に分化し，その中の中層の chambers には 4 stolons を具えておる。*Gypsina* CARTER にはこの様な特性はないので本種は *Gypsina* から区別される可きものとし新属 *Tayamaia* を提議した。グアム島鮮新統 Alifan 石灰岩産で *Rotalia atjehensis* VAN DER VLERK, 1924 : COLE, 1963 の一部は plano-convex で殻壁は *Calcarina* D'ORBIGNY のもの同様2重になっており構造上 *Baculogypsinoides* YABE and HANZAWA に似ておるが後者にある様な spinose structure を欠き新属 *Quasirotalia* として区別される。 半 沢 正 四 郎

Introduction and Acknowledgement

Review of the previous works on the Tertiary larger Foraminifera from the Gulf of Mexico and Pacific regions has led the writer to establish three new genera, *Quasiborelis* from the lower Eocene of Florida, *Tayamaia* from the Aquitanian of Saipan and *Quasirotalia* from the Pliocene of Guam. For *Quasirotalia*, the writer is much indebted to Dr. Arthur COOPER of the U. S. National Museum and Dr. Joshua I. TRACEY, Jr. of the U. S. Geological Survey, Washington, D. C. who kindly loaned to the writer limestone sections of the Alifan and Bonya limestones from Guam containing the afro-mentioned Foraminifera and helped the writer's investigation.

Systematic Descriptions

Family Alveolinidae EHRENBERG

All the foraminiferal genera which were grouped up into a single family Alveolinidae EHRENBERG by REICHEL (Treaties on Invertebrate Paleontology, C2, vol. 1, p. C503-C510) vary from spherical, subspherical, ovoidal, ellipsoidal, fusiform, cylindrical, to nautiloidal in external form. Their wall structure and mode of growth are similar. Their shell walls are solid and porcellaneous, consisting of a number of whorls coiling planispirally around a juvenarium. The whorls of all the genera of this family consists of a single sheet of the spiral lamella, excepting for *Multispira* REICHEL, which consists of a composite whorl of a number of successively superposed spiral lamellae. The whorls of all the genera are divide into multitudes of chambers by radial septa extending from pole to pole of the test. The chambers are subdivided into many chamberlets by the septula normal to the septa.

The alveolinids range stratigraphyically from the upper Albian to Recent. In

* Received May 8, 1966; Read June, 20, 1966.

both the Mesozoic and Cenozoic genera, two different modes are detected in the disposition of the septula, either continuous or alternating. The continuous septula are aligned in the next succeeding chambers, whereas the alternating ones are arranged alternatingly in succeeding chambers. Most of the Mesozoic genera are equipped with continuous septula, whereas some Cenozoic forms have continuous septura and the remainder have alternating ones. The arrangement of the septula may furnish some clue to the phylogenetic relations among the genera.

The ontogeny of *Yabeina* DEPRAT, a Permian fusulinid clearly illustrates the phylogenetic succession of this genus (HANZAWA and MURATA, 1965. HANZAWA, 1965, p. 241). Namely its endothyroid juvenarium is immediately followed by some whorls of the *Cancellina*-structure, which is in turn succeeded by several whorls of the *Neoschwagerina*-structure before the final ontogenetic stage of *Yabeina* proper begins. However, most of the alveolinid genera do not appear to show such a differential ontogenetic development as shown in *Yabeina*. In all the alveolinid genera, all the post-juvenarium whorls shows their own generic characteristics. The earliest whorls of *Alveolinella* DOUVILLÉ have two-tired chambers, while the later whorls are subdivided into three or more tiers. But *Flosculinella* SCHUBERT, which has the characteristic two-tired chambers is difficult to consider representing the earliest ontogenetic stage of *Alveolinella* DOUVILLÉ because the septula of the former are of the alternating type and the latter is equipped with continuous septula.

Ovalveolina REICHEL and *Praealveolina* REICHEL occur in the same geologic ages and their internal structures are alike. But the apertural features of the former are somewhat simpler than those of the latter. The former may be regarded as the predecessor of the latter.

Simpalveolina (*Praealveolina*) REICHEL may have been derived from *Praealveolina* s. s. REICHEL. The former made its first appearance later than the latter.

The unique form, *Multispira* REICHEL may be considered to have originated from *Praealveolina* REICHEL by the proliferation of the sheets of whorls.

Cisalveolina REICHEL, which is characterized by a single slit-like aperture and the alternating septura may be considered to have been derived from *Praealveolina* REICHEL, or from another miliolid ancestor independent from the last-named genus. *Subalveolina* REICHEL also may be regarded to have originated from this independent ancestral stock of the miliolids or from *Praealveolina* REICHEL. Its septula have no definite arrangement.

Fasciolites PARKINSON (=*Alveolina* D'ORBIGNY) and *Glamalveolina* HOTTINGER are surely independent from the Mesozoic alveolinids in phylogeny. The youngest Mesozoic genus, *Subalveolina* REICHEL became extinct in the Campanian and the oldest Cenozoic one, *Fasciolites* PARKINSON, made its first appearance in the Paleocene. Therefore, a stratigraphic interval, from the base of the Maastrichtian to the top of the Danian Stage, exists between the two genera. Paleontologically, it is incredible that the above Cenozoic form is heritable from the above-named Mesozoic one. The Cretaceous forms now in question should be excluded from the Alveolinidae EHRENBERG as the isomorphs of the Cenozoic alveolinids and allocated into a new independent family.

Both *Bullalveolina* REICHEL and *Flosculinella* SCHUBERT are also characterized by alternating septula. There is the possiblity that they are phylogenetically continuous with *Fasciolites* PARKINSON, considering the structural similarities and stratigraphic distribution of the three forms.

Borelis EHRENBERG which is characterized by continuous septula may be phylogenetically independent from *Fasciolites* PARKINSON which has alternating septula. The former ranges from the lower Eocene to Recent, and the latter from the Paleocene to the lower Upper Eocene (Bartonian).

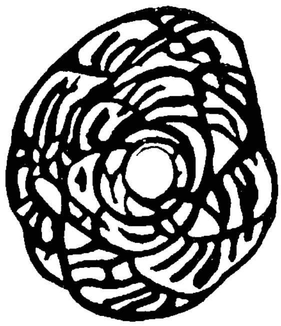
Alveolinella DOUVILLÉ with continuous septula may be phylogenetically independent from *Flosculinella* in spite of the structural resemblance of both forms.

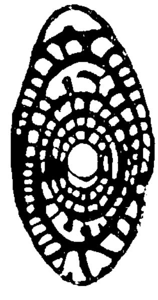
Genus *Quasiborelis*, nov.

Type-species: *Borelis gunteri* COLE (1941, p. 34, pl. 3, figs. 1–3; pl. 18, figs. 5, 6) from the lower Eocene of Florida.

Borelis gunteri COLE may not be congeneric with *Borelis melo* (FICHTEL and MOLL). The former is similar to the latter in almost every respect. Especially, the former is characterized by the continuous septula (COLE, 1941, pl. 2, fig. 3) as the latter. But the chambers of the former are subdivided into two or several tiers by one or five horizontal septa, whereas those of *Borelis melo* (FICHTEL and MOLL) are undivided. COLE's illustration of *Borelis gunteri* COLE (1941, pl. 2, fig. 1) shows that this form of Foraminifera is equipped with several rows of apertules. However, the above description shows that this form is indistinguishable from *Alveolinella* DOUVILLÉ in the fundamental internal structure.

Borelis melo (FICHTEL and MOLL) is spherical, whereas *Borelis schlumbergeri*





1 2

Figs. 1, 2. *Quasiborelis gunteri* (COLE) Schematic drawings of eqatorial (Fig. 1) and axial (Fig. 2) sections. ×26.8 (Original: COLE, 1941, pl. 2, figs. 2, 3).

(REICHEL) and *Borelis pygmaeus* (HANZAWA) are fusiform. *Flosculinella bontangensis* (RUTTEN) is fusiform, whereas *Flosculinella globulosa* RUTTEN is spherical. But nobody has ever tried to distinguish generically *Borelis melo* from *Borelis schlumbergeri* or from *Borelis pygmaeus*, similarly *Flosculinella bontangensis* from *Flosculinella globulosa*.

Borelis gunteri COLE is nautiliform, whereas *Alveolinella quoyi* D'ORBIGNY is fusiform. Both are common in having the same internal structural constituents. They differ from each other by their external form and the latter is much more delicate than the former in internal structure. Considering the interrelation between *Borelis melo* and *Borelis schlumbergeri* or that between *Flosculinella bontangensis* and *Flosculinella globulosa*, *Borelis gunteri* may not be rationally distinguished from *Alveolinella quoyi* generically because of having the same structural constituents. But *Borelis gunteri* is found in the lower Eocene of Florida and *Alveolinella quoyi* ranges from Miocene? to Recent. It is easily considered that both the forms are not in any close phylogenetic relation. A new genus name *Quasiborelis* is proposed for *Borelis gunteri* COLE. *Quasiborelis*, gen. nov. is supposed to have arisen from *Borelis* EHRENBERG in the lower Eocene.

Family Planorbulinidae SCEWAGER

Genus *Tayamaia*, nov.

Type-species: *Gypsina marianensis* HANZAWA (1957, 66, 67, pl. 31, fig. 8; pl. 27) from the Aquitanian Stage of Saipan, Mariana Is.-COLE, 1957, p. 337, pl. 103, figs. 1-4.

The characteristic features of *Gypsina marianensis* are as follows:

The test is helmet-shaped and is differentiated into three sets of layers of different-shaped chambers, *viz.*, a dome-shaped median layer, some tiers of superjacent dorsal layers and those of subjacent ventral ones. The median layer consists of spherical proloculus and annularly disposed chambers, which are of truncated-arcuate type, equipped with four stolons (refer to HANZAWA, 1957, pl. 27, fig. 3). The dorsal layers consists of chambers which are quadrangular and irregular in transverse and horizontal sections respectively. The ventral layers consists of chambers, which are arcuate in transverse section and irregular in horizontal section. All the chambers cited above are common in having solid vertical walls and finely cribrated roofs and floors.

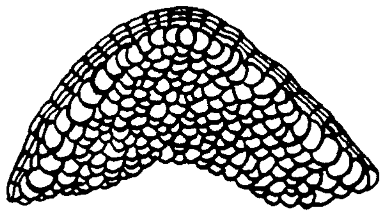


Fig. 3. *Tayamaia mariaensis* (HANZAWA) Schematic drawing of transverse section. ×26.5.

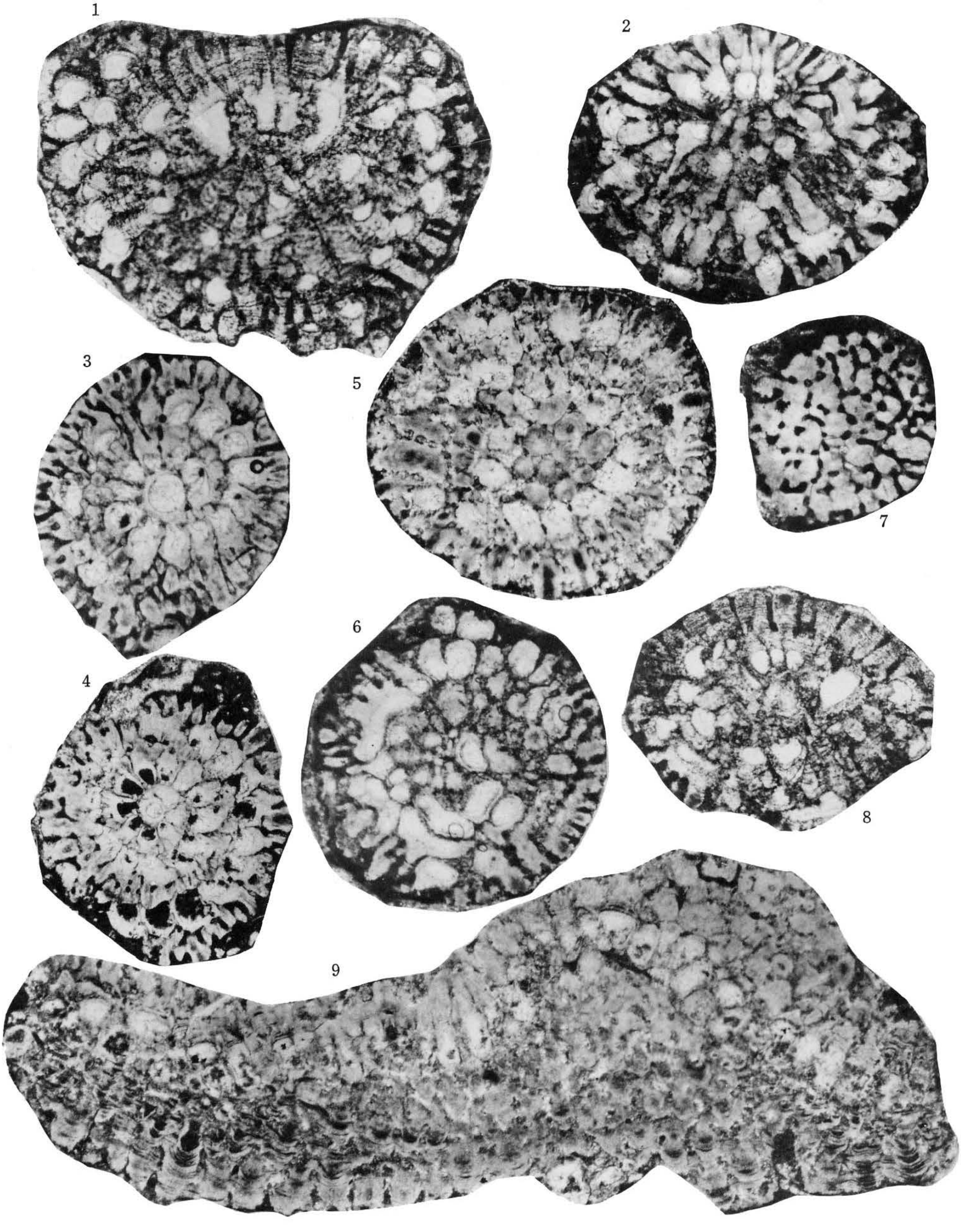
LOEBLICH and TAPPAN (1964, Treatise on Invertebrate Paleontology, C2, vol. 2, p. 696) pointed out that the type species of *Gypsina* CARTER is *Gypsina mastelensis* BURSCH, not *Orbitolina concava* var. *vesicularis* PARKER and JONES. The characteristic features of the chambers of *Gypsina mastelensis* BURSCH are quite the same as those of *Gypsina vesicularis*

Explanation of Plate 3

Quasirotalia guamensis, gen. nov. and sp. nov.

Figs. 1 (Holotype), 2, 8. Transverse sections.
1, 2, 8. Locality Ts 16-14, Guam, Mariana Is. USGS coll.
Figs. 3, 4. Equatorial sections.
3. Locality Ts 16-14, Guam, Mariana Is. USGS coll.
4. Locality Ts 16-12, Guam, Mariana Is. USGS coll.
Figs. 5-7. Tangential sections.
5, 6. Near ventral sides of tests.
5. Locality. Ts 16-1, Guam, Mariana Is. USGS coll.
6. Locality. Ts 16-14, Guam, Mariana Is. USGS coll.
7. Near dorsal side of test.
Locality. Ts 16-14, Guam, Mariana Is. USGS coll.
Fig. 9. Transverse section of microspheric form?
Locality. Ts 16-5, Guam, Mariana Is. USGS.

All figures thirty times naturl saize



Kumagai photo.

(PARKER and JONES) and *Gypsina plana* (CARTER). The chambers of these species are destitute of stolon passages in their chamber-walls.

Gypsina marianensis is like *Gypsina vesticularis* (PARKER and JONES), one of the typical *Gypsina* CARTER in major structure (refer to HANZAWA, 1957, pl. 21, fig. 9). But the internal structure of *Gypsina vesicularis* is not differentiated into any sets of layers as that of *Gypsina marianensis*. Moreover, the whole surface of all the chambers of *Gypsina vesicularis* is cribrated and devoid of any stolen passage. Thus *Gypsina marianensis* may be distinguished from *Gypsina vesicularia* in having arcuate median chambers with four stolons. Therefore, it must be assigned to a different genus. A new genus name, *Tayamaia* is proposed for *Gypsina marianensis* HANZAWA, dedicated to the late Dr. Risaburo TAYAMA who made valuable contributions to the geology of Micronesia.

Tayamaia, gen. nov. is considered to to be more rationally referred to the family Planorbulinidae SCHWAGER than to the Acervulinidae SCHULTZE because its median chambers are characterized in having solid vertical walls with stolons.

Geologic horizon and locality: Aquitanian Tagpochau limestone, S88, R. TAYAMA, Kanat Fahan Lichan, Saipan, Mariana Is.

Family Calcarinidae SCHWAGER

Genus *Quasirotalia*, nov.

The test is lenticular or plano-convex and may be structurally distinguished into a rotaloid juvenarium and a maturitas consisting of two or three layers of chambers added on the periphery and ventral side of the juvenarium, and almost spirally disposed. The test walls are double in structure like those of *Calcarina* D'ORBIGNY. The type-species is *Quasirotalia guamensis* sp. nov.

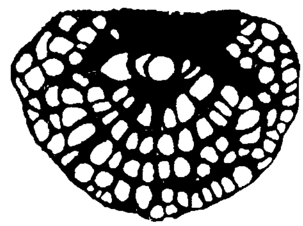


Fig. 4. *Quasirotalia guamensis*, nov. Schematic drawing of transverse section. ×13.3.

Remarks: This new genus is more advanced than *Rotalia* LAMARCK in structure and is distinguished from it in having layers of chambers on the ventral side and periphery of the test, and double walls with thick and densely crowded ventral canals. It resembles *Baculogypsinoides* YABE and HANZAWA, but lacks the spinose structure of the latter Pliocene.

Quasirotalia guamensis, nov.

Pl. 3; Pl. 4, Figs. 1-8

Rotalia atjehensis VAN DER VLERK.-COLE, part. 1953, p. E20, pl. 5, figs. 1, 3, 9, not figs. 3, 4.

The test is biconvex or plano-convex, the dorsal side is flat or slightly vaulted, whereas the ventral side is broadly rounded. It is small, 2 mm across and 1.5 mm thick. The proloculus is spherical, 120-220μ in diameter and surrounded by a thin walls, 20-40μ thick and it is followed by 7 trochispiral nepionic chambers of the juvenarium which is 760-800μ across and 420μ thick. The juvenarium is succeeded by the trochispiral second and third and sometimes fourth whorls of the maturitas; the size of chambers of the first, second, and third whorls is usually smaller, $100\mu \times 100\mu$ and that of the fourth whorl is larger, $160\mu \times 300\mu$. The walls of the chambers are usually composed of double layers, the inner one is thin, $20\text{-}60\mu$ in thickness, whereas the outer one is thick, 300μ in thickness, and piereced by numerous thick vertical canals, $20\text{-}40\mu$ across.

Geologic horizon: Pliocene Alifan Limestone.

Localities: Ts 16 and Gj9, northern and southern Guam, Mariana Is. respectively.

Remarks on COLE's *Rotalia atjehensis* VAN DER VLERK: *Rotalia atjehensis* (COLE, 1963, p. E20, pl. 5, figs. 1-4, 8, 9) comprises two forms of Foraminifera, which are distinguishable generically as well as specifically from each other in this writer's view. One of them was depicted by COLE in figures 1, 2, 9 just cited and is dealt with in this paper as *Quasirotalia guamensis*, gen. nov. and sp. nov., and occurs in localities Ts 16 and Gj 9, northern and southern Guam, Mariana Is. respectively, whereas the other illustrated by COLE in figures 3, 4 (Plate 4, figs. 14, 15) occurs in locality Ih 5, central Guam. Referring to the Geological Map and Locality Map of Guam (TRACEY, *et al.*, 1964, pls. 1, 2) should be noted that localities Ts 16 and Gj 9 are located in the area of Tal, Alifan Limestone, whereas locality Ih 5 is in the area of Tb Bonya Limestone. Under the microscope, the limestone with *Rotalia atjehensis* appears to be more advanced in recrystallization than that with *Quasirotalia guamensis*, and these two forms are never associated with each other in the same limestone from the localities just cited. COLE (1963, *loc. cit.*) identified all the forms mentioned above with *Rotalia becarii* (LINNEAUS) var. *atjehensis* VAN DER VLERK from Atjeh, North Sumatra (VAN DER VLERK, 1924, p. 25, 26, pl. 5, figs. 21-24) and with HANZAWA's *Rotalia schroeteriana* PARKER and JONES (HANZAWA, 1931, p. 157, pl. 26, figs. 6-8) (Plate 2, figs. 9-13) from the lower Miocene Misaka Formation of Japan, associated with *Nephrolepidina japonica* YABE and *Miogypsina kotoi* HANZAWA. As shown in Plate 4, figures 9-15 in this paper, the form are lenti-

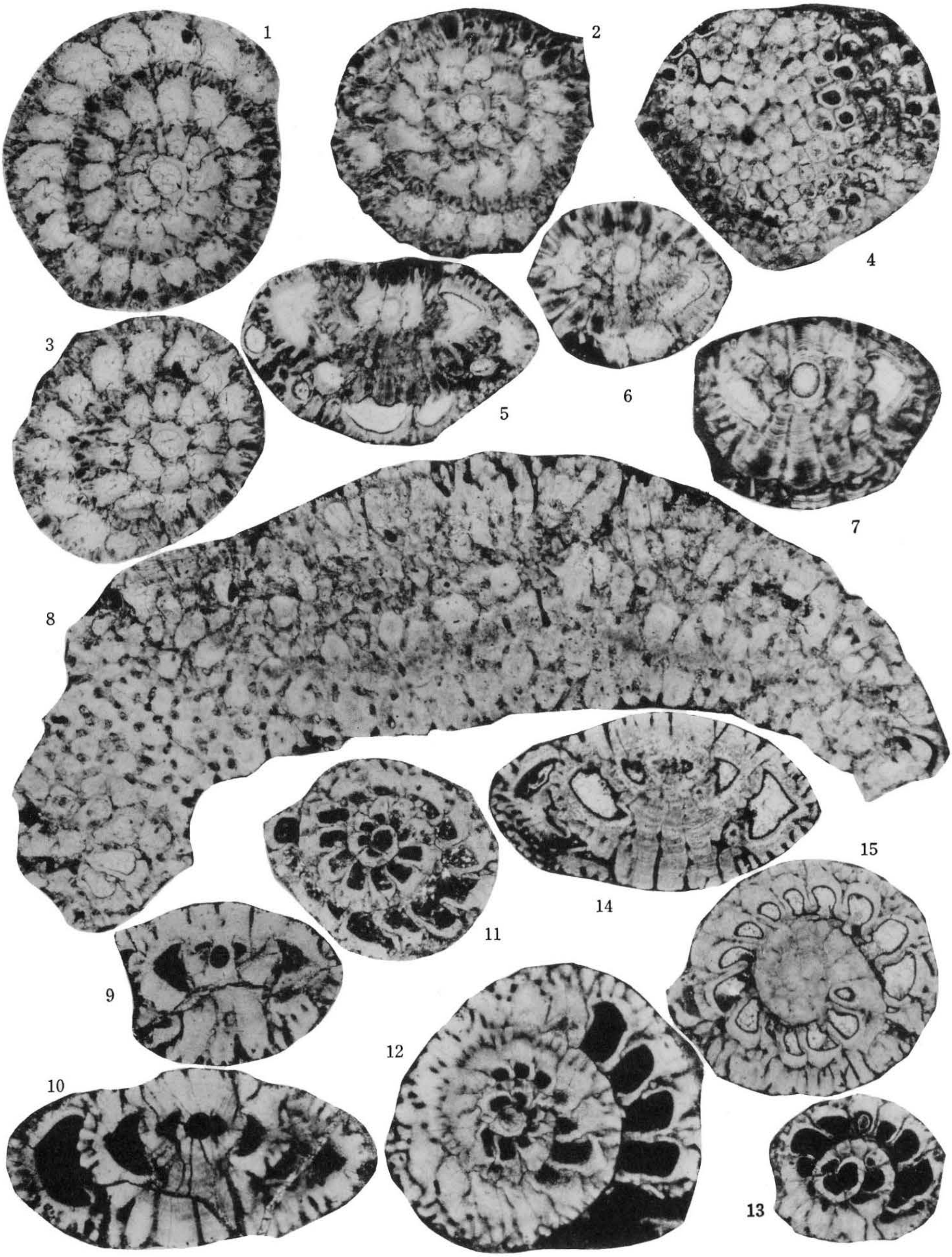
Explanation of Plate 4

Figs. 1-8. ***Quasirotalia guamensis***, gen. nov. and sp. nov.
 1-3. Equatorial sections.
 4. Tangential section near ventral side.
  Locality. Ts 16-10, Guam, Mariana Is. USNM. 625565.
 5-7. Transverse sections.
  Locality. Ts 16-10, Guam, Mariana Is. USNM. 625565.
 8. Transverse section of microspheric form?
  Locality. Ts 16-10, Guam, Mariana Is. USNM. 625565.

Figs. 9-13. ***Rotalia*** sp.
 Locality. The mountain creek at the east of Hisari, Kwanto Massif, Japan.
 9, 10. Transverse sections.
 11-13. Equatorial sections.

Figs. 14, 15. ***Rotalia*** sp. (***Rotalia atjehensis*** VAN DER VLERK, COLE, 1963, pl. 5, figs. 3, 4)
 Locality. Ih 5-3, Guam, Mariana Is. USNM. 625567.

All figures thirty times natural size



KUMAGAI photo.

cular with a broadly rounded periphery and lack the accessory chambers on the periphery and ventral side of the test unlike the form referred to *Quasirotalia guamensis*. The statistics cited below show that the forms from the locality Ih 5, Guam and Hisari, Japan are alike, but they are not quite identical with the type of *Rotalia atjehensis* VAN DER VLERK, which periphery is rather acuminated and with *Rotalia schroeteriana* PARKER and JONES.

Comparison of the statistic of *Rotalia atjehensis* VAN DER VLERK and *Rotalia* sp. from Guam and Japan

	Sumatra	Guam (Ih 5)	Japan
Diameter	1.00 mm	1.77 mm	2.00 mm
Thickness	0.50 mm	1.00 mm	1.00 mm
Number of chambers in the whorls	3-4	2.5-3	2.5-3
1st whorl		7	7
2nd whorl		13	11-13
3rd whorl		14?	14?
Number of chambers in the last-formed whorl	15-18	16?	14-16?

References cited

COLE, W.S. (1941): Stratigraphic and Paleontologic Studies of Wells in Florida. *Florida Geol. Surv., Geol. Bull.*, no. 19, p. 1-91, pls. 1-18.

—— (1957): Larger Foraminifera (Geology of Saipan, Mariana Islands, pt. 3, Paleont.), *U.S. Geol. Surv., Prof. Papar* 280, p. 321-360, pls. 54-118.

—— (1963): Tertiary Larger Foraminifera from Guam. *Ibid.*, 403-E, p. 1-23, pls. 11.

HANZAWA, S. (1931): Notes on Tertiary Foraminiferous Rocks from the Kwanto Mountainland, Japan. *Tohoku Univ., Sci. Rep., 2nd Ser. (Geol.)*, v. 12, no. 2A, p. 141-157, pls. 24-26.

—— (1957): Cenozoic Foraminifera of Micronesia. *Geol. Soc. Amer., Mem.* 66, p. 1-111, pls. 1-41, 5 tab.

—— (1965): The Ontogeny and the Evolution of Larger Foraminifera. *Tohoku Univ., Sci. Rep., 2nd Ser. (Geol.)*, v. 36, no. 2, p. 239-256, 1 tab. pls. 30-40.

—— and MURATA, M. (1963): The Paleontologic and Stratigraphic Considerations on the Neoschwagerininae and Verbeekininae, with the Descriptions of Some Fusulinid Foraminifera. *Ibid.*, v. 35, no. 1, p. 1-31, pls. 1-20.

LOEBLICH, J., A.R. and Helen TAPPAN, (1964): Treatise on Invertebrate Paleontology, pt. C, Protista, 2, Sarcodina, v. 1, p. 1-510, figs. 1-399; v. 2, p. 511-900, figs. 400-653.

TRACEY, J.I., SCHLANGER, S.O., STARK, J.T., DOAN, D.B. and MAY, H.G. (1964): General Geology of Guam. *U.S. Geol. Surv., Prof. Paper*, 403-A, p. A1-A104, pls. 1-3, text-figs. 1-53.

VLERK, I.M. VAN DER, (1924): Foraminiferen uit het Tertiair van Java, I. *Dienst. Mijnb. Wetensch. Meded.*, no. 1, p. 1-13, pls. 3-5.

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 65, p. 26, Apr. 10, 1967

SHORT NOTE

13. *EPONIDES BOSOENSIS* NEW NAME FOR *EPONIDES ASANOI* HIGUCHI, PREOCCUPIED*

YU HIGUCHI

Suncoh Consultants Co., Ltd.

While carrying out a study of Foraminifera from the gas field in Chiba Prefecture, it was discovered that *Eponides asanoi* HIGUCHI (Trans. Proc. Palaeont. Soc. Japan, N.S., No. 60, pp. 178-181, pl. 21, Dec. 20, 1965) from the boring well at Kujukuri-machi, Sanbu-gun, Chiba Pref. is preoccupied by *Eponides asanoi* YOSHIDA, 1958 (Hokkaido Gakugei Univ., Jour., vol. 9, No. 1, p. 257, pl. 2, figs. 4a-c) from the Cretaceous of Hokkaido.

The new name *Eponides bosoensis* is proposed for *Eponides asanoi* HIGUCHI, 1965.

Acknowledgement is paid to Mr. Richard CHARMATZ, American Museum of Natural History, for his kind advice about the preoccupied species.

References

HIGUCHI, Y. (1965). On the some new species of fossil foraminifera from the boring cores in the gas field in Chiba Prefecture, Japan. *Trans. Proc. Palaeont. Soc. Japan, N.S.*, No. 60, pp. 178-181, pl. 1, 1 table, 1 text-fig.

YOSHIDA, S. (1958). The foraminiferal fauna of the upper Cretaceous Hamanaka and Kiritappu formations of eastern Hokkaido, Japan. *Jour. Hokkaido Gakugei Univ.*, Vol. 9, No. 1, pp. 250-264, pls. 1-3, 1 table, 2 text-figs.

* Received July 28, 1966

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 65, pp. 27-46, April 10, 1967

518. GRAPTOLITE AND TENTACULITE CORRELATIONS AND PALAEOGEOGRAPHY OF THE SILURIAN AND DEVONIAN IN THE YUNNAN-MALAYA GEOSYNCLINE*

C. K. BURTON

Department of Geology, Faculty of Science, Chulalongkorn University
Bangkok, Thailand

雲南—マライ地向斜のシルル・デボン系の筆石と tentaculites による対比と古地理：近年北西マライから多数の筆石と tentaculites が発見されている。筆石の大部分は Llandovery 期のもので一部 Wenlock 型がある。Tentaculites は明らかに中下部デボン系のものである。時代が異るにもかかわらず両者は密接に伴っていて，16 産地では同一層理面上に伴って産出している。集められた事実を照合し再検した結果判ったことは，このようなシルル紀筆石とデボン紀 tentaculites の共存という異常な産状は，北西マライからタイ西部，ビルマ東部をへて雲南西部に続く地向斜地帯ではごく普通にみることができる。このようなフォーナの混合は，一時的な隔離と，その結果として浮游生物が堆積地帯から消失し，続いて外的連繫が復旧した時に造山的擾乱が起った結果であると考えられる．この古生代中期の地向斜は，雲南から北東に中国にのび，それから恐らくはヨーロッパと連絡があったことを示すいくつかの証拠がある。この雲南—マライ地向斜はまた，ヒマラヤ地域とも時々連っていた。南方では，Kalimantan（インドネシアのボルネオ）からニューギニアの Irian Barat をへて東オーストラリアにのびていた可能性がある。時代の異るシルル紀筆石とデボン紀 tentaculites とが相伴って産出することは，Victoria でも知られている。 C. K. BURTON

"....I can well recall the thrill of delight and astonishment with which I recognised, in the first fossiliferous piece of rock that I broke off, a fragment of a graptolite...."
LA TOUCHE, "The Geology of the Northern Shan States"

Introduction

Graptolites and tentaculites are now known from several areas disposed in a narrow zone extending from west Yunnan through east Burma and west Thailand into northwest Malaya.

The first discovery of graptolites in this region was made by LA TOUCHE in 1899 in the Northern Shan States of Burma. Continued investigations by this pioneer yielded more graptolites, with numerous other fossils, including tentaculites (LA TOUCHE, 1913; REED, 1906, 1915).

Graptolites of Silurian age were next found in the Chinese province of Yunnan by BROWN (BROWN, 1913; REED, 1917) and the faunal census here has been continuously augmented by later workers (YIN & LU, 1937; SUN, 1945; SUN & SZETU, 1947 etc.). BROWN and SONDHI (1933a, b) then extended the record of graptolites and tentaculites to the Southern Shan States, their collections being described by ELLES and by REED (REED, 1932, 1936).

Later, tentaculites were also proved in west Yunnan (by WANG) and the geo-

* Received Apr. 9, 1966; Read Jan. 22, 1967.

synclinal nature of the tract between this area and the Northern Shan States was recognised and named the Sino-Burmese geosyncline (SUN, 1945).

Tentaculites were found in Thailand in 1950 (BROWN *et al.*, 1953) and graptolites were encountered in Malaya, close to the Thai border in 1956 (JONES, 1959). KOBAYASHI (1960) now realised that the geosynclinal belt extended to this vicinity from Burma. He subsequently termed this the Burmese-Malayan geosyncline, at the same time reporting graptolites from two localities in Thailand (KOBAYASHI, 1964).

Recent work by the writer and his former colleagues in the Geological Survey of Malaysia (Malaya) has shown that there is a considerable expanse of Silurian to Devonian graptolite- and tentaculite-bearing strata in northwest Malaya, and we have further been able to demonstrate (BURTON, in the press, b) that the mid-Palaeozoic geosyncline extended through the country for some 300 miles from the Thailand frontier to the western seaboard in Malacca state.

For convenience the term "Yunnan-Malaya geosyncline" is used here to designate the whole geosynclinal tract from west Yunnan to south Malaya (see (Fig. 1). The informal nature of this usage is emphasized since it is not yet fully established that the entire belt constituted an uninterrupted basin of deposition at any one time and since extensions may exist beyond Malaya and Yunnan (see below). Until these questions are resolved, "Yunnan-Malaya geosyncline" may be used concurrently with such conceptual terms as Sino-Burmese geosyncline, Burmese-Malayan geosyncline, Malayan geosyncline etc.

Details of graptolites and tentaculite occurrences in the Yunnan-Malaya geosyncline

a) Malaya

The beginning of a new era in Malayan geological research was signalized in 1956 by JONES's discovery of graptolites on the Langkawi Islands in the northwest (Lat. 6°25′N; Long. 99°55′E). Tentaculites were later found in this vicinity, although their identity was not appreciated at the time (JONES, 1959, 1961).

Subsequent work has shown that the occurrence on the Langkawi Islands is but the outpost of an extensive development of Silurian to Devonian graptolite- and tentaculite-bearing rocks located 60 miles to the southeast in the states of Kedah, Perak and Penang. As presently known, the bulk of these rocks (some 600 square miles of outcrop) lies between 5°17′ and 5°56′N and between 100°21′ and 101°04′E. In all, 103 graptolite localities and 45 tentaculite localities have been recorded in northwestern Malaya (of which 87 and 36 respectively were found by the writer and his assistants during the past three years, 1962-65). The majority of these fossils occur in the euxinic Mahang Formation (86 graptolite and 40 tentaculite localities) and nearly all the remainder are contained in black shale members of the contemporaneous limestone-rich "Baling Formation"* (or Group) to the east (13 graptolite and 4 tentaculite occurrences) and the "Setul Formation" of the Langkawi Islands in the northwest (2 incid-

* Throughout this communication the convention is followed of placing informal stratigraphic names between inverted commas.

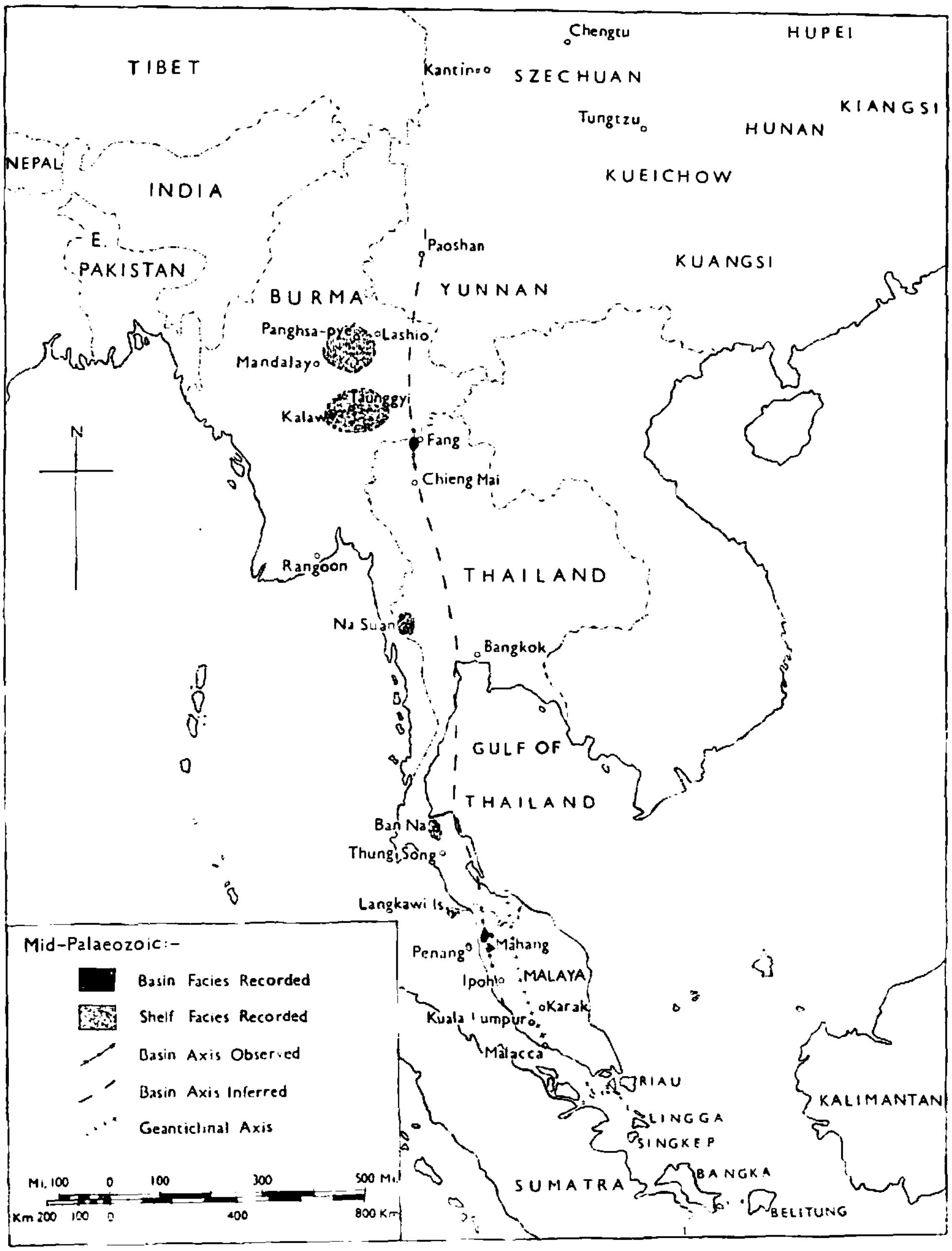


Fig. 1. Map of South East Asia showing the location of the Yunnan-Malaya Geosyncline and the disposition therein of some Mid-Palaeozoic features and localities of significance.

ences of graptolites and one of tentaculites).

Farther south, in the centre of Perak state, two other discoveries of graptolites have been made. So far, tentaculites have not been found in this area.

Study of Malayan graptolites is still at an early stage. Ten collections from the Mahang Formation have been examined in detail by STRACHAN and JONES (COURTIER, in manuscript) and in five of these specific determinations were possible, viz.,

Locality	Location	Fossil identifications	Age
KKF8	5°21′22″N ; 100°44′51″E Map 21/11 482641	*Monograptus gregarius* LAP. *Monograptus* cf. *inopinus* TORN. *Monograptus* sp. *Glyptograptus* cf. *sinnuatus* NICH. *Diplograptus modestus* LAP. *Climacograptus rectangularis* M'COY	lower Middle Llandovery
KKF9	5°20′57″N ; 100°45′25″E Map 21/12 493633	*Monograptus* aff. *concinnus* LAP. *Diplograptus modestus* LAP. *Orthograptus* sp. *Climacograptus* sp.	lower Middle Llandovery
KKF10	5°22′10″N ; 100°43′04″E Map 21/11 459658	*Monograptus decipiens* TORN. *Monograptus* sp. *Glyptograptus sinnuatus* NICH. *Climacograptus* cf. *rectangularis* M'COY	upper Middle Llandovery
KKF24	5°19′02″N ; 100°45′04″E Map 21/12 487594	*Monograptus decipiens* UORN. *Monograptus convolutus* HIS. *Monograptus* sp. *Cephalograptus tubulariformis* NICH. *Diplograptus* sp. *Climacograptus hughesi* NICH.	upper Middle Llandovery
KKF18	5°21′46″N ; 100°24′03″E Map 21/11 473649	*Monograptus* aff. *galaensis* LAY.	middle Upper Llandovery

These fossils span a rather limited time range, from graptolite zone 19 (*Monograptus gregarius*) to zone 22 (*Monogratus turriculatus*) or 23 (*Monograptus crispus*). The remaining collections of Mahang graptolites have been examined only briefly as yet, but the bulk of them are clearly Llandovery in age (JONES, personal communication). *Orthograptus* aff. *vesiculosus* and *Monograptus cyphus* are the oldest forms reported, respectively zone fossils of graptolite zone 17 and 18, whilst in a very recent (personal) communication JONES records the presence of the Wenlock *Cyrtograptus*.

Graptolites of the "Baling Formation" have not yet been studied, but it is evident that they also comprise diplograptids in association with mongraptids, indicative of a Llandovery date. Two argillite horizons occur amidst the limestone of the "Setul Formation" in Langkawi (see Table 1). Both contain graptolites. From the "Lower Detrital Band", STRACHAN (in KOBAYASHI *et al.*, 1964a) determined :—

Monograptus (?) 2 spp.
Dimorphograptus sp.
Climacograptus rectangularis
Climacograptus sp.
Orthograptus sp.
Glyptograptus sp.

The horizon yielding *Dimorphograptus* was said to approximate to the Lower Llandovery zone of *Orthograptus vesiculosus* (17). Some 400 to 650 feet higher in the succession, the "Upper Detrital Band" carries the Middle Llandovery species *Monograptus clingani*, identified by BALL and STRACHAN (KOBAYASHI *et al.*, 1964a).

Southwards (along the strike) of the Mahang outcrop, in the Sungei Siput-Ipoh area of central Perak, the proportion of limestone is again high. Associated shale near Kanthan (c 4°46′N; 101°06′E) contains graptolites, determined by BALL as diplograptids with faint indications of being of the (Middle Ordovician to Lower Silurian) orthograptid type (INGHAM and BRADFORD, 1960, p. 20). Another locality at Chemor, 1½ miles to the south was found to carry *Orthograptus* sp. (BALL, written communication).

Finally, an isolated discovery of monograptids has been made by Inche JA'AFAR BIN AHMAD in the Foothills Formation at Karak, Pahang state, central Malaya (JONES, personal communication).

The Malayan tentaculite discoveries have recently been announced and preliminary descriptions given (BURTON, in the press, a). Subsequently systematic examination has been carried out by Professor BOUČEK. His findings are summarized below. These fossils are small, less than 10 mm in length, thin-shelled forms manifestly belonging to FISHER's (1962) Order Dacryoconarida, although they usually do not possess a drop-like embryonal bulb, but rather a more primitive tubular projection. As is common elsewhere, ringed and unringed types of similar proportions occur together and it seems conceivable to the present writer that this may represent some kind of dimorphism.

BOUČEK (personal communication) says that the Malayan ringed tentaculites commonly prove to be close to the Lower Devonian *Nowakia acuaria*. In the Mahang Formation he has distinguished another form with scantier rings, similar to some Eifelian or even Givetian species of *Nowakia* (e.g., locality KKF14, 5°21′51″N; 100°43′04″E; Survey Dept. of Malaya map 21/11 445651). BOUČEK likewise considers that there may be two species of smooth tentaculite in the Mahang. The larger individuals (as at locality Kh13, 5°43′07″N; 100°36′29″E; map 21/7 313080) belong to the group of *Styliolina fissurella* HALL, mostly of Middle Devonian (Eifelian-Givetian) date in Europe, although possibly somewhat earlier elsewhere. Smaller shells, if they are not *Styliolina fissurella* too, may be compared with similar forms which occur together with *Nowakia acuaria* in Europe.

Tentaculites from one locality in the "Baling Formation" have been seen by BOUČEK, who observes :—

> "In loc. rl (Upper Perak), together with *Styliolina* is....(a form)....very close to *Nowakia acuaria* (smaller forms) and I think it is possible to correlate the beds with Lower Emsian (middle part of Lower Devonian)"

We have also identified Striatostyliolinids (Lower to Middle Devonian) at this locality (BURTON, in the press, a).

The "Upper Detrital Band" of the "Setul Formation" bears tentaculites at one point. These comprise *Styliolina* cf. *fissurella* again, with a Nowakiid.

BOUČEK considers this horizon Middle Devonian (Eifelian, or more likely Givetian).

Thus, in northwest Malaya, the graptolites are Lower to Middle Silurian in age, whilst the tentaculites are Lower to Middle Devonian. No fossils of Ludlow age have been proven in the area. It is surprising to find that at 16 localities graptolites and tentaculites occur together on the same bedding planes. 15 such localities lie in the Mahang Formation where the graptolites accompanying the tentaculites are often poorly preserved and have so far proved specifically identifiable in only two cases. Both of these are referred to the mid-Upper Llandoverian *Monograptus galaensis*. Associated tentaculites appear to comprise both Lower and Middle Devonian forms.

Whilst no admixture of graptolites and tentaculites has been found in the "Baling Formation", a comparable situation exists therein for the Lower Emsian tentaculites detailed above are intermixed with Ordovician graptolites, including the agnostid genus *Trinodus* (identified by KOBAYASHI, personal communication). Similarly, in the "Setul Formation" the Middle Llandovery *Monograptus clingani* and Middle Devonian tentaculites are intimately associated together in the "Upper Detrital Band".

b) Thailand

In Thailand, where a time-stratigraphic rather than a rock-stratigraphic classification has been adopted (BROWN *et al.*, 1953) the Kanchanaburi Series extends from the Silurian to the Carboniferous. Information is at present limited, but three graptolite and/or tentaculite localities are known herein.

At Ban Na, northeast of Thung Song, in peninsular Thailand (see Fig. 1), poorly preserved specimens of *Climacograptus* and *Diplograptus* from a thin shale band in a limestone succession indicate an Upper Ordovician to Lower Silurian age (KOBAYASHI, 1964, p. 6; KOBAYASHI *et al.*, 1964b, p. 49-50).

A little over 400 miles north-northwest of Ban Na and about 150 miles west-northwest from Bangkok is Na Suan, in King Amphur Si Sawat, where tentaculites of Mahang type occur in pinkish sandy shale. DUNCAN (in BROWN *et al.*, 1953, p. 33) has likened these to forms referred to *Styliolina clavula* and *Tentaculites elegans* by PATTE and REED in Indochina and Burma respectively. "*Styliolina clavula*" is a synonym for *Styliolina fissurella* HALL (usually of Middle Devonian age) whilst BARRANDE'S "*Tentaculites elegans*" is now regarded as comprising several (Lower to Middle Devonian) species of *Nowakia* (BOUČEK, 1964, p. 59, 80).

Some 350 miles farther north, just south of Fang in the extreme northwest of the country are black argillites, partly siliceous and associated with chert. KOBAYASHI (1964, p. 6) reports that these strata contain the Lower Llandoverian *Monograptus cyphus*, which is also known from the lithologically similar Mahang Formation of Malaya. Other graptolites at Fang may be Llandeilian or Lower Caradocian.

Colonel Samak BURAVAS, who discovered these graptolites, informs the writer (personal communication) that tentaculites also occur close by.

c) Burma

In the Northern Shan States, graptolite- and tentaculite-bearing rocks are known from the early work of LA TOUCHE (1913). The succession he elucidated, with suggested correlations by the present writer, is set out in Table 1. The Upper Ordovician with, according to SUN (SUN & SZETU, 1947), the lowest Silurian, comprises limestones and shales with shelly fossils. This is followed by a discontinuous horizon of white shale (black at one locality) which outcrops in the vicinity of Panghsa-pyé (c22°47′N; 97°16′E), some 90 miles northeast of Mandalay. It carries the following graptolites:—

Orthograptus vesiculosus	(M)
Mesograptus modestus	(M)
Glyptograptus cf. *persculptus*	
Climacograptus medius	
Climacograptus törnquisti	
Climacograptus rectangularis	(M)
Monograptus tenuis	
Monograptus gregarius	
Monograptus cyphus	(M)
Monograptus concinnus	(M)
Rastrites peregrinus	

Forms marked (M) are known in Malaya, where much systematic work remains to be done. The Panghsa-pyé gratolites listed above are rather early in the Llandovery, pertaining to the zones of *Orthograptus vesiculosus* (17), *Monograptus cyphus* (18) and *Monograptus gregarius* (19). In addition to these, *Monograptus priodon* and *Cyrtograptus*, possibly indicating the base of the Wenlock, were found at one locality whose stratigraphic position appears to correspond to that of the Panghsa-pyé band (LA TOUCHE, 1913, p. 129).

The succeeding Namhsim Stage comprises coarse clastics with a Wenlockian shelly fauna, but graptolites reappear in the Zebingyi Stage (limestone and shale) in the form of *Monograptus* cf. *riccartonensis* and *Monograptus dubius*. The former is a Wenlock zone (27) fossil and the latter is Wenlock to Ludlow in age. Together with these graptolites are other apparently Wenlockian fossils (*Merestina*, *Modiolopsis* etc.) plus some of Devonian aspect, including numerous tentaculites and *Orthoceras* aff. *commutatum* and *Phacops* (*Dalmanites*) *swinhoei*. This faunal admixture is recorded at five places, between 20 and 30 miles east and southeast of Mandalay. Tentaculites are present at all five localities, usually in great proliferation. They were identified by REED (1906) as *Tentaculites elegans* and *Styliolina* cf. *laevis*, but BOUČEK (1964, p. 81) believes the former to be, in fact, the Middle Devonian *Nowakia cancellata* and has further shown that "*Styliolina laevis*" is another synonym of *Styliolina fissurella*, usually Middle Devonian also, although similar forms may be somewhat earlier. The associated *Orthoceras commutatum* is of Lower Devonian age in the Harz and *Phacops* (*Dalmanites*) *swinhoei* is closely allied to south European Lower Devonian forms. Subsequent to LA TOUCHE's work a wholly Lower Devonian shelly fauna was recorded from the Zebingyi on the Lashio-Möng-pyen road (PASCOE, 1959, p. 650).

REED (1906, 1915) and LA TOUCHE (1913) regarded the Zebingyi Stage as Upper Silurian or transitional Silurian-Devonian and later than the Namhsims. It is contended here that this syncretism is not valid. The two dates indicated by the Zebingyi fauna are too well defined and too far apart for this to be a chronologically homogeneous assemblage. In particular, the exclusively Lower Wenlock *Monograptus riccartonensis* could not have been a contemporary of the Middle Devonian *Nowakia cancellata* with which it is associated in LA TOUCHE's locality 44, Pyinthá (21°51′30″N; 96°24′30″E). It is therefore postulated that, as in Malaya, two faunules of differing ages are mixed together in the Zebingyi of the North Shan States. As

Table 1. Mid-Palaeozoic Correlations in the

		Mahang Basin N.W. Malaya [1]	Langkawi Is. N.W. Malaya [2]	West Thailand [3]
Devonian	Middle	Kampong Sena Formation Argillites & Arenites with shelly fauna Mahang Formation (Pars)	Kampong Sena Formation Argillites & Arenites with Shelly Fauna Setul Formation: Upper Detrital Band (Pars) Black Shale with Tentaculites	Kanchanaburi Series: Na Suan Shale Reddish Grey Shale & Fang Shale (Pars) Black Shale with Tentaculites
	Lower	Black Shale plus lenticular arenites near top with Tentaculites	Setul Formation: ? Non-deposition	Kanchanaburi Series: ? Non-deposition
Silurian	Upper (Ludlow)	? Non-deposition	Setul Formation: ? Non-deposition	Kanchanaburi Series: ? Non-deposition
	Middle (Wenlock)	Mahang Formation (Pars.)	Setul Formation: ? Non-deposition	Kanchanaburi Series: ? Non-deposition
	Lower (Llandovery)	Black Shale with Graptolites and	Setul Formation: Upper Detrital Band (P) Black Shale with Graptolites Limestone Lower Detrital Band	Kanchanaburi Series: Fang Shale (Pars) & Ban Na Shale with Graptolites
Upper Ordovician		with Cyclopygids	Setul Formation: Limestone with Shelly Fauna	Thung Song Series Limestone with Shelly Fauna

M = Monograptus

1 From Burton (in the press, b).
2 Modified after Jones (1961) and Kobayashi *et al.* (1964a, b).
3 Modified after Brown *et al.* (1953) and Kobayashi (1964).

in northwest Malaya the older component is Wenlockian and the younger is Lower to Middle Devonian. The Wenlockian portion of the Zebingyi may be, in part, the lateral equivalent of the Namhsim stage.

Geological survey in Burma was extended to the Southern Shan States by Brown and Sondhi (1933a, b) and their fossil collections were examined by Elles and by Reed (Reed, 1932, 1936). The mid-Palaeozoic sedimentary succession here is included in Table 1.

Limestone, argillaceous limestone and shale with shelly faunas constitute the Upper Ordovician. The Llandovery is again represented by black and bleached graptolite-bearing shales, apparently more extensive here than in the Northern Shan States. They appear at three major localities (Wabya Taung, Mebyataung and Panghkawkwo) and one or two minor ones, lying in a zone some 60 miles from east to west between Kalaw and Loilem (see Fig. 1). A composite list of all the graptolite species

Yunnan-Malaya Geosyncline.

South Shan States East Burma[4]	North Shan States East Burma[5]	West Yunnan[6]		
LOWER PLATEAU LIMESTONE with Shelly Fauna	LOWER PLATEAU LIMESTONE & WETWIN SHALE with Shelly Fauna	HOYUANCHAI LIMESTONE with Shelly Fauna	MIDDLE	DEVONIAN
ZEBINGYI STAGE (Pars) Limestone & Shale with Tentaculites	ZEBINGYI STAGE (Pars) Grey & Black Limestone & Shale with Tentaculites	WASHIH FORMATION (Pars) Yellow Shale, Shaley & Cherty Limestone with Tentaculites & Shelly Fauna	LOWER	
? NON-DEPOSITION	? NON-DEPOSITION	? NON-DEPOSITION Yin & Lu's Graptolite Beds	UPPER (LUDLOW)	SILURIAN
ZEBINGYI STAGE (Pars) with *M. vomerinus* LOILEM STAGE Sandst., Limest., Sandy Shale with Shelly Faunas & *M. vulgaris*	ZEBINGYI STAGE (Pars) with *M. cf. riccartonensis*, *M. dubius* NAMHSIM STAGE Sandy marls, Limestones & Sandstones with Shelly Fauna	WASHIH FORMATION (?) with *M. vomerinus* UPPER JENHOCHIAO SERIES Shales with Graptolites	MIDDLE (WENLOCK)	
MEBYATAUNG, PANGHKAWKWO, WABYA &c. GRAPTOLITE BEDS Black & Pale Shales with Graptolites	PANGHSA-PYE GRAPTOLITE BAND White (& Black) Shales with Graptolites NYAUNGBAW LIMESTONE	LOWER JENHOCHIAO SERIES Black shales, Sandstones & Limestones with Graptolites CAMAROCRINUS LIMESTONE	LOWER (LLANDOVERY)	
PINDAYA BEDS & MAWSON SERIES Limest., Argillaceous limest. & Calcareous Shale with Shelly Fauna	UPPER NAUNGKANGYI STAGE Shales with Shelly Fauna	UPPER PUPIAO FORMATION Shales & Earthy Limestone with Shelly Fauna	UPPER ORDOVICIAN	

: P = pars.

4 Modified after BROWN and SONDHI (1933a, b) and REED (1936).

5 Modified after LA TOUCHE (1913).

6 Modified after SUN and SZETU (1947).

recorded is given below. Those accompanied by an (N) also occur in North Shan and those with an (M) are present in Malaya.

Monograptus circularis
- ,, *concinnus* (NM)
- ,, *convolutus* (M)
- ,, *cyphus* (NM)
- ,, *decipiens* (M)
- ,, *difformis*
- ,, *distans*
- ,, *fimbriatus*
- ,, *gemmatus*
- ,, *gregarius* (NM)
- ,, *incommodus*
- ,, *jaculum*
- ,, *lobiferus*
- ,, *millepoda*
- ,, *regularis*

Diplograptus (*Mesograptus*) *magnus*

Orthograptus mutabilis
- ,, *vesiculosus* (NM)
- ,, sp.

Climacograptus innotatus
- ,, *medius* (N)
- ,, *rectangularis* (NM)
- ,, *scalaris*
- ,, *törnquisti* (N)

" sp.
Glyptograptus tamariscus
" *serratus*
Retiolites sp.
Monograptus revolutus
" *sandersoni*
" *sedgwicki*
" *tenuis* (N)
" *undulatus*

Due largely to a rather confused statement by REED (1936, p. 103), PASCOE's (1959, p. 654) summary of the Llandovery graptolite beds of the Southern Shan States contains a number of errors. He says,

> " The lowest zone is that of *Monograptus cyphus*, the highest that of *M. sedgwicki*, and above this comes the zone containing *M. lobiferus*, which is also present in the Panghsa-pye area of the Northern Shan States. These three zones are all represented in the Wabya Taung exposure. The zone of *M. sedgwicki* has not been found in the country between Kalaw and Taung-gyi, nor has it been recognised in the Northern Shan States ".

The actual position is as follows. The zone of *Monograptus cyphus* (18) is known only at Wabya Taung, in the west (c.23°53′N ; 96°32′E). The *Monograptus sedgwicki* (21) zone is *not* proven here but apparently occurs at Mebyataung (20°26′N ; 97°47′30″E) and at Panghkawkwo, near Loilem, in the east. In conflict with PASCOE's statement, the former locality lies between Kalaw and Taung-gyi. The range of *Monograptus lobiferus* is normally from zone 19 to 21, but it is perhaps most often found in zone 20 and possibly occupies this horizon in the Southern Shan States, for in both of its appearances there, at Wabya Taung and Panghkawkwo, it is accompanied by the zone fossil *Monograptus convolutus*. This zone may conceivably be represented at Mebyataung too, but this is not yet established. It is *not* known in the Northern Shan States.

The Llandoverian graptolite beds are succeeded by the Loilem Stage, comprising sandstones, limestones and sandy shales and bearing a poorly preserved brachiopod fauna plus *Monograptus* cf. *vulgaris*, suggestive of a Salopian date. The Loilem Stage is probably to be correlated with the Namhsim Stage of North Shan (PASCOE, 1959, p. 651).

Limestone and shale of the Zebingyi Stage re-appear in South Shan, once again with an asynchronous faunal association. In a mauve mudstone southeast of Taung-ni (20°34′N : 96°49′E) and not far from Mebyataung, SONDHI discovered the Wenlock graptolite *Monograptus vomerinus*, along with tentaculites referred by REED (1936) to *Tentaculites elegans* and *Styliolina clavula*.

d) Yunnan

Farther north, graptolites and tentaculites are known in the Paoshan region of west Yunnan, southwest China (BROWN, 1913 ; REED, 1917 ; YIN & LU, 1937 ; SUN, 1945 ; SUN & SZETU, 1947 etc.). According to the last-named authors, the Paoshan succession is very similar to that of the Northern Shan States (see Table 1). The Upper Ordovician and lowest Silurian again constitutes limestone and shale with a shelly fauna and the Llandovery (Lower Jenhochiao Series) includes black shales with abundant graptolites. 45 species recorded here are set out in Table 2 beside lists of Llandovery graptolites from the areas discussed above. In Yunnan all Llandovery zones from that of *Orthograptus vesiculosus* (no. 17) to that of *Monograptus crispus* (no. 23) are recorded, a range corresponding to that indicated in Malaya and which overlaps those of Burma.

As in Burma and Malaya, Wenlock

graptolites are known from west Yunnan, zones 28 and 29 being represented in the Upper Jenhochiao Series (SUN and SZETU, 1947). Exceptionally, however, Ludlow graptolites (zones 32 and 35) are also reported here (YIN and LU, 1937).

Furthermore, in common with other graptolite-bearing areas in the Yunnan-Malaya geosyncline, tentaculites are encountered in the Paoshan region and are again referred to the superceded *Tentaculites elegans* (SUN, 1945). Sun regarded the tentaculite beds as younger than the Jenhochiao and named them the Washih (Waseh) Formation, corresponding to the Burmese Zebingyi Stage. On the other hand, WANG, the discoverer of these tentaculites, believed the containing rocks to be the lateral equivalents of the Upper Jenhochiao (SUN and SZETU, 1947, p. 8). This would seem to be the correct interpretation since the Wenlock *Monograptus vomerinus* was collected immediately above the "*Tentaculites elegans*" horizon. Nevertheless, SUN's correlation of the Washih with the Zebingyi still holds good.

Graptolite and tentaculite correlations within the Yunnan-Malaya Geosyncline

From the foregoing survey it emerges that the anomalous association of Silurian graptolites and Devonian tentaculites recorded in Malaya (BURTON, in the press, a, b) also occurs in the Northern Shan States, the Southern Shan States and west Yunnan. The close proximity of graptolites and tentaculites at Fang in northwest Thailand implies that the same faunal admixture may feature there (see Table 1).

It might be contended that this anomaly is only apparent and that either the graptolites involved are Devonian in age, or that the tentaculites are Silurian forms. However, the Silurian dating of the graptolites is attested by the renowned graptolite experts ELLES (for Burma) and STRACHAN (for Malaya). In addition, BOUČEK (1964) has stated that, "The first representatives of the pelagic nowakia-like tentaculites......appeared only *at the end of the Silurian*" and the same authority has personally testified to the Devonian age of the Malayan and one at the Burmese tantaculites.

Complimentary to this mingling of faunas is a palaeontological hiatus and possibly a sedimentation hiatus also. The time interval between the two admixed faunules is not represented in the local fossil record (except, partially, in Yunnan) and rocks of this age, it they exist, cannot therefore be recognised.

There is some variation in the ages of the component faunules, particularly the earlier one, and hence the fossil gap is not everywhere of the same duration, viz.,

West Yunnan:
Wenlock—Devonian
Northern Shan:
L. Wenlock—L.-M. Devonian
Southern Shan:
Wenlock—Devonian
Northwest Thailand:
L. Llandovery—Devonian
Northwest Malaya
a) West (Langkawi):
M. Llandovery—M. Devonian
b) Central (Mahang):
Wenlock—L.-M. Devonian
c) East (Baling):
Ordovician—L. Devonian

Further work may well modify this picture. At present the Malayan evidence suggests that the dating of the interval depends, to some extent at least, on position in the depositional zone.

Table 2. Llandovery Graptolite Correlations in the Yunnan-Malaya Geosyncline.

Species[1]	West[2] Yunnan	North[3] Shan	South[4] Shan	N. W.[5] Malaya
Monograptus atavus	×	—	—	—
„ *becki*	×	—	—	—
„ *circularis*	—	—	×	—
„ *clingani*	—	—	—	×
„ *concinnus*	×	×	×	×
„ *convolutus*	×	—	×	×
„ *cyphus*	—	×	×	×
„ *decipiens*	×	—	×	×
„ *dextrosus*	×	—	—	—
„ *difformis*	—	—	×	—
„ *distans*	—	—	×	—
„ *fimbriatus*	—	—	×	—
„ *flagellaris*	×	—	—	—
„ *galaensis*	×	—	—	×
„ *gemmatus*	×	—	×	—
„ *gregarius*	×	×	×	×
„ *halli*	×	—	—	—
„ *hybridus*	×	—	—	—
„ *incommodus*	×	—	×	—
„ *inopinus*	—	—	—	×
„ *intermedius*	×	—	—	—
„ *involutus*	×	—	—	—
„ *jaculum*	×	—	×	—
„ *leptotheca*	×	—	—	—
„ *lobiferus*	×	—	×	—
„ *m'coyi*	×	—	—	—
„ *millipoda*	—	—	×	—
„ *nodifer*	×	—	—	—
„ *nudus*	×	—	—	—
„ *planus*	×	—	—	—
„ *priodon*	×	—	×[6]	—
„ *regularis*	×	—	×	—
„ *revolutus*	—	—	×	—
Monograptus runcinatus	×	—	—	—
„ *sandersoni*	×	—	×	—
„ *sedgwicki*	×	—	×	—
„ *spiralis*	×	—	—	—
„ *tenuis*	×	×	×	—
„ *turriculatus*	×	—	—	—
„ *undulatus*	—	—	×	—
Rastrites equidistans	×	—	—	—
„ *linnaei*	×	—	—	—
„ *maximus*	×	—	—	—
„ *peregrinus*	×	×	—	—
Cephalograptus tubulaliformis	—	—	—	×
Climacograptus hughesi	—	—	—	×
„ *innotatus*	—	—	×	—
„ *medius*	×	×	×	—
„ *rectangularis*	×	×	×[7]	×
„ *scalaris*	×	—	×	—
„ *törnquisti*	×	×	×	—
Diplograptus (Mesograptus) modestus	×	×	—	×
Mesograptus magnus	×	—	×	—
Gladiograptus perlatus	×	—	—	—
Glyptograptus incertus	×	—	—	—
„ *persculptus*	—	×	—	—
„ *serratus*	×	—	×	—
„ *sinnuatus*	—	—	—	×
„ *tamariscus*	—	—	×	—
Orthograptus vesiculosus	—	×	×	×
„ *mutabilis*	—	—	×	—
Petalograptus minor	×	—	—	—
„ *palmeus*	×	—	—	—

1 All specific references are listed here, including the comparative "aff.", "cf." and "?" identifications.
2 Taken from Reed (1917), Yin and Lu (1937) and Sun and Szetu (1947).
3 Taken from La Touche (1913).
4 Taken from Brown and Sondhi (1933b) and Reed (1932, 1936).
5 Taken from Courtier (in manuscript), Kobayashi et al. (1964a) and Jones (personal communications) N.B. Numerous collections made in this area have not yet been examined in detail.
6 *Monograptus priodon* occurs here in beds assigned to the Wenlock by La Touche (1913, p. 129).
7 This form is referred to *Climacograptus prerectangularis* in Brown and Sondhi (1933b, p. 213) but to *Cl. rectangularis* in Reed (1936, p. 104-6).

Llandovery graptolites occur in all the documented fossiliferous areas in the Yunnan-Malaya geosyncline except for Na Suan in central western Thailand, and possibly Ban Na in south Thailand. The species reported from the four best-known regions are listed in Table 2, which shows that close correlation exists in the lower half of the Llandovery. *Monograptus gregarius*, *Monograptus concinnus* and *Climacograptus rectangularis* are present in all four regions. Furthermore, *Monograptus cyphus*, whilst not known in Yunnan, occurs at Fang in northwest Thailand as well as in Malaya and in the Northern and Southern Shan States. Seven other species of Llandovery graptolites appear at three out of the four main fossiliferous areas. It is likely that further work on the Malayan collections will buttress these correlations and additional discoveries will almost certainly be made in Thailand.

Wenlock graptolites have recently been proven in northwest Malaya, but full details are not yet available. The Zebingyi Stage of the North Shan area contains the Wenlockian *Monograptus* cf. *riccartonensis* and *Monograptus dubius* together with tentaculites and in the same stage in South Shan the Wenlockian *Monograptus vomerinus* accompanies tentaculites. In the equivalent Washih Formation of Yunnan, *Monograptus vomerinus* enters into a similar association. This species and *Monograptus dubius* also occur in the Upper Jenhochiao Series (SUN and SZETU, 1947), thought here to be contemporaneous with the Washih.

A small ringed tentaculite, everywhere referred to BARRANDE'S *Tentaculites elegans* is recorded at Na Suan, Thailand, in North and South Shan and in west Yunnan. The original discovery from the Northern Shan States has, as observed above, now been re-designated as the Middle Devonian *Nowakia cancellata* (BOUCEK, 1964, p. 81). The other three occurrences have all been compared with the Northern Shan forms (REED, 1936; BROWN *et al.*, 1953; SUN and SZETU, 1947) and it therefore seems probable that these are *Nowakia cancellata* also, or a closely related species. Additionally, BOUCEK has reported a Middle Devonian *Nowakia* from Malaya as well as the common Lower Devonian *Nowakia acuaria*.

In Malaya, Thailand and the Shan States, the Nowakiids are accompanied by smooth-shelled tentaculites, all of which appear to correspond to *Styliolina fissurella* HALL. So far as the writer is aware, this form has not yet been found in China.

Palaeogeography

The Mahang Formation, which contains the bulk of the Malayan graptolites and tentaculites, is comprised to the extent of more than 90% of carbonaceous, more or less siliceous, argillites and is considered to have been generated in a barred or restricted basin of deposition. East of the basin facies, in the contemporaneous "Baling Formation" (or group), similar black argillites are repeatedly intercalated with limestone, apparently expressing intermittantly shallower and better-aerated conditions on the flank of a mobile geanticline. To the northwest, the Ordovician-Silurian "Setul Formation" of the Langkawi Islands consists of limestone with only two thin bands of shale (JONES, 1961). This rock unit overlies coarse arenites, is affected by earth movements to only a limited degree compared with the basin and appears to represent a shelf facies (BURTON, in the press, b).

The anomalous admixture of Silurian graptolites and Devonian tentaculites in Malaya is ascribed to temporary isolation of the depositional zone and very slow sedimentation, or even non-deposition, together with orogenic disturbance when external contacts were reestablished. It seems that the initial geosynclinal downwarp (?Ordovician) in northwest Malaya was compensated by a geanticlinal upwarp to eastward which, as it rose, came to restrict the natural circulation of the seawater. This promoted anaerobic conditions at depth and the generation of black shales, mainly in the Mahang basin, but at times on the shelf and geanticlinal flank too. Life was thus confined to the surface waters and there flourished here, in the Lower Silurian, a graptolitic plankton which probably originated in the adjacent Palaeozoic Ocean, just as RUEDEMANN (1934, p. 63) has proposed in North America.

In the northwest Malayan region Middle Silurian graptolites seem to be rather restricted in number and in Upper Silurian times pelagic plankton was apparently entirely excluded from the area by the emergence of the geanticlinal barrier above sea-level. Communication with the ocean is thought to have been subsequently restored by the collapse of the geanticline in a chain of islands in the Lower Devonian, whereupon a tentaculite plankton invaded the northwest Malayan area. Associated earth movements would have agitated both the sediments and the waters in the depositional zone. Disturbed toxic bottom water would then have stifled the tentaculites whose shells would have sunk to the bottom in large numbers to join a minority of displaced graptolite (and trilobite) remains dating from 20 to 30 million years earlier. This process of annihilation and faunal mixing was probably repeated several times in the Lower to Middle Devonian.

The anomalous faunal associations in Thailand, Burma and China all lie on a similar strike to those of Malaya, all span an apparent hiatus at a similar time and all involve similar faunas, both before and after the hiatus. It does not seem unreasonable, therefore, to propose the same explanation for all the mid-Palaeozoic mixed faunas in the geosynclinal tract from Malaya to Yunnan.

The emergence of the geanticline, which is of critical importance to our thesis, could have been accomplished by absolute marine regression, said to have been widespread in the Wenlock (PASCOE, 1959, p. 658). However, since the period of isolation seems to have begun earlier in the south than in the north, orogenic uplift is perhaps indicated. KOOPMANS (1965) has postulated a late Silurian to Devonian "Langkawi folding phase" in northwest Malaya, and it is conceivable that these movements upraised the barrier. Alternatively, the rise of the geanticline may be a normal feature of (ortho) geosynclinal evolution, as implied by JAMES (1954, p. 279) and PETTIJOHN, (1957, p. 626, 637), and effected by slow, progressive uplift. The "Langkawi folding phase" might then mark the subsequent breakdown of the geanticlinal ridge.

Although Silurian to Devonian rocks are known at intervals in the Yunnan-Malaya geosynclinal tract, owing to the sparsity of information, it is uncertain whether there were several distinct mid-Palaeozoic basins, or whether a continuous trough occupied the whole stretch from northwest Malaya to southwest China.

The Mahang Formation of Malaya is of euxinic facies and the rocks at Fang in northwest Thailand are almost inentical in lithology. In the Huronian of Michigan, U.S.A., JAMES (1954, p. 280) has suggested that restricted (euxinic) basins may have been about 500 miles long by 100 miles wide. On the other hand, the Mahang Formation has an almost wholly planktonic fauna (BURTON, in the press, b) and corresponds to what RUEDEMANN (1934, 1935) has called true or pure graptolitic shale, which in eastern North America is distributed throughout the 1800 miles length of a single trough.

The writer has recently had the opportunity of visiting the Fang area, and was impressed by the very close similarity of the geology here to that of northwest Malaya. The black, siliceous, graptolitic shale of Fang duplicates the Mahang Formation and is associated in place with pale gray shales and greywackes indistinguishable from the Middle Devonian to Lower Carboniferous "Kampong Sena Formation" which succeeds the Mahang in the type area. In both Thailand and Malaya this succession is followed by massive, white, Permian limestone. That three consecutive rock units should maintain their character and mutual relationships in these two areas, 1000 miles apart, is perhaps best explained by postulating a single elongate and persistent basin of deposition.

Possibly then, there was a continuous trough from northwest Malaya to west Yunnan, at least at times of marine transgression. When external contacts were interrupted, this geosynclinal belt may have broken down into a number of sub-basins, each with a slightly different history (witness the limited development of Ludlovian in west Yunnan).

It has been established that a basin existed in the Silurian and Devonian in the northwestern coastal lowlands of Malaya with, to the west, a shelf or platform (possibly marginal to the Gondwana continent) and a geanticline to the east (see Fig. 1).

Ban Na in south Thailand exhibits an Ordovician-Silurian succession, very like that of Langkawi, 170 miles to the south. It appears likely that the shelf lay across the peninsula in this latitude (c.9° north) whilst the contemporary basin was sited near or within the present Gulf of Thailand (Fig. 1). The basin facies reappears at Fang in northwest Thailand.

In the Shan States the Llandovery often comprises black shale, but the dominance of limestones and arenites in the preceding and succeeding strata, together with their situation to the west of the Mahang-Fang (basin) axis, indicates that these areas were mostly near the shelf. This accords with the view of LA TOUCHE (1913, p. 347) who believed that the Palaeozoic rocks of North Shan were laid down along the eastern shore of Gondwanaland. Apparently the euxinic basin facies encroached westwards onto the continental shelf in Llandovery times. The rocks at the Na Suan locality in central west Thailand have been likened to those of the contemporary Zebingyi Stage of Burma (BROWN *et al.*, 1953, p. 33) and presumably reflect similar shelf-like conditions.

West Yunnan is situated close to the Mahang-Fang axis, but its mid-Palaeozoic succession is not that of a typical euxinic basin facies. Black shale is again present in the Llandovery, but here it is admixed with sandstone and limestone. It seems likely that the character of the Yunnan-Malaya geosyncline is somewhat different in this area. Whilst throughout Malaya and Thailand it constitutes an orthogeosyncline, the succession discussed above occupying the miogeosynclinal zone, in west Yunnan MISCH (1945, p. 48) has classified it as a parageosyncline (intracratonic) and SUN (1945, p. 6) has located its eastern shore in this vicinity.

Similarly, although the mid-Palaeozoic geosynclinal belt continues southwards throughout Malaya, its history elsewhere manifestly diverges from that indicated in the northwest. South of the Mahang basin, around Sungei Siput and Ipoh in central Perak, the succession from Upper Carboniferous is mainly limestone, with subsidiary shale (in the ratio 4 : 1 according to INGHAM and BRADFORD, 1960). It appears that this area subsided more slowly and/or a geanticlinal barrier was not well-developed here. At some stage in the Upper Ordovician to Lower Silurian, however, a euxinic environment temporarily obtained, when the graptolitic shales of Kanthan and Chemor were formed. Devonian conodonts are reported in central Perak, but no fossil material of Middle to Upper Silurian date has been found and it is therefore conceivable that this area experienced the period of isolation recognised to the north. Near Kuala Lumpur in the state of Selangor, this interval is spanned by limestone with Middle to Upper Silurian corals (THOMAS, 1963) and Ludlow brachiopods (BOUCOT, JOHNSON and JONES, 1966). The limestone does not persist southwards from south Selangor, but associated clastics and chert extend to the sea coast in Malacca state.

The foregoing areas all lie on the western side of the contemporary geanticline. The Malacca outcrop, however, is physically continuous with the Foothills Formation (RICHARDSON, 1946) on the eastern flank of this feature (whose site is now occupied by the Main Range granite batholith). A recent discovery of monograptids from the Foothills Formation, confirms its inferred mid-Palaeozoic date. This formation, with its included ultrabasic bodies and situation to seaward of the former geanticline (island arc) seems to represent deposition in a deep marginal trough or geotectocline (HESS, 1938, p. 79).

Further graptolite and tentaculite correlations beyond the Yunnan-Malaya geosyncline

A mid-Palaeozoic geosynclinal tract has now been traced for some 1600 miles from Yunnan to southern Malaya. It is possible that further extensions exist.

In the north, SUN (1946, p. 6) and PASCOE (1959, p. 658) believed that the North Shan-Yunnan sector was connected with the Himalayan geosyncline in Silurian times. On the other hand, as long ago as 1913, LA TOUCHE (p. 349-50) had pointed out "....the marked discrepancy that exists, until we arrive at the Permo-Carboniferous epoch, between the faunas of the Himalayas and of the Shan States...." and he had postulated an "unsurmountable barrier" between the Shan and Himalayan areas.

In part, LA TOUCHE's hypothesis rested on the apparent absence of graptolites from the whole of the Himalayan tract. Recent discoveries, however, necessitate a re-assessment. GUPTA has found graptolites in the Kashmir Himalayas (SAHNI and GUPTA, 1964a, 1964b), identified by Stubblefield as:—

Monograptus cf. *vulgaris*
Monograptus cf. *colonus*
Monograptus cf. *dubius*

apparently indicative of a Lower Ludlow age. It will be recalled that *Monograptus* cf. *vulgaris* occurs in the Loilem Stage of the Southern Shan States, whilst *Monograptus dubius* is known from the

Zebingyi Stage, Northern Shan and the Upper Jenhochiao of west Yunnan.

Graptolites have now also been reported from the Himalaya of Nepal. STRACHAN *et al.* (1964) list:—

Climacograptus cf. *medius*
Orthograptus sp.
Dimorphograptus extenuatus
Glyptograptus sp.
Diplograptus s. str. sp.
Monograptus lobiferus
Monograptus aff. *tenuis*
Rastrites sp. (cf. *hybridus*)

This assemblage is clearly Llandovery in age. Whilst *Dimorphograptus extenuatus* and *Rastrites hybridus* are not known in the Yunnan-Malaya geosyncline, the other three species identified in Nepal, *Monograptus lobiferus*, *Monograptus tenuis* and *Climacograptus medius* are all recorded from both Yunnan and South Shan and the two latter are also found in North Shan (Table 2).

In the light of this new evidence it appears that the proposed barrier between the Himalayan and Shan areas was in fact surmounted, or more probably circumvented, in lower Silurian and in Middle-Upper Silurian times. Nevertheless, there remains a considerable body of faunistic evidence to support LA TOUCHE's thesis and probably the connection between the two geosynclinal zones was neither direct nor sustained.

T'AN (1937), in reconstructing the palaeogeography of west China shows, in his plate II-figure 2, the Silurian sea as swinging northeastwards from north Yunnan and expanding to cover much of Szechuan, plus west Hupei, southeast Kansu, north Kueichow and south Shensi. He does not give details of the lithofacies and fauna, but graptolitic Fuchih Shale of Llandovery age occurs at three localities in Hupei according to SUN (1931) and is also known in the Szechuan (SUN and WANG, 1946, p. 92). YIN and MU (1945) have further described Lower Silurian graptolites from the Tungtzu area on the Szechuan/Kueichow border. Moreover, the ECAFE "Geological Map of Asia and the Far East" (1959) portrays a discontinuous belt of Silurian rocks extending from west Yunnan north-northeast to Kanting (Tatsienlu) and thence northeastwards towords Sian.

A northeastward extension of the Yunnan-Malaya geosyncline thus seems to be better established than a westward connection with the Himalayan geosyncline.

LA TOUCHE (1913, p. 349) remarked on the European affinities of the Palaeozoic fossils from the Shan States and in particular he drew attention (p. 179) to the Bohemian or Hercynian facies of the Zebingyi fauna. He inferred therefrom some sort of contemporary communication between Europe and Southeast Asia. Similarly, whilst SUN and SZETU (1947) believed that the Palaeozoic faunas of Yunnan were essentially of oriental origin, they aver (p. 12) that "....connection with Europe is quite certain due to the occurrence of cosmopolitan graptolites".

It is noteworthy, therefore, that GANSSER's map of the Himalayan region (1964, plate 1-b) depicts two arms of Palaeozoic strata leading westwards from southern China to Ferghana, one via the Kun Lun Shan and the other by way of the Tsingling Shan, the Nan Shan and the Tien Shan. MUIR-WOOD (1948, p. 19) considers that the latter, rather than the Himalayan geosyncline, served as a connection between Europe and Malaya in Visean time and BULMAN's (1964, p. 473) distribution map of *Monograptus turriculatus* suggests a similar route from Europe to Yunnan in the Llandovery.

At its southern end the Yunnan-Malaya geosynclinal tract passes beneath the Straits of Malacca and is therefore difficult to trace farther. In a discussion of structural belts in the East Indies, WESTERVELD (1952) assigned peninsular Thailand and Malaya to the " Malaya Orogen " which stretches southwards to Singkep and Bangka, whence it bends east-northeast through Belitung (Billiton) to continue into west and central Kalimantan (Indonesian Borneo). Whilst no pre-Carboniferous rocks have been found in the Riau and Lingga Archipelagoes (Fig. 1) or in the " tin islands ", the discovery of the Lower Devonian *Clathrodicton* and *Heliolites* in central Kalimantan (VAN BEMMELEN, 1949, p. 366) may mean that the mid-Palaeozoic geosyncline extended throughout the length of the " Malaya Orogen ".

Some 1200 miles farther east, Silurian rocks are known at the western end of Irian Barat (Indonesian New Guinea) where BULMAN (1964, p. 473) has indicated an occurrence of *Monograptus turriculatus*.

These tenuous correlations to south and east of Malaya are enhanced by evidence from the Tasman geosyncline of eastern Australia. Association of graptolites with tentaculites, a distinctive and characteristic feature of the mid-Palaeozoic in the Yunnan-Malaya geosyncline, recurs in Victoria where SKEATS (1928, p. 229) reported the concurrence of *Monograptus* and *Styliola*. GILL (1941) later showed that this " *Styliola* " is apparently to be referred to *Styliolina fissurella* and is frequently accompanied by " *Tentaculites matlockiensis* ". The latter seems to be, in fact, *Nowakia acuaria* (BOUČEK, 1964) and hence the Victorian tentaculites correspond to the two most common forms in Malaya.

The *Monograptus* found with tentaculites in Victoria has not been specifically determined, but *Monograptus dubius* occurs close by (SKEATS, 1928) and the same stratigraphic unit, the Melbournian, contains *Monograptus vomerinus* (GILL, 1941, p. 159). *Monograptus dubius* is known from the mixed fauna of the Northern Shan States and is also reported in west Yunnan (and Kashmir). *Monograptus vomerinus* similarly participates in the graptolite-tentaculite admixture in the Southern Shan States and Yunnan. It is evident that the graptolite member of the Australian faunal association is also similar in character to that of the Yunnan-Malaya geosyncline.

These graptolite and tentaculite correlations engender the suggestion that the Yunnan-Malayan and the Tasman geosynclines were formerly confluent. Their present separation is perhaps largely a result of continental drift, particularly the oft-postulated eastward migration of Australia.

Acnowledgements

The author wishes to express here his gratitute to Professor Bedřich BOUČEK of the Czechoslovak Academy of Sciences who has examined the Malayan tentaculites and given us permission to quote his findings. Acknowledgement is also due to Mr. C. R. JONES who has informed us of his preliminary determinations of the Malayan graptolites.

We would further like to take this opportunity to thank Mr. Wattanachai BOONYAKIART and his colleagues in the Thai Department of Mineral Resources who conducted us to the important Fang locality in northwest Thailand.

Dr. K. CHINZEI very kindly prepared the Japanese abstract of this article.

References

BEMMELEN, R. W. van (1949): The Geology of Indonesia, Volume 1A, General Geology of Indonesia and Adjacent Archipelagoes: *The Hague, Martinus Nijhoff*, 732 p., 378 figs.

BOUČEK, B. (1964): The Tentaculites of Bohemia: Their Morphology, Taxonomy, Phylogeny and Biostratigraphy: Prague, *Publishing House of Czech Academy of Sciences*, 215 p., 40 pl., 36 figs.

BOUCOT, A. J., JOHNSON, J. G. and JONES, C. R. (1966): Silurian Brachiopods from Malaya: *Jour. Palaeontology*, vol. 40, p. 1027-31.

BROWN, J. C. (1913): Contributions to the Geology of the Province of Yunnan in Western China, III. Notes on the Stratigraphy of the Ordovician and Silurian Beds of Western Yunnan: *Rec. Geol. Surv. India*, vol. 43, p. 327-34.

BROWN, J. C. and SONDHI, V. P. (1933a): Geological Reconnaissance in the Southern Shan States: *Ibid.*, Vol. 67, p. 134-65 (1934).

—— and —— (1933b): The Geology of the Country between Kalaw and Taunggyi, Southern Shan States: *Ibid.*, vol. 67, p. 166-248 (1934).

BROWN, G. F. *et al.* (1953): Geologic Reconnaissance of the Mineral Deposits of Thailand: *Geol. Surv. Mem.* 1, *Bangkok, Royal Dept. Mines*, 183 p., 38 figs., 20 pl.

BULMAN, O. M. B. (1964): Lower Palaeozoic Plankton: *Geol. Soc. London Quart. Jour.*, vol. 120, p. 455-76.

BURTON, C. K. (in press, a): Dacryoconarid Tentaculites from the Euxinic Facies of the Malayan Geosyncline. *Jour. Paleontology*.

—— (in the press, b). The Mahang Formation: A Mid-Palaeozoic Euxinic Facies from Malaya, with Notes on its Conditions of Deposition and Palaeogeography. *Geologie en Mijnbouw*.

ECAFE (1959): Geological Map of Asia and the Far East. 1:5,000,000: *Bangkok. ECAFE, United Nations Secretariat.*

FISHER, D. W. (1962): Small Conoidal Shells of Uncertain Affinities: *in* Treatise on Invertebrate Palaeontology—Dir. & Ed. R. C. MOORE, Part W, p. 98-143, *Geol. Soc. Am. and Univ. of Kansas Press.*

GANSSER, A. (1964): Geology of the Himalayas: *New York, J. Wiley*, 289 p., 4 pl.

GILL, E. D. (1941): The Place of the Genus *Styliolina* in the Palaeozoic Palaeontology and Stratigraphy of Victoria: *Proc. Roy. Soc. Victoria*, vol. 53, N. S., p. 145-164.

HESS, H. H. (1938): Gravity Anomalies and Island Arc Structure with Particular Reference to the West Indies: *Am. Phil. Soc., Proc.*, vol. 79, p. 71-96.

INGHAM, F. T. and BRADFORD, E. F. (1960): The Geology and Mineral Resources of the Kinta Valley, Perak: *Fed. of Malaya Geol. Survey, Mem. No.* 8: *Kuala Lumpur, Govt. Press*, 347 p., 20 figs., 18 pl., 2 maps.

JAMES, H. L. (1954): Sedimentary Facies of Iron-Formation: *Econ. Geol.*, vol. 49, p. 236-93.

JONES, C. R. (1959): Graptolites Recorded from Malaya: *Nature*, vol. 183, p. 232 only.

—— (1961): A Revision of the Stratigraphical Sequence of the Langkawi Islands, Federation of Malaya: *9th Pacific Sci. Congr.*, 1957, Proc., vol. 12, p. 287-300.

KOBAYASHI, T. (1960): Notes on the Geologic History of Thailand and Adjacent Territories: *Japan. Jour. Geol. Geogr.* vol. 31, p. 129-48.

—— (1964): Geology of Thailand: *Geology and Palaeontology of Southeast Asia*, Vol. 1: Tokyo, Univ. of Tokyo Press, p. 1-15.

——, JONES, C. R. and HAMADA, T. (1964a): On the Lower Silurian Shelly Fauna in the Langkawi Islands, Northwest Malaya: *Japan. Jour. Geol. Geogr.*, vol. 35, p. 75-80.

—— *et al.* (1964b): Report on the Stratigraphical and Palaeontological Reconnaissance in Thailand and Malaysia, 1963-1964: *Tokyo, Overseas Technical Cooperation Agency*, 72 p., 10 figs.

KOOPMANS, B. N. (1965): Structural Evidence for the Presence of a Palaeozoic Orogeny in North West Malaya: *Geol. Mag.*, vol. 102, p. 501-20.

La Touche, T. H. D. (1913): Geology of the Northern Shan States: *Mem. Geol. Surv. India*, vol. 39, 379 p., 27 pl., 3 coloured maps.

Misch, P. (1945): Remarks on the Tectonic History of Yunnan with Special Reference to its Relations to the Type of the Young Orogenic Deformation: *Geol. Soc. China, Bull.*, vol. 25, p. 47-154 (1946).

Muir-Wood, H. M. (1948): Malayan Lower Carboniferous Fossils and their Bearing on the Visean Palaeogeography of Asia: *British Museum*, 118 p., 3 figs., 17 pl.

Pascoe, Sir E. H. (1959): A Manual of the Geology of India and Burma, Vol. 2 (1960): *Calcutta, Govt. of India Press*, p. 485-1344.

Pettijohn, F. J. (1957): Sedimentary Rocks (2nd Ed.): *New York, Harper Bros.*, 718 p., 173 figs., 119 tables.

Reed, F. R. C. (1906): The Lower Palaeozoic Fossils of the Northern Shan States, Burma: *Mem. Geol. Surv. India, Pal. Indica, N. S.* vol. 2, Mem. No. 3, 154 p., 8 pl.

—— (1915): Supplementary Memoir on New Ordovician and Silurian Fossils from the Northern Shan States: *Ibid.*, vol. 6, Mem. No. 1, 123p., 12 pl.

—— (1917): Ordovician and Silurian Fossils from Yunnan: *Ibid.*, vol. 6, Mem. No. 3, 85 p., 8 pl.

—— (1932): Notes of some Lower Palaeozoic Fossils from the Southern Shan States: *Rec. Geol. Surv. India*, vol. 66, p. 181-211 (1933).

—— (1936): The Lower Palaeozoic Fossils of the Southern Shan States: *Mem. Geol. Surv. India, Pal. Indica, N. S.* vol. 21, Mem. No. 3, 130 p., 18 pl.

Richardson, J. A. (1946): The Stratigraphy and Structure of the Main Range Foothills, F. M. S.: *Geol. Mag.*, vol. 83, p. 217-29.

Ruedemann, R. (1934): Palaeozoic Plankton of North America: *Geol. Soc. America, Mem.* No. 2, 141 p., 6 figs., 26 pl.

—— (1935): Ecology of Black Mud Shales of Eastern New York: *Jour. Palaeont.*, vol. 9, p. 79-91.

Sahni, M. R. and Gupta, V. J. (1964a): Graptolites on the Indian Sub-Continent: *Nature*, vol. 201, p. 385-6.

—— and —— (1964b): Graptolites from the Kashmir Himalayas, also a Note on the Discovery of Fossils in the Muth Quartzite: *Nature*, vol. 204, p. 1081-2.

Skeats, E. W. (1928): Stratigraphical and Structural Relations of Silurian Rocks of Walhalla—Woods Point District, Victoria, in Relation to the "Tanjilian" Series: *Rep. of the Hobart Meeting, 1928, Australasian Assoc. for Adv. of Sci.*, p. 219-30.

Strachan, I., Bodenhausen, J. W. A., de Booy, T. and Egeler, C. G. (1964): Graptolites in the "Tibetan zone" of the Nepalese Himalayas: *Geol. en Mijnb.*, vol. 43, p. 380-82.

Sun, Y. C. (1931): Graptolite-bearing Strata of China: *Geol. Soc. China, Bull.*, vol. 10, p. 291-99.

—— (1945): The Sino-Burmese Geosyncline of Early Palaeozoic Time with Special Reference to its Extent and Character: *Ibid.*, vol. 25, p. 1-8 (1946).

Sun, Y. C. and Szetu, S. S. (1947): Preliminary Notes on the Stratigraphy and Structure of the Paoshan Region, W. Yunnan: *Contr. Geol. Inst., Nat. Univ. Peking*, No. 32, 26 p., 7 figs., maps, sections.

Sun, Y. C. and Wang, H. C. (1946): Silurian Stratigraphy of the Malung and Kutsing Districts, Eastern Yunnan: *Geol. Soc. China, Bull.*, vol. 26, p. 83-99.

T'an, H. C. (1937): A Summary of the Geologic History of Szechuan and Sikang: *Ibid.*, Bull., vol. 16, p. 389-416.

Thomas, H. D. (1963): Silurian Corals from Selangor, Federation of Malaya: *Overseas Geology and Min. Resc.*, vol. 9, p. 39-46.

Westerveld, J. (1952): Phases of Mountain Building and Mineral Provinces in the East Indies: *Internat. Geol. Congr., 18th, Gt. Britain, 1948, Proc. Section M*, p. 245-55.

Yin, T. H. and Lu, C. H. (1937): On the Ordovician and Silurian of Shihtien, Western Yunnan: *Geol. Soc. China, Bull.*, vol. 16, p. 41-56.

Yin, T. H. and Mu, A. T. (1945): Lower Silurian Graptolites from Tungtzu: *Ibid.*, vol. 25, p. 211-20 (1946).

PROCEEDINGS OF THE PALAEONTOLOGICAL SOCIETY OF JAPAN

日本古生物学会第95回例会は，1966年11月26日（土）名古屋大学理学部地球科学教室講義室において開催された。(参加者15名)

個　人　講　演

兵庫県佐用郡万の峠産石炭紀珊瑚化石について (代読)………………後藤博弥・山際延夫

名古屋港地域の沖積層より産出した海胆類，とくに *Astriclypeus* の幼形標本について‥森下 晶

一志層群および山辺層群の貝化石群集‥‥柴田 博

千草累層（中新統）の化石貝類群………………………糸魚川淳二・秦 好利

瀬戸内東部地域（兵庫県・岡山県）の中新世化石貝類群…………………………糸魚川淳二

赤石山地龍笠山地域の戸台層産三角貝……………………………前田四郎・川辺鉄哉

日本古生物学会1967年度総会及び年会は，1967年1月21日（土），22日（日）の両日，東京大学理学部地質学教室講義室において開催された。多数の参会者・個人講演があり，盛会裡に終了した。(参会者95名)

特　別　講　演

西欧における海洋底棲群集の研究……首藤次男

解　説　講　演

古生物学と相対成長………………小畠郁生

個　人　講　演

日本とアメリカ西海岸の紡錘虫の比較（予報）‥……………………………森川六郎

On the genus *Pseudofusulinella*, with description of a new species from Japan.. ……………………… Tomoo OZAWA

Fusulinids of the *Millerella* zone of the Taishaku Limestone. (Studies of the stratigraphy and the microfossil faunas of the Carboniferous and Permian Taishaku Limestone in West Japan, No. 1) (代読)………………Kimiyoshi SADA

Fusulinids of the *Profusulinella* zone of the Taishaku Limestone. (*Ditto*, No. 2) (代読) …………………Kimiyoshi SADA

Fusulinids of the *Fusulinella* zone of the Taishaku Limestone. (*Ditto*, No. 3) (代読) …………………Kimiyoshi SADA

Species and subspecies concept in paleontology ………………Takayasu UCHIO

長沼層の有孔虫の示す古水温について‥内尾高保

高知県登層の地質時代について……内尾高保

三浦半島，上総層群の有孔虫群集について……………………………………青木直昭

On the Triassic Myophoriidae and Trigoniidae in the Asio-Pacific area ……… ..Teiichi KOBAYASHI & Minoru TAMURA

Claraia from North Pahang, Malaya…… …………………… Minoru TAMURA

Some lower Cretaceous bivalves from the Shimantogawa Group of South Shikoku …… Itaru HAYANI & Keizo KAWASAWA

Paleoecology of shallow sea molluscan faunae in the Neogene deposits of Northeast Honshu, Japan ……………… ..Kiyotaka CHINZEI & Yasuhide IWASAKI

Dosinia tatunokutiensis NOMURA について‥…………………………増田孝一郎

Fulgoraria 類の進化……………鹿間時夫

Carboniferous ammonoids from Akiyoshi. (Molluscan paleontology of the Akiyoshi Limestone Group, Pt. 3) ……Tamio NISHIDA, Masamichi OTA & K. HASHIMOTO

Occurrence of *Metoicoceras* in Trichinopoly Cretaceous ……………………… M. V. A. SASTRY & Tatsuro MATSUMOTO

Lower Cretaceous ammonites from the Miyako Group, Pt. 2: Some Silesitids from the Miyako Group....Ikuwo OBATA

Graptolite and Tentaculite correlations and paleogeography of the Silurian and Devonian in the Yunnan-Malaya Geosyncline (代読) ....C. K. BURTON

手取統産の爬虫類について ....鹿間時夫

栃木県塩原産コイ科魚類の化石について 上野輝弥

本邦における顕郷屯動物相要素の存在について ....長谷川善和

Pleistocene monkey and human remains from Ojikado Cave of Hiraodai Karst Plateau, northern Kyushu ....Yoshikazu HASEGAWA

On two new species of Cervidae from the Kuchinotsu Group of West Japan ....Hiroyuki OTSUKA

Ordovician and Silurian Conodonts from Langkawi, Malaya, (supplement)................ Hisayoshi IGO & Toshio KOIKE

Carboniferous Conodonts from Kuantau, Malaya ..Hisayoshi IGO & Toshio KOIKE

静岡県女神石灰岩の岩相及び生相解析 ....小西健二・伊藤信吾

珪藻と硼素含量による古鹹度の検討の一例 ....市川 渡・小西健二・石塚明男

沖縄石垣島に発見された埋没林 ....前田四郎

東北海道の段丘及び沖積層の花粉 I ....鈴木順雄

Permian Plants from Loei, Thailand ....Kazuo ASAMA

満州北東部産開山屯植物群について ....今野円蔵

学　会　記　事

◎ 1966年度中に特別会員尾崎金右衛門君及び，在外会員 B. PEYER 君が逝去された。

◎ 1966年度中の退会者は（敬称略）
四十物秀蔵，秋山雅彦，藤江　力，池辺展生，熊野純男，前川文夫，松沢　勲，三宅　淑，成瀬　洋，野上裕生，柴田松太郎，高橋由美子，寺岡易司，矢部之男.

◎ 1967年度よりの入会者は，（申込順・敬称略）
J. X. CORGAN，西脇昌治，P. PARIWATVORN，C. R. JONES，C. K. BURTON，D. J. GOBBETT，佐藤睦治，平　一弘，後藤仁敏，石川　正，三木昭夫，西田史朗，T. K. TACH，長谷川康雄，松尾康弘，橋本恭一，神保幸則，石橋　毅，榊原信夫，加藤国男，中村萬次郎，福留高明，成瀬武彦，尾崎公彦，太田信機，亀山徳彦，柳沢一郎，高畠　誠，国方光治，山口寿之.

◎ 1967年度評議員会により，次の諸君が特別会員に推薦された。（敬称略・順不同）
石和田靖章，小畠郁生，神戸信和，鎮西清高，長谷　晃，浜田隆士，速水格，堀越増興

◎ 1966年末に行われた，評議員選挙の結果，次の諸君が，1967，1968年度評議員に当選した。（敬称略・五十音順）
浅野　清，市川浩一郎，尾崎　博，金谷太郎，勘米良亀齢，小高民夫，小林貞一，鹿間時夫，首藤次男，高井冬二，橋本　亘，畑井小虎，花井哲郎，松本達郎，湊　正雄

◎ 1967年1月21日に開かれた評議員会における会長選挙の結果，浅野　清君が再選された。

◎ 学会誌論文賞が，1967年度総会の席上，氏家　宏君の「Shell Structure of Japanese smaller Foraminifera. Part 1, *Ammonia tochigiensis* (UCHIO, 1951) ; Ditto, Part 2, *Pararotalia nipponica* (ASANO, 1936)」に対して贈られた。尚，学術奨励金は今回は見送られた。

◎ 本会誌の定価が No. 65 より1冊 600円に値上された。

◎ 本会誌の出版は一部文部省研究成果刊行費による。

例　会　通　知

	開催地	開催日	講演申込締切日
第96回　例　会	大阪市大	1967年6月17日	1967年5月10日
第97回　例　会	国立科学博物館	1967年9月　下旬	1967年8月10日
第98回　例　会	東北大学	1967年11月　下旬	1967年10月10日
1968年総会・年会	九州大学	1968年1月26, 27日	1967年12月10日

第96回例（大阪市立大学）：　シンポジウム・日本における二畳・三畳紀境界付近の動物群について.

（世話人：　市川浩一郎）

なお，1968年年会（九州大学）では，carbonate sediments に関するシンポジウムを行う予定である。

（世話人：　勘米良亀齢・小西健二）

1967年4月5日　印　刷
1967年4月10日　発　行

日本古生物学会報告・紀事
新篇第65号
600円

東京大学理学部地質学教室内
日本古生物学会

編集兼発行者　花井哲郎

（振替口座東京84780番）

印刷者　東京都練馬区豊玉北2ノ13
学術図書印刷株式会社　富田元

日本古生物学会会則　　(1964, 1, 18)

第１条　本会は日本古生物学会という。
第２条　本会は古生物学およびこれに関係ある諸学科の進歩および普及を計るのを目的とする。
第３条　本会は第２条の目的を達するため次の事業を行う。
1. 会誌そのほかの出版物の発行。 2. 学術講演会の開催。
3. 普及のための採集会・講演会そのほかの開催。
4. 研究の援助・奨励および研究業績ならびに会務に対する功労の表彰その他第２条の目的達成に資すること。

第４条　本会の目的を達するため総会の議を経て本会に各種の研究委員会を置くことができる。
第５条　本会は古生物学およびこれに関係ある諸学科に興味を持つ会員で組織する。
第６条　会員を分けて普通会員・特別会員・賛助会員および名誉会員とする。
第７条　普通会員は所定の入会申込書を提出した者につき評議員会の議によって定める。
第８条　特別会員は本会に10年以上会員であり古生物学について業績のあるもので，特別会員５名の推薦のあったものにつき評議員会の議によって定める。
第９条　賛助会員は第２条の目的を賛助する法人で評議員会の推薦による。
第10条　名誉会員は古生物学について顕著な功績のある者につき評議員会が推薦し，総会の決議によって定める。
第11条　会員は第12条に定められた会費を納めなければならない。会員は会誌の配布を受け第３条に規定した事業に参加することができる。
第12条　会費の金額は総会に計って定める。会費は普通会員年1,000円，特別会員年1,500円，賛助会員年10,000円以上とする。名誉会員は会費納入の義務がない。在外の会員は年４弗とする。
第13条　本会の経費は会費・寄付金・補助金などによる。
第14条　会費を１ヶ年以上滞納した者および本会の名誉を汚す行為のあった者は，評議員会の議を経て除名することができる。
第15条　本会の役員は会長１名，評議員15名とし，うち若干名を常務委員とする。任期は総て２年とし再選を妨げない。
会長の委嘱により本会に幹事および書記若干名を置くことができる。
常務委員は評議員会において互選される。評議員は特別会員の中から会員の通信選挙によって選出される。
第16条　会長は特別会員の中から評議員会において選出され，本会を代表し会務を管理する。
会長に事故ある場合は会長が臨時に代理を委嘱する。
第17条　本会には名誉会長を置くことができる。名誉会長は評議員会が推薦し総会の決議によつて定める。名誉会長は評議員会に参加することができる。
第18条　本会は毎年一回定例総会を開く。その議長には会長が当り本会運営の基本方針を決定する。
総会の議案は評議員会が決定する。
会長は必要があると認める時は臨時総会を召集する。総会は会員の十分の一以上の出席をもつて成立する。
会長は会員の三分の一以上の者が会議の目的たる事項および召集の理由を記載した書面をもつて総会召集の請求を受けた場合は臨時総会を召集する。
第19条　総会に出席しない会員は他の出席会員にその議決権の行使を委任することができる。但し，欠席会員の議決権の代行は１人１名に限る。
第20条　総会の議決は多数決により，可否同数の時は議長がこれを決める。
第21条　会長および評議員は評議員会を組織し，総会の決議による基本方針に従い運営要項を審議決定する。
第22条　常務委員は常務委員会を組織し評議員会の決議に基づいて会務を執行する。
第23条　本会の会計年度は毎年１月１日に始まり12月31日に終る。
第24条　本会会則を変更するには総会に付議し，その出席会員の三分の二以上の同意を得なければならない。
付　則　1) 評議員会の議決は総て無記名投票による。