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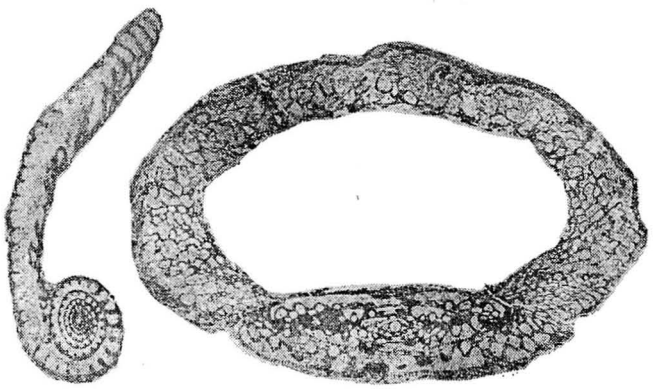

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The fossil on the cover is *Nipponitella explicata* HANZAWA, an aberrant uncoiled fusulinacean from the Lower Permian Sakamotozawa Formation, southern Kitakami, Northeast Japan.

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715. PERMIAN ECTOPROCTA (BRYOZOA) FROM THE ABADEH REGION, CENTRAL IRAN*

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Abstract. The biostratigraphic distributions of some Permian bryozoans in the Abadeh region, Central Iran are studied. These bryozoans are closely related to those from the Gnishik-Khachik-Lower Dzhulfian Stages of Armenian Dzhulfa, and some of them are known also from the Permian of Pamir, Russian platform, Salt Range, Kashmir, South China and Timor. Fifteen species, including four new species, of the bryozoans in all are described and illustrated.

Introduction and Acknowledgements

The present article deals with the result of biostratigraphic and paleontological studies of bryozoans collected from the Abadeh region during our field survey made as one of the research projects on the Permian/Triassic boundary problems.

Before going further, I would like to express my sincere thanks to the staff members of the Geological Survey of Iran in Tehran for their hearty arrangement and help in making the research successful, especially Dr. H. TARAZ and Mr. F. GOLSHANI for their kind guidance in the field. I would also like to thank in particular the members of the Japanese party: Drs. Y. BANDO, K. ISHII, M. MURATA, K. NAKAZAWA, K. NAKAMURA, Y. OKIMURA and D. SHIMIZU for their kind cooperations in the field. The field survey was financed by the Overseas Scientific Research Fund of the Ministry of Education, Japan for this project in 1972.

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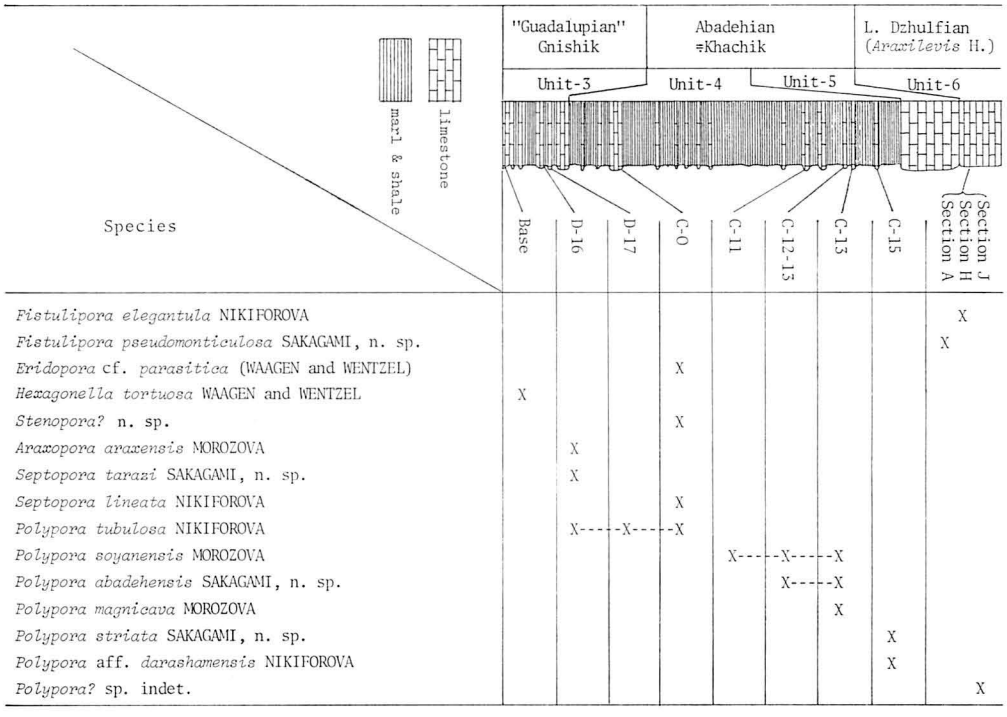
Bryozoan biostratigraphy

Most of the bryozoans studied here were collected by us in the Abadeh region from D and C Sections, which contain Unit-3 and Unit-4 by TARAZ (1971, 1974). These two units were considered to be the upper part of the "Guadalupian" and the lower part of the Abadehian by him. Only three bryozoan species were found sporadically in the lower parts of A, H and J Sections corresponding to the lower part of Unit-6 (the *Araxilevis* bed of the lower Dzhulfian) by TARAZ (1971, 1974).

The biostratigraphic distributions of the Permian bryozoans in the Abadeh region are shown in Table 1. Fifteen species in seven genera, including four new and one indeterminable species were discriminated. Of eleven known species, five have been reported originally from Armenian Dzhulfa, three species from Pamir, two species from the Russian platform and Salt Range, and one from Kashmir, South China and Timor.

Table 1. Biostratigraphic distribution of the bryozoans in the Abadeh sections.
(Columnar section was compiled by the Research Group)



Species	Base	D-16	D-17	C-O	C-11	C-12-13	C-13	C-15	Section A	Section H	Section J
Fistulipora elegantula NIKIFOROVA											X
Fistulipora pseudomonticulosa SAKAGAMI, n. sp.									X		
Eridopora cf. *parasitica* (WAAGEN and WENTZEL)				X							
Hexagonella tortuosa WAAGEN and WENTZEL	X										
Stenopora? n. sp.				X							
Araxopora araxensis MOROZOVA		X									
Septopora tarazi SAKAGAMI, n. sp.		X									
Septopora lineata NIKIFOROVA				X							
Polypora tubulosa NIKIFOROVA		X	X	X							
Polypora soyanensis MOROZOVA					X	X	X				
Polypora abadehensis SAKAGAMI, n. sp.						X	X				
Polypora magnicava MOROZOVA							X				
Polypora striata SAKAGAMI, n. sp.								X			
Polypora aff. *darashamensis* NIKIFOROVA								X			
Polypora? sp. indet.											X

Some of the present specimens are identical with the original specimen of *Hexagonella tortuosa* WAAGEN and WENTZEL which was described from the Middle Productus Limestone of the Trans-Indus, Pakistan. *Araxopora araxensis* NIKIFOROVA was originally described from the Gnishik to Khachik of Armenian Dzhulfa. Recently it was reported also from the Permian of Sainbeyli, Turkey by SAKAGAMI (1976). Further, according to MOROZOVA (1970), *Stenodiscus granularis* YANG from the Permian of China may be identical with *A. araxensis*. *Polypora tubulosa* NIKIFOROVA and *Septopora lineata* NIKIFOROVA were both described originally from the Gnishik of Armenian Dzhulfa and the former species also from the Permian of Sainbeyli, Turkey by SAKAGAMI (1976). *Eridopora parasitica* (WAAGEN and WENTZEL) was described originally from the Middle Productus Limestone. I am of the opinion that *Eridopora major* BASSLER from Timor may be synonymous with *E. parasitica*. *Stenopora?* n. sp. coincides with *S.? kashmirensis* SAKAGAMI (1980, MS) from the lower part of the Zewan Formation of Kashmir. Thus it is noted that all of the bryozoan species from C-O horizon of the lower part of Unit-4 have been hitherto known from the Pre- Abadehian. However, this unit contains *Codonofusiella* and *Reichelina*, which characterize the Abadehian age as shown in Table 1 that was compiled by our Research Group (MS). *Polypora soyanensis* MOROZOVA and *Polypora magnicava* MOROZOVA were both described originally

from the lower Kazanian of the Russian platform, USSR. According to MOROZOVA (1970), the Kazanian of the Russian platform can be correlated to the Khachik of Armenian Dzhulfa. Among two bryozoan species from the C-15 horizon of Unit-4, one is thought to be an *affinis* of *Polypora darashamensis*, which was described originally from the lower Dzhulfian of Armenian Dzhulfa, and the other is a new species: *P. striata*. Accordingly the geological age of this horizon can not be decided certainly. From Unit-5, any bryozoan remains have not been found. The occurrence of *Fistulipora elegantula* NIKIFOROVA, which has been known from the Lower Dzhulfian of Armenian Dzhulfa, ensures that Unit-6 in the Section H can be correlated to the lower Dzhulfian. According to MOROZOVA (1970), this species may be identical with *Dybowskiella sinensis* YANG and LOO which was described from the upper part of the Nuoyinhé Formation (Upper Permian) of Qilianshan, North China. The other two species: *Fistulipora pseudomonticulosa* and *Polypora* sp. were collected from the lower Dzhulfian of the Sections H and J, respectively.

Description of Species

Genus *Fistulipora* McCOY, 1850

Fistulipora elegantula NIKIFOROVA

Pl. 31, Figs. 1-3.

1933. *Fistulipora elegantula* NIKIFOROVA, p. 11, 12, pl. 2, figs. 1-9, text-figs. 5, 6.
1962. *Dybowskiella sinensis* YANG and LOO, p. 23, pl. 3, figs. 10, 11.
1970. *Fistulipora elegantula*: MOROZOVA, p. 62, pl. 1, figs. 3, 4.
1975. *Fistulipora elegantula*: GORJUNOVA, p. 44, pl. 1, fig. 4.

In surface specimen, zoarium consisting of straight, cylindrical hollow stem, about 45 mm in length and 13 mm in diameter. Well developed monticules regularly arranged, their intervals about 6 to 7 mm. Zooecial apertures densely distributed without any special regularity except for the flat areas of monticules. Diameter of monticule about 2 mm. Thickness of zoarium ranging from 2.5 to 3.3 mm.

In tangential section, zooecial tube nearly circular with well developed lunarium, the inside longitudinal diameter excluding lunarium 0.303 mm average, ranging from 0.280 to 0.320 mm (12 measurements); outside diameter including lunarium 0.391 mm average, ranging from 0.350 to 0.420 mm (30 measurements); and inside transverse diameter 0.272 mm average, ranging from 0.230 to 0.300 mm (20 measurements); outside diameter 0.452 mm average, ranging from 0.400 to 0.550 mm (30 measurements). Usually 4 to 4.5 zooecia per 2 mm diagonally. Well developed lunarium, typically crescentic shaped in tangential section, usually disposed at proximal part of zooecial margin, occupying about one-fourth of zooecial circumference. Thickness of lunarium including fibrous tissue ranging from 0.050 to 0.070 mm in mature region, thickness of dark line of lunarium about 0.015 mm, length between the tips of lunarium ranging from 0.200 to 0.230 mm. Vesicular tissue regularly arranged, usually one vesicle between adjacent zooecia near surface, but one to three in inner section, 7 to 9 vesicles per mm diagonally.

In longitudinal section, zooecial tubes run for a short distance along coenelasma, but curve gradually upward, making a right angle in mature region. Diaphragms thin, nearly straight or slightly concave, usually 5 to 6 diaphragms countable in a tube. Interspaces between diaphragms usually 0.200 to 0.250 mm, but 0.500 to 0.750 mm in middle part of tube. Interzooecial tissue consisting of regularly

arranged vesicular tissue which is quadrate but seems to be depressed in outer zone. 9 to 11 vesicles in inner zone, but 13 to 16 in outer zone per mm longitudinally.

Remarks.—Conspicuously developed lunarium with very sharp and juted tips, and regularly arranged vesicular tissue are characteristic of *Fistulipora elegantula.* The present specimen agrees with *Fistulipora elegantula* which was originally described by NIKIFOROVA (1933) from the Permian of the Djhulfa region. Later MOROZOVA (1965 in RUZHENCHEV and SARYCHEVA; 1970) revised it and made the horizon of its occurrence clear, that is the lower Dzhulfian (the *Araxilevis* horizon). The present species was also described from the Pamirian (Upper Permian) of Southwestern Darvaz of Pamir by GORJUNOVA (1975).

Horizon and Specimen no.—The *Araxilevis* horizon of Section H. Reg. nos. DESC-80001, DESC-80002 and DESC-80003.

Fistulipora pseudomonticulosa
SAKAGAMI, n. sp.

Pl. 31, Figs. 4-6.

In surface specimen, zoarium consisting of straight, subcylindrical hollow stem, more than 70 mm in length and 10 to 12 mm in diameter. Monticules more or less regularly arranged in space of 6 to 9 mm. Zooecial apertures densely distributed without any special regularities except for the flat areas of monticules. Thickness of zoarium ranging from 1.0 to 1.5 mm.

In tangential section, zooecial tube subcircular or ovate. Its inside longitudinal diameter excluding lunarium 0.339 mm average, ranging from 0.290 to 0.390 mm; outside diameter including lunarium 0.364 mm average, ranging from 0.310 to 0.410 mm (25 measurements) and inside transverse diameter 0.191 mm average, ranging from 0.170 to 0.210 mm; outside diameter 0.269 mm average, ranging from 0.240 to 0.310 mm (25 measurements). Usually 4 to 5 zooecia per 2 mm diagonally. Thin lunarium disposed at proximal part of zooecial margin, occupying about one-fourth of zooecial circumference, its thickness about 0.010 to 0.020 mm. Vesicular tissue rather coarse and regular in size, usually one occasionally two or three vesicles between adjacent zooecia, and 6 to 8 vesicles per mm diagonally.

In longitudinal section, zooecial tubes run for nearly parallel direction to coenelasma, curve gradually upward, making a large angle to surface. Usually three diaphragms disposed in lower to middle part of a zooecial tube. Interzooecial tissue consisting of regularly arranged vesicular tissue which is quadrate but in some cases depressed. About 10 vesicles per mm longitudinally.

Remarks.—The present new species is not unlike *Fistulipora monticulosa* NIKIFOROVA which was known from the lower Dzhulfian of Trans-Caucasia in the general appearance, and especially it is similar to the specimen illustrated by MOROZOVA (1970, fig. 2 of plate I). However, the present species differs from *F. monticulosa* by the fewer number of diaphragms, namely, there are usually only 3 diaphragms in a zooecial tube of the present new species but about 10 or more diaphragms in *F. monticulosa.*

Horizon and Specimen no.—The *Araxilevis* horizon of Section A. Reg. nos. DESC-80004 (holotype), DESC-80005 and DESC-80006.

Genus *Eridopora* BASSLER, 1929

Eridopora cf. *parasitica* (WAAGEN and WENTZEL)

Pl. 31, Figs. 7-9.

Compare :—

1886. *Fistulipora parasitica* WAAGEN and WENTZEL, p. 923, 924, pl. 45, fig. 6; pl. 105, figs. 1-4.
1929. *Eridopora major* BASSLER, p. 52, pl. 225, figs. 1-4.
1975. *Eridopora major*: GORJUNOVA, p. 45, 46, pl. 3, fig. 1.

Zoarium incrusted on the obverse surface of *Septopora lineata* and *Polypora tubulosa*, and composed of relatively thick layer, varying from 2 to 2.5 mm in thickness. Surface of the zoarium could not be observed.

In tangential section, zooecial tube roundly triangular with moderately developed lunarium. Its inside longitudinal diameter excluding lunarium 0.416 mm average, ranging from 0.360 to 0.460 mm (23 measurements) in outer part of zooecial tube, 0.316 mm average, ranging from 0.280 to 0.360 mm (20 measurements) in the inner part; and inside transverse diameter 0.351 mm average, ranging from 0.300 to 0.400 mm (23 measurements) in outer part of zooecial tube, 0.313 mm average, ranging from 0.290 to 0.350 mm (20 measurements) in the inner part. Usually 4 to 4.5 zooecia, but 4.5 to 5 in inner part, per 2 mm diagonally. V-shaped lunarium disposed at proximal end of zooecial tube. The thickest part of lunarium measured 0.052 mm average, ranging from 0.040 to 0.070 mm (23 measurements) in outer part of zooecial tube, but very thin in inner part. In the opposite side of lunarium in a tube, a pair of small projections occasionally visible. Vesicular tissue not so regularly in size and arrangement, usually one to two vesicles between adjacent zooecia in outer part, but two to three in inner part, and 8 to 10 vesicles per mm diagonally.

In longitudinal section, zooecial tubes run for a short distance along coenelasma, but curve rather rapidly upward, grow straightly and making a right angle in mature region. Many diaphragms disposed throughout tube. Interval between diaphragms usually 0.100 to 0.250 mm. There are 6 to 8 diaphragms in inner part of tube, but not any diaphragms in about 0.5 mm of outer part of tube. Interzooecial tissue consisting of not so regularly arranged vesicular tissue and depressed quadrate in form. About 9 to 11 vesicles per mm longitudinally.

Remarks.—The present species is characterized by the subtriangular zooecial aperture with lunarium developed at the posterior end of aperture in tangential section. These characters show that the present species belongs to *Eridopora*. Further, the most conspicuous character of the present species is the existence of a pair of small projections at the opposite side of lunarium in the tangential section of tube. BASSLER (1929) recognized it as a lunarium in the illustration of *Fistulipora parasitica* by WAAGEN and WENTZEL (1886), and he distinguished *Eridopora major* from *F. parasitica* by the difference of the mode of lunaria. However, in the illustration of *E. major* by BASSLER (1929), the small but distinct projections disposed at the opposite side of lunarium can be observed. Therefore, *Eridopora major* may be a junior synonym of *E. parasitica*. *E. major* was recently described also from the upper part of the Lower Permian of Central Pamir by GORJUNOVA (1975).

Horizon and Specimen no.—C-O bed of Unit-4 in Section C. Reg. nos. DESC-80007, DESC-80008a and DESC-80009a.

Genus *Hexagonella* WAAGEN and WENTZEL, 1886

Hexagonella tortuosa WAAGEN and WENTZEL

Pl. 31, Figs. 10-12.

1886. *Hexagonella tortuosa* WAAGEN and WENTZEL, p. 914, 915, pl. 108, figs. 1, 3-5.

Zoarial surface not observed. Zoarium bifoliate, consisting probably of subcylindrical branch. In tangential section near surface, the lines of hexagonellid ridges consisting of polygonal areas but not regular pattern can be observed. Thickness of zoarium 6 to 7 mm.

In tangential section, zooecial tube nearly circular to oval, their inside diameter 0.195 mm average, ranging from 0.160 to 0.270 mm (200 measurements on two sections), usually 4.5 to 5 zooecia per 2 mm diagonally. Vesicular tissue irregular in shape and size in inner zone, usually one to three vesicles between adjacent zooecia, but undeveloped in outer zone because it is filled with thin fibrous tissue. Usually 7 to 9 vesicles per mm horizontally. Lunarium usually absent but occasionally developed weakly, occupying about one third of zooecial circumference, the thickness very thin.

In longitudinal section, zooecial tubes proximally parallel to mesotheca for a very short distance, then curve upward, making a right angle with outer surface of zoarium. Diaphragms usually one to two times of zooecial diameter, irregularly spaced, 5 to 7 per 2 mm length of zooecial tube. Vesicular tissue relatively coarse and irregular in form, size and arrangement in immature region, but more depressed, rectangular or rounded quadrate and regularly arranged in longitudinal series in middle region, but becoming relatively coarse again in mature region, 10 to 12 vesicles in the middle. Vesicular tissue replaced by dense lamellar tissue near surface.

Remarks.—Although some thin sections made from only one zoarium were examined, the present form can be easily identified with *Hexagonella tortuosa* WAAGEN and WENTZEL which was originally described from the middle division of Productus Limestone at Bilot and Gulámi of the Trans-Indus of Pakistan. The present species can be distinguished from *Hexagonella ramosa* by the different mode of growth and the more irregular network of hexagonellid ridge.

Horizon and Specimen no.—Base of Unit-3. Reg. nos. DESC-80010, DESC-80011 and DESC-80012.

Table 2. Measurements of *Stenopora?*

Specimen no.	80013	80014	80015a
Orientation of section	L	Tr	L
Diameter of zoarium	5.0	5.5	5.0
Diameter of immature zone	2.2	2.0	2.0
Thickness of mature zone	1.3-1.5	1.6-1.9	1.5-1.6
Diameter of zooecium (shorter)	0.160-0.240	—	0.200-0.260
Diameter of zooecium (longer)	0.160-0.310	—	0.200-0.300
Diameter of mesoecium (shorter)	0.030-0.070	—	0.040-0.080
Diameter of acanthoecium (outer)	less than 0.030	—	?
No. of zooecia per 2 mm longitudinally	ca. 6-7		ca. 6

L: longitudinal section, Tr: transverse section, T: tangential section, Ob: oblique section.

Genus *Stenopora* LONSDALE, 1844

Stenopora? n. sp.

Pl. 32, Figs. 1, 2.

1980. *Stenopora? kashmirensis* SAKAGAMI (MS)

Among more than ten thin sections of zoaria, seven sections were examined. Zoaria consisting of cylindrical stems, rarely branched, ranging from 4.0 to 5.5 mm in diameter. Diameter of immature zone 2.0 to 2.5 mm and length of mature tube ranging from 0.8 to 1.9 mm. Ratio of half diameter of zoarium to thickness of mature zone varying from 1.3 : 1 to 2.5 : 1 measured on seven specimens.

In tangential section, zooecial tube nearly circular or rounded polygonal in mature region. Diameter of zooecial tube measured along transverse direction ranging from 0.160 to 0.280 mm and another diameter measured along longitudinal direction ranging from 0.160 to 0.310 mm. Zooecial apertures may be arranged without special regularities. Mesoecia rarely present, rounded, oval or rounded polygonal, the shorter diameter varying from 0.030 to 0.100 mm. In mature region, thick walls of adjacent zooecial tubes separated by a dark divisional wall. Small acanthoecia usually disposed at each point of intersection of zooecial tube, the outer diameter less than 0.030 mm and the central pore is extremely small.

In longitudinal section, zooecial tubes trend parallel to longitudinal direction of zoarium in inner region, curve more rapidly outward at boundary between inner and outer regions of zooecial tube and making nearly right angle with surface. Zooecial wall thin in inner region, but making rapidly thick in outer region. No diaphragm but usually one superior hemiseptum, occasionally two, well developed at the boundary between inner and outer regions of zooecial tube.

In transverse section, inner part of zooecial tube polygonal with very thin zooecial wall. Other characters in this section can also be observed in longitudinal section.

Measurements.—See Table 2.

Remarks.—The present form is identical with *S.? kashmirensis* SAKAGAMI (MS) from the lower part of Zewan Formation of Kashmir, India in the essential characters, but the diameters of zoaria and zooecia of the present form are both slightly larger than those of the Kashmir specimen.

kashmirensis SAKAGAMI (in mm).

80015b	80016a	80016b	80017
Ob(L)	L, T	L, T	Tr
5.0	5.5	4.0	5.2
2.2	2.0-2.2	2.3	2.5
1.4-1.5	1.5-1.8	0.8-0.9	1.2-1.4
0.180-0.270	0.170-0.280	0.160-0.280	0.170-0.260
0.180-0.300	0.180-0.300	0.180-0.300	—
0.050-0.100	0.040-0.100	0.040-0.100	—
less than 0.030	less than 0.030	less than 0.030	—
5-6	5-6	5-6	

Horizon and Specimen no.—C-O bed of Unit-4 in Section C. Reg. nos. DESC-80013, DESC-80014, DESC-80015a, b, DESC-80016a, b and DESC-80017.

Genus *Araxopora* MOROZOVA, 1965

Araxopora araxensis (NIKIFOROVA)

Pl. 32, Figs. 3-5.

1933. *Batostomella spinigera* var. *araxensis* NIKIFOROVA, p. 13, 14, 36, pl. 4, figs. 1-4.
1958. *Stenodiscus granularis* YANG, p. 133, 134, pl. 11, figs. 2-8.
1965. *Araxopora araxensis*: MOROZOVA, p. 186, pl. 25, figs. 4, 5, pl. 26, fig. 5, text-fig. 20.
1975. *Araxopora araxensis*: GORJUNOVA, p. 59, pl. 9, fig. 3.
1976. *Araxopora araxensis*: SAKAGAMI, p. 402, 403, pl. 42, figs. 8-11.

Two typically longitudinal, one tangential and one oblique sections were examined. Zoarium consisting of straight, cylindrical stem, 5.3 mm in diameter. All of inner region obliterated by the secondary alteration.

In longitudinal section, zooecial tubes may run parallel to longitudinal direction of zoarium in inner part, but rapidly bend at the inner edges of mature region, and go straight throughout mature region reaching the surface at an angle of about 90°. Length of zooecial tube of mature region ranging from 0.9 to 1.1 mm. Zooecial wall very thin in immature region but becoming thick rapidly and consisting of dark, coarse, laminated fibrous tissue in mature region. Diaphragm disposed at outer edge of immature tube and one to two, occasionally three in mature tube.

In tangential section, zooecial tube oval in mature region but irregularly polygonal in the nearest part to surface. Zooecial diameters at the middle level of mature tube, one measured along horizontal (shorter) direction 0.156 mm average, ranging from 0.110 to 0.200 mm (50 measurements) and another measured along longitudinal (longer) direction 0.245 mm average, ranging from 0.200 to 0.300 mm (50 measurements). Zooecial apertures arranged longitudinally but not so regularly. Mesoecia irregularly arranged, oval to somewhat irregular in form, variable in size, 0.070 mm average, ranging from 0.030 to 0.110 mm (15 measurements). Usually 8 to 12 zooecial apertures and 5 to 8 mesoecia in a field of one sq. mm. Acanthoecia present, 5 to 8 in one sq. mm, its inside diameter ranging from 0.010 to 0.030 mm.

Table 3. Measurements of *Araxopora araxensis* (NIKIFOROVA) (in mm).

Specimen no.	80018	80019	80020
Orientation of zoarium	L(T)	L(T)	T
Diameter of zoarium	5.3	5.3	—
Diameter of inner region	3.5	3.5	—
Thickness of outer region	0.9-1.1	0.9-1.1	
Diameter of zooecia (shorter)	0.110-0.180	0.140-0.200	0.110-0.200
Diameter of zooecia (longer)	—	—	0.200-0.300
Inner diameter of mesoecium	0.030-0.090	0.040-0.110	0.040-0.110
Outside diameter of acanthoecium	—	0.050-0.100	0.050-0.120
Inner diameter of acanthoecium	—	0.010-0.030	0.010-0.030

Measurements.—See Table 3.

Remarks.—Owing to the very thin immature wall, the inner zone of zoarium of the present species is obliterated in many occasions. The present form is identical not only with the originally described specimen from Armenian Dzhulfa of Trans-Caucasia but also with the Turkish specimens, which was recently described by SAKAGAMI (1976), in all of the essential characters. The present species was also described from the Murgavskian (the middle part of Upper Permian) of southeastern Pamir by GORJUNOVA (1975). Detailed comparisons between the specimens hitherto described were discussed by SAKAGAMI (1976).

Horizon and Specimen no.—D-16 bed of Unit-3 in Section D. Reg. nos. DESC-80018, DESC-80019, DESC-80020 and 80039.

Genus *Polypora* McCOY, 1844

Polypora tubulosa NIKIFOROVA

Pl. 32, Fig. 7.

1933. *Polypora tubulosa* NIKIFOROVA, p. 15, 20-22; 37, 38, pl. 3, figs. 1-6, pl. 4, figs. 1-3.
1970. *Polypora tubulosa*: MOROZOVA, p. 213, 216, pl. 49, figs. 3, 4.
1976. *Polypora tubulosa*: SAKAGAMI, p. 403-405, pl. 42, fig. 5.

Three tangential sections of zoaria were examined. Zoarium expanded laterally, may be fan shaped. Straight branches connected by dissepiments at regular intervals ranging from 1.000 to 1.200 mm measured from center to center of dissepiments. Bifurcation of branch not frequent. Width of branch wider than that of fenestrule, ranging from 0.550 to 0.750 mm, after bifurcation about 0.350 mm, before bifurcation about 0.900 mm, usually 8 to 11 branches per 10 mm horizontally. Intervals between branches ranging from 0.875 to 1.250 mm measured from center to center of branches. Fenestrule elongated elliptical in outline, width usually ranging from 0.375 to 0.500 mm, occasionally 0.625 mm, length ranging from 0.625 to 0.750 mm, 9 to 10 fenestrules per 10 mm length of branch. Dissepiment narrower than that of branch, width ranging from 0.300 to 0.650 mm. Zooecial tubes arranged usually in 4 to 5 intersecting longitudinal rows, but 3 rows in short distance after bifurcation and 6 rows at just before bifurcation. In tangential section, zooecial tube hexagonal, rhomboidal or somewhat irregularly formed at lower and middle levels of branch, and circular at upper level. Zooecial diameter near surface ranging from 0.100 to 0.120 mm. Zooecial apertures 14 to 18 per 5 mm length of one row, usually 4 apertures per fenestrule. Interval between zooecial apertures in longitudinal series from center to center ranging from 0.250 to 0.380 mm. Nodes may be disposed at each intersection of zooecial apertures but indistinct. Interzooecial materials consisting of dark, very fine fibrous tissue with closely arranged fine granules. Stereom covering the reverse side consisting of inner tissue with 3 to 5 prominent capillary canals on which large capillaries regularly arranged in longitudinal series, 10 to 12 per mm length of one row, and outer thick, dark, fine fibrous tissue with very fine granules.

Meshwork formula.—8-11/9-10//14-18/4(3-6).

Measurements.—See Table 4.

Remarks.—The most conspicuous characteristic of *Polypora tubulosa* is in having the very prominent capillary canals. The present form agrees well with the original specimen in all the essential characters. *Polypora tubulosa* was originally described by NIKIFOROVA (1933)

Table 4. Measurements of *Polypora tubulosa* NIKIFOROVA (in mm).

Specimen no.	80021	80022	80008b
No. of branches per 10 mm horizontally	8-10	10-11	9-11
No. of fenestrules per 10 mm length	9-10	9-10	9-10
No. of zooecia per 5 mm length	15-16	16-18	14-16
No. of rows of zooecia	4(3-5)	4-5(3-6)	3-4
No. of zooecia per fenestrule	3-4	4	3-4
Width of branch	0.625-0.875	0.550-0.600 (0.350-0.900)	0.600-0.750
Interval between branches (center to center)	1.125-1.250	1.000-1.075	0.875-1.250
Interval between dissepiments (c. to c.)	1.025-1.125	1.000-1.200	1.000-1.200
Width of dissepiment	0.375-0.500	0.300-0.350	0.375-0.650
Diameter of zooecia near surface	0.100-0.120	0.100-0.110	0.100-0.120
Distance between zooecia (c. to c.)	0.300-0.380	0.250-0.280	0.320-0.380
Distance between nodes (c. to c.)	—	ca. 0.025	—

from the "Upper Carboniferous" of Armenian Dzhulfa, but later MOROZOVA (1965, 1970) revised it as an Upper Permian Dzhulfian species.

Horizon and Specimen no.—D-16 and D-17 beds of Unit-3, and C-O bed of Unit-4 in Sections D and C. Reg. nos. DESC-80021, DESC-80022, DESC-80008b and DESC-80009b.

Polypora soyanensis MOROZOVA

Pl. 32, Fig. 6.

1970. *Polypora soyanensis* MOROZOVA, p. 211, 212, pl. 48, figs. 3, pl. 49, fig. 2.

Five tangential sections of fragmentary zoaria were examined. Straight branches nearly parallel to each other, connected by dissepiments at regular intervals ranging from 0.875 to 1.250 mm measured from center to center of dissepiments. Bifurcation of branch very rare. Width of branch wider than that of fenestrule,

Table 5. Measurements of *Polypora*

Specimen no.	80023	80024b
No. of branches per 10 mm horizontally	14-16	14
No. of fenestrules per 10 mm length	9-10	10
No. of zooecia per 5 mm length	18-19	19?
No. of rows of zooecia	3-4	4
No. of zooecia per fenestrule	4	4
Width of branch	0.350-0.500	0.375-0.450
Interval between branches (center to center)	0.625-0.875	0.625-0.750
Interval between dissepiments (c. to c.)	1.000-1.100	0.950-1.000
Width of dissepiment	0.375-0.500	0.300-0.350
Diameter of zooecia near surface	0.090-0.100	0.090-0.100
Distance between zooecia (c. to c.)	0.250-0.325	0.250-0.300

ranging from 0.300 to 0.500 mm, usually 13 to 16 branches per 10 mm horizontally. Interval between branches ranging from 0.500 to 0.750 mm measured from center to center of branches. Fenestrule elongated elliptical in outline, width ranging from 0.160 to 0.475 mm, length ranging from 0.625 to 0.950 mm and 8 to 10 fenestrules per 10 mm length of branch measured on 4 specimens. Dissepiment relatively wide but narrower than that of branch, ranging from 0.275 to 0.500 mm in width. Zooecial tubes arranged usually in 3, occasionally 4 intersecting longitudinal rows. In tangential section, zooecial tubes hexagonal or rhomboidal except for the both sides whose tubes are pentagonal or triangular at lower to middle levels of branch. Zooecial tubes near surface circular, ranging from 0.080 to 0.100 mm in diameter. 18 to 20 zooecial apertures arranged per 5 mm length of one row, usually 4 apertures per fenestrule. Interval between zooecial apertures in longitudinal series from center to center ranging from 0.250 to 0.350 mm. Stereom covering the reverse side consisting of inner tissue with 6 to 8 prominent capillary canals on which capillaries are not developed, and outer fine grained fibrous tissue.

Meshwork formula.—13-16/8-10//18-20/3(4).

Measurements.—See Table 5.

Remarks.—The present species is nearest to *Polypora magnicava* MOROZOVA in the essential characters. The differences between these two species will be discussed in the description of *P. magnicava*.

Horizon and Specimen no.—C-11, C-12-13 and C-13 beds of Unit-4 in Section C. Reg. nos. DESC-80023, DESC-80024b, DESC-80025, DESC-80026 and DESC-80027b.

Polypora magnicava MOROZOVA

Pl. 32, Fig. 8.

1970. *Polypora magnicava* MOROZOVA, p. 210, pl. 49, fig. 1.

A single tangential section of fragmentary zoarium was examined. Branches usually straight, connected by dissepiment at regular intervals ranging from 0.875 to 1.000 mm measured from center to center of dissepiments, but occasionally slightly zigzag and anastomosing. Width

soyanensis MOROZOVA (in mm).

80025	80026	80027b
ca. 14	18	16-17
9.5-10	10	8-9
18-20	19-21	18-20
3-4	3-5	3-4
4	4	4
0.375-0.450	0.375-0.425 (0.300-0.500)	0.300-0.375
0.575-0.875	0.500-0.625	0.500-0.750
1.000-1.125	1.000-1.100	1.125-1.250
0.250-0.300	0.325-0.450	0.250-0.325
0.080-0.090	0.080-0.100	0.080-0.100
0.250-0.300	0.250-0.280	0.250-0.350

of branch as wide as that of fenestrule, ranging from 0.300 to 0.400 mm, usually 12 to 16 branches per 10 mm, horizontally. Interval between branches ranging from 0.550 to 0.800 mm measured from center to center of branches. Fenestrule irregularly elongated elliptical or rectangular with rounded corners, width ranging from 0.250 to 0.475 mm, length ranging from 0.880 to 0.950 mm and 10 fenestrules per 10 mm length of branch. Dissepiment rather weak, ranging from 0.150 mm to 0.250 mm in width. Zooecial tubes arranged usually in 3, occasionally 3 weakly intersected longitudinal rows in a branch. In tangential section, zooecial tubes rounded triangular in both sides and rounded rhomboidal in central row at lower level of branch, becoming kidney shaped to circular at middle to upper levels, 0.100 to 0.125 mm in diameter near surface. Zooecial apertures 18 to 20 per 5 mm length of one row, usually 4 apertures per fenestrule. Interval between zooecial apertures in longitudinal series from center to center 0.250 to 0.300 mm. Stereom covering the reverse side consisting of inner thin tissue with relatively fine striations and outer darker tissue with fine granules of about 0.003 mm in diameter.

Meshwork formula.—12-16/10//18-20/3(3).

Measurements.—See Table 6.

Remarks.—The present form is identical with the original specimen which was described from the lower Kazanian of the Russian platform except that the numbers of branches per 10 mm horizontally is 12 to 16 in the present form instead of 10 in the Russian specimen. As MOROZOVA (1970) pointed out, the present species resembles *Polypora soyanensis* MOROZOVA which occurs in association with the present species in the Russian platform and also in the present locality. *P. magnicava* can be distinguished from *P. soyanensis* by the larger fenestrule, narrower dissepiment, larger zooecial aperture and in the shape of zooecial tube in tangential section.

Horizon and Specimen no.—C-13 bed of Unit-3 in Section C. Reg. no. DESC-80027a.

Polypora abadehensis SAKAGAMI, n. sp.

Pl. 33, Fig. 1.

Four tangential sections of zoaria were examined. Straight branches connected

Table 6. Measurements of *Polypora magnicava* MOROZOVA (in mm).

Specimen no.	80027a
No. of branches per 10 mm horizontally	ca. 16
No. of fenestrules per 10 mm length	10
No. of zooecia per 5 mm length	20
No. of rows of zooecia	3-4
No. of zooecia per fenestrule	4(5)
Width of branch	0.300-0.350
Interval between branches (center to center)	0.550-0.800
Interval between dissepiments (c. to c.)	0.875-1.000
Width of dissepiment	0.200-0.300
Diameter of zooecia near surface	0.090-0.100
Distance between zooecia (c. to c.)	0.250-0.300

by dissepiments at regular intervals, ranging from 0.875 to 1.150 mm measured from center to center of dissepiments. Interval between branches from center to center 0.750 to 1.000 mm. Bifurcation of branch infrequent. Width of branch wider than that of fenestrule, ranging from 0.375 to 0.625 mm, 10 to 13 branches per 10 mm horizontally. Fenestrule elongated elliptical in outline, width ranging from 0.250 to 0.450 mm, length ranging from 0.500 to 0.825 mm, 9 to 12 per 10 mm length of branch. Dissepiment strong, width ranging from 0.325 to 0.500 mm. Zooecial tube arranged usually in 5 intersecting longitudinal rows, but 4 rows after bifurcation and 6 rows before bifurcation in a short distance. In tangential section, zooecial tubes rhomboidal or elongated hexagonal at lower to middle levels of branch, and circular near surface, separated by a nearly straight line, ranging from 0.090 to 0.110 mm in diameter. Zooecial apertures 17 to 20 per 5 mm length of one row, almost perfectly stabilized in position of aperture in relation to dissepiments, 4 apertures per fenestrule. Interval between zooecial apertures in longitudinal series from center to center ranging from 0.220 to 0.320 mm. Stereom covering the reverse side consisting of inner tissue 4 to 6 prominent capillary canals on which any capillaries can not be observed, and outer fibrous tissue with coarse granules.

Meshwork formula.—10-13/9-12//17-20/5(4-6).

Measurements.—See Table 7.

Remarks.—The present new species is not unlike *Polypora darashamensis* NIKIFOROVA which was described originally as a variety of *Polypora timorensis* BASSLER from the Permian of Armenian Dzhulfa in the general appearance, but the present species differs from *P. darashamensis* in the meshwork formula. According to MOROZOVA (1970), the meshwork formula of *P. darashamensis* is 8-11/5-6//14-15/4(3-6).

Horizon and Specimen no.—C-12-13 and C-13 beds of Unit-4 in Section C. Reg. nos. DESC-80024a, DESC-80028 (holotype), DESC-80029 and DESC-80030.

Table 7. Measurements of *Polypora abadehensis* SAKAGAMI, n. sp. (in mm).

Specimen no.	80024a	80028	80029	80030
No. of branches per 10 mm horizontally	10	12-13	12	ca. 11
No. of fenestrules per 10 mm length	9-11	10	9	11-12
No. of zooecia per 5 mm length	20	17-19	18-20	18-19
No. of nodes per 5 mm length	—	—	—	18
No. of rows of zooecia	5(6)	3-5	5	4(3-6)
No. of zooecia per fenestrule	4	4	4	4
Width of branch	0.550(0.675)	0.450-0.550	0.500-0.625	0.375-0.475
Interval between branches (center to center)	0.875-1.000	0.750-0.950	0.750-0.900	0.700-1.000
Interval between dissepiments (c. to c.)	0.875-1.125	0.950-1.125	1.050-1.150	0.875-1.000
Width of dissepiment	0.325-0.350	0.325-0.350	0.450-0.500	0.325-0.375
Diameter of zooecia near surface	0.100-0.110	0.100-0.110	0.090-0.110	0.100-0.110
Distance between zooecia (c. to c.)	0.250-0.300	0.270-0.320	0.250-0.300	0.220-0.280

Polypora aff. *darashamensis* NIKIFOROVA

Pl. 32, Fig. 9.

Compare.—

1933. *Polypora timorensis* var. *darashamensis* NIKIFOROVA, p. 22-24, 38, pl. 4, figs. 1-4.

1970. *Polypora darashamensis*: MOROZOVA, p. 219, 220, pl. 51, fig. 1.

Two tangential sections of fragmentary zoaria were examined. Straight branches connected by dissepiments at regular intervals, 1.300 to 1.400 mm measured from center to center of dissepiments. Interval between branches from center to center ranging from 0.625 to 1.375 mm. Bifurcation of branch not observed. Width of branch almost as wide as that of fenestrule, usually ranging from 0.400 to 0.550 mm, 8 to 11 branches per 10 mm horizontally. Fenestrule elongated elliptical in outline, width ranging from 0.250 to 0.750 mm, length ranging from 0.800 to 1.125 mm and about 7.5 per 10 mm length of branch. Dissepiments not so strong, ranging from 0.375 to 0.475 mm in width. Zooecial tubes arranged normally in 4 to 5 intersecting longitudinal rows. In tangential section, zooecial tubes rhomboidal at lower and middle levels of branch, and circular near surface, separated by a fine wavy line, ranging from 0.100 to 0.120 mm in diameter. Zooecial apertures 15 to 16 per 5 mm length of one row, usually 5 apertures per fenestrule. Interval between zooecial apertures in longitudinal section from center to center 0.300 to 0.350 mm. Stereom covering the reverse side consisting of inner tissue with 6 to 7 prominent capillary canals and outer fibrous tissue with very small granules.

Meshwork formula.—8-11/7.5//15-16/4-5.

Measurements.—See Table 8.

Remarks.—Although *Polypora darashamensis* was originally described from the Permian of Armenian Dzhulfa by NIKIFOROVA (1933), all of the illustrations were only those of surface specimens. Later, MOROZOVA (1970) revised this species and made clear that its geological range is from the Dzhulfian up to the Lower Triassic.

The present form is nearest to *P. darashamensis* in the general appearance, but slight differences in the meshwork between them are recognized, especially in the numbers of zooecial rows: usually 5 in the present species instead of usually

Table 8. Measurements of *Polypora* aff. *darashamensis* NIKIFOROVA (in mm).

Specimen no.	80031b	80032
No. of branches per 10 mm horizontally	11	8
No. of fenestrules per 10 mm length	ca. 7.5	ca. 7.5
No. of zooecia per 5 mm length	15-16	15-16
No. of rows of zooecia	3-5	4 (3-6)
No. of zooecia per fenestrule	5	5
Width of branch	0.400-0.550	0.500-0.550
Interval between branches (center to center)	0.625-1.050	1.125-1.375
Interval between dissepiments (c. to c.)	1.300-1.400	1.375
Width of dissepiment	0.375-0.475	0.375
Diameter of zooecia near surface	0.110-0.120	0.100-0.110
Distance between zooecia (c. to c.)	0.300-0.350	0.300-0.350

4 in *P. darashamensis*.

Horizon and Specimen no.—C-15 bed of Unit-4 in Section C. Reg. nos. DESC-80031b and DESC-80032.

Polypora striata SAKAGAMI, n. sp.

Pl. 33, Fig. 2.

Two tangential sections of fragmentary zoaria were examined. Straight branches connected by very strong dissepiments at regular interval, ranging from 1.250 to 1.500 mm measured from center to center of dissepiments. Bifurcation of branch infrequent. Width of branch wider than that of fenestrule, usually ranging from 0.500 to 0.750 mm, 8 to 10 branches per 10 mm horizontally. Fenestrule slightly elongated elliptical in outline, width ranging from 0.375 to 0.625 mm, length ranging from 0.550 to 1.075 mm, about 8 per 10 mm length of branch. Dissepiment ranging from 0.500 to 0.750 mm in width. Zooecial tubes arranged usually in 5 intersecting longitudinal rows. In tangential section, zooecial tubes of the central three rows rhomboidal and those of both sides pentagonal or hexagonal at middle level of branch, and circular near surface, ranging from 0.110 to 0.130 mm in diameter. Zooecial apertures usually 18 per 5 mm length of one row, usually 5, occasionally 6 apertures per fenestrule. Intervals between zooecial apertures from center to center ranging from 0.250 to 0.300 mm. Stereom covering the reverse side consisting of inner tissue with 7 to 8 strongly developed capillary canals and outer tissue with very coarse fibrous striations and fine granules.

Meshwork formula.—8-10/8//18/5.

Measurements.—See Table 9.

Remarks.—The most conspicuous character of the present new species is the presence of the outer tissue with very remarkable, fibrous striations and fine granules. In the meshwork formula it is near to the precedently described species: *Polypora darashamensis* NIKIFOROVA.

Horizon and Specimen no.—C-15 bed of Unit-4 in Section C. Reg. no. DESC-80031a (holotype) and DESC-80033.

Polypora? sp. indet.

Pl. 33, Figs. 3, 4.

Two tangential sections of fragmentary zoaria were examined. Zoarium frequen-

Table 9. Measurements of *Polypora striata* SAKAGAMI, n. sp. (in mm).

Specimen no.	80031a	80033
No. of branches per 10 mm horizontally	ca. 9	8-10
No. of fenestrules per 10 mm length	ca. 8	8
No. of zooecia per 5 mm length	18	18(?)
No. of rows of zooecia	4 (occas. 5)	4
No. of zooecia per fenestrule	5-6(?)	5
Width of branch	0.625-0.750	0.500-0.625
Interval between branches (center to center)	0.875-1.125	1.000-1.250
Interval between dissepiments (c. to c.)	1.250-1.500	1.250-1.500
Width of dissepiment	0.625-0.750	0.450-0.500
Diameter of zooecia near surface	0.110-0.130	0.110-0.120
Distance between zooecia (c. to c.)	0.250-0.300	0.250-0.300

Table 10. Measurements of *Polypora* sp. indet. (in mm).

Specimen no.	80034	80035
No of branches per 10 mm horizontally	7-8	7
No. of fenestrules per 10 mm length	5-6	5.5
No. of zooecia per 5 mm length	14-15	15-16
No. of rows of zooecia	5	5
No. of zooecia per fenestrule	5	5-6
Width of branch	0.700-0.800	0.750-0.850
Interval between branches (center to center)	1.125-1.500	1.500-1.625
Interval between dissepiments (c. to c.)	1.875-2.125	1.875-2.125
Width of dissepiment	0.550-0.700	0.600-0.850
Diameter of zooecia near surface	0.120-0.130	0.110-0.130
Distance between zooecia (c. to c.)	0.300-0.400	0.250-0.380

tly bifurcated and expanded laterally may be fan shaped. Nearly straight or weakly zigzag branches anastomosing or connected by very short dissepiments at regular intervals ranging from 1.875 to 2.125 mm measured from center to center of dissepiments. Width of branch almost as wide as that of fenestrule, ranging from 0.700 to 0.850 mm, usually 7 to 8 branches per 10 mm horizontally. Intervals between branches ranging from 1.125 to 1.625 mm measured from center to center of branches. Fenestrule usually elongated elliptical but occasionally irregularly shaped, width ranging from 0.675 to 0.875 mm, length ranging from 1.125 to 1.550 mm, and 5 to 6 fenestrules per 10 mm length of branch. Dissepiment usually nothing but occasionally very short and wide, 0.550 to 0.850 mm in width. Zooecial tubes arranged usually in 5 intersecting longitudinal rows. In tangential section, zooecial tube rhomboidal at lower to middle levels of branch and circular at upper level. Zooecial diameter near surface ranging from 0.110 to 0.130 mm. Zooecial apertures 14 to 16 per 5 mm length of one row, usually 5 to

Explanation of Plate 31

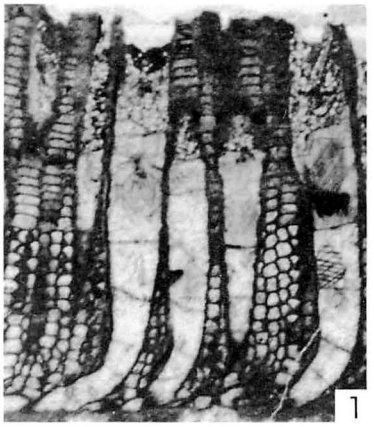
(All figures are in ×20)

Figs. 1-3. *Fistulipora elegantula* NIKIFOROVA
1, longitudinal section of zoarium, DESC-80001. 2, transverse section of zoarium, DESC-80002. 3, tangential section of zoarium, DESC-80003.

Figs. 4-6. *Fistulipora pseudomonticulosa* SAKAGAMI, n. sp.
4, longitudinal section of zoarium, DESC-80004 (holotype). 5, transverse section of zoarium, DESC-80005. 6, tangential section of zoarium, DESC-80006.

Figs. 7-9. *Eridopora* cf. *parasitica* (WAAGEN and WENTZEL)
7, longitudinal section of zoarium, DESC-80007. 8, tangential section (inner part) of zoarium, DESC-80009a. 9, tangential section (outer part) of zoarium, DESC-80008a.

Figs. 10-12. *Hexagonella tortuosa* WAAGEN and WENTZEL
10, longitudial section (half side) of zoarium, DESC-80010. 11, 12, tangential sections of zoaria, DESC-80011 and DESC-80012, respectively.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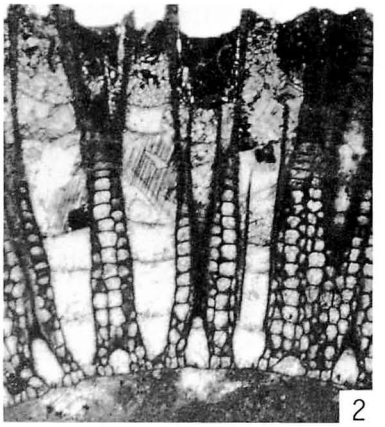
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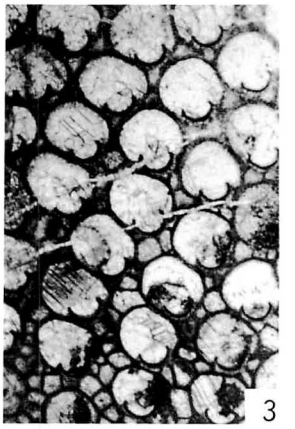
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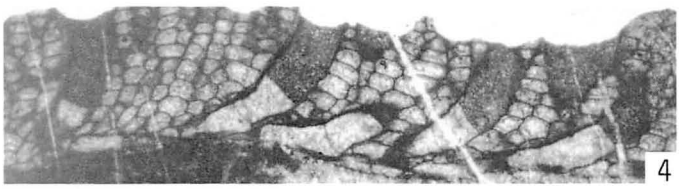
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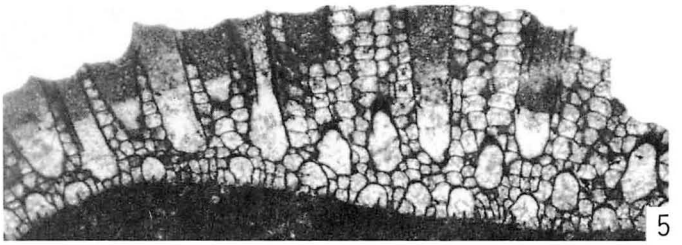
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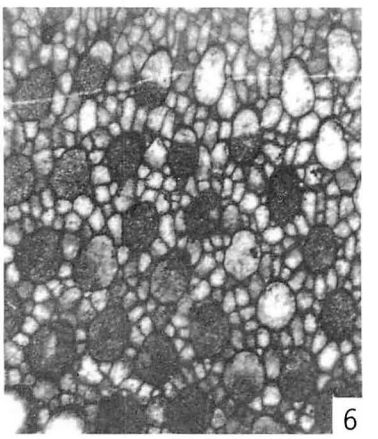
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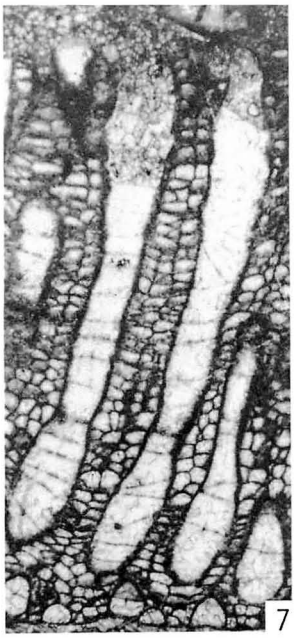
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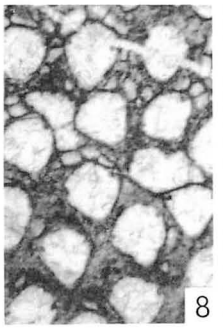
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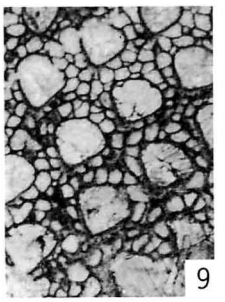
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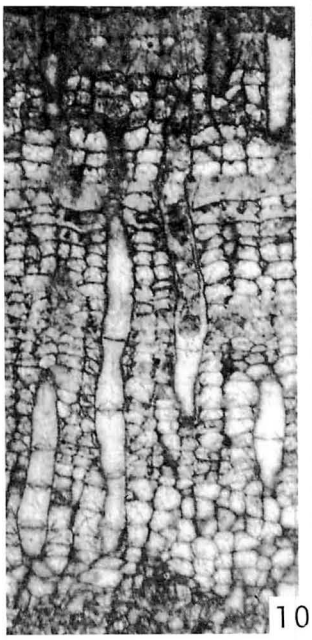
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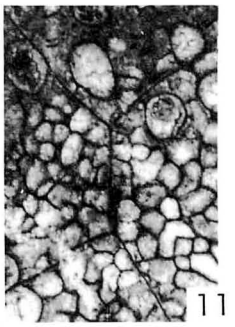
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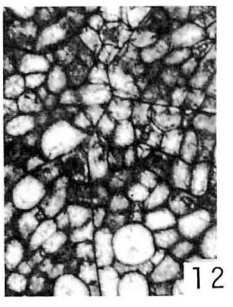
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6 apertures per fenestrule. Intervals between zooecial apertures in longitudinal series from center to center ranging from 0.250 to 0.400 mm. Interzooecial materials consisting of dark, dense tissue with abundant capillaries. Stereom covering the reverse side composed of inner coarse fibrous tissue and outer dark, dense tissue consisting of 4 to 5 layers with abundant capillaries. Diameter of capillaries ranging from 0.003 to 0.005 mm.

Meshwork formula.—7-8/5-6//14-16/5.

Measurements.—See Table 10.

Remarks.—The present form is not unlike *Polypora*? *macrops* YANG and LOO which was described from the upper part of the Bayinhé Formation (the upper part of Lower Permian) in the zoarial structure, i. e. the dissepiments are very short or almost absent and branches anastomosing each other in many cases. However, the present species can be distinguished from *P. macrops* in the meshwork formula. The specific denomination must be postponed until more materials are accumulated.

Horizon and Specimen no.—The *Araxilevis* horizon of Section J. Reg. nos. DESC-80034 and DESC-80035.

Genus *Septopora* PROUT, 1859

Septopora lineata NIKIFOROVA

Pl. 33, Fig. 5.

1933. *Septopora subquadrans* var. *lineata* NIKIFOROVA, p. 28, 29, 39, pl. 6, fig. 7, text-figs. 9, 10.
1970. *Septopora lineata*: MOROZOVA, p. 199, 200, pl. 44, figs. 1, 2.

Two tangential sections made out of the same zoarium were examined. Straight branches connected by dissepiments at regular intervals ranging from 0.700 to 0.850 mm measured from center to center of dissepiments, but occasionally amalgamated to adjacent branch and in some cases, branch detached from old one. No branch arising directly from the center of dissepiment observed. Width of branch ranging from 0.375 to 0.750 mm, 10 to 14 branches per 10 mm horizontally. Intervals between branches varying from 0.500 to 2.250 mm measured from center to center of branches. Fenestrule spherical to somewhat squeezed elliptical but in case of that surrounded by long dissepiments crescentic with rounded corners in outline, width varying from 0.250 to 1.250 mm, length ranging from 0.250 to 0.425 mm, and 13 to 14 fenestrules per 10 mm length of branch. Dissepiment narrower than that of branch, ranging from 0.375 to 0.450 mm, in which zooecial tubes arranged in intersecting longitudinal rows, bearing usually 5 to 8, sometimes even to 10 zooecia. Zooecial apertures arranged in 2 longitudinal rows, divided by well developed carina, 18 to 20 per 5 mm length of one row, perfectly stabilized in position of aperture in relation to dissepiments, 3 apertures per fenestrule.

In tangential section, zooecial tube rhomboidal with rounded corners to kidney shaped at lower to middle levels and circular near surface. Zooecial diameter near surface 0.120 to 0.140 mm. Intervals between zooecial apertures in longitudinal series from center to center ranging from 0.240 to 0.300 mm. Stereom covering the reverse side consisting of inner thin translucent tissue and outer thick tissue with coarse fibrous striations.

Meshwork formula.—10-14/13-14//18-20.

Measurements.—See Table 11.

Remarks.—Although there are slight differences between the present form and the originally described specimens of *Septopora lineata* which was described from Armenian Dzhulfa as a variety of

Table 11. Measurements of *Septopora lineata* NIKIFOROVA (in mm).

Specimen no.	80036	80037
No. of branches per 10 mm horizontally	10-14	9
No. of fenestrules per 10 mm length	ca. 13	ca. 14
No. of zooecia per 5 mm length	18-20	19-20
No. of zooecia per fenestrule	3	3
Width of branch	0.375-0.500	0.625-0.750
Interval between branches (center to center)	0.500-1.100	1.000-2.250
Interval between dissepiments (c. to c.)	0.700-0.850	0.700-0.750
Width of dissepiment	0.375-0.450	0.375-0.425
Diameter of zooecia near surface	0.120-0.140	0.120-0.140
Distance between zooecia (c. to c.)	0.260-0.300	0.240-0.300
No. of zooecia in dissepiment	5-6	5-10

Septopora subquadrans ULRICH by NIKIFOROVA (1933) in the measurements of the meshworks, the present form can be identified with *Septopora lineata*. Especially, there is a wide range of variations in the width of fenestrule in the same zoarium. In other microscopic characters the present specimens agree well with those from Armenian Dzhulfa described by NIKIFOROVA (1933) and MOROZOVA (1970).

Horizon and Specimen no.—C-O bed of Unit-4 in Section C. Reg. nos. DESC-80036 and DESC-80037.

Septopora tarazi SAKAGAMI, n. sp.

Pl. 33, Figs. 7, 8.

A single tangential section was examined. Zoarium consisting of nearly straight, parallel branches connected by dissepiments at regular intervals ranging from 0.625 to 0.675 mm measured from center to center of dissepiments. Usually a new branch detached infrequently from

Explanation of Plate 32

(All figures are in ×20)

Figs. 1, 2. *Stenopora?* n. sp.
1, longitudinal section of zoarium, DESC-80017. 2, tangential section of zoarium, DESC-80016a.

Figs. 3-5. *Araxopora araxensis* (NIKIFOROVA)
3, longitudinal section (half side) of zoarium, DESC-80018. 4, tangential section (inner part) of zoarium, DESC-80020. 5, tangential section (outer part) of zoarium, DESC-80039.

Fig. 6. *Polypora soyanensis* MOROZOVA
Tangential section of zoarium, DESC-80023.

Fig. 7. *Polypora tubulosa* NIKIFOROVA
Tangential section of zoarium, DESC-80022.

Fig. 8. *Polypora manicava* MOROZOVA
Tangential section of zoarium, DESC-80027a.

Fig. 9. *Polypora* aff. *darashamensis* NIKIFOROVA
Tangential section of zoarium, DESC-80032.


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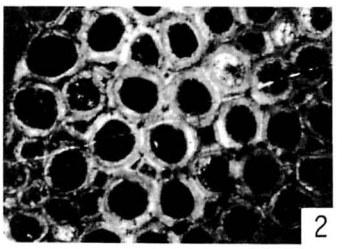
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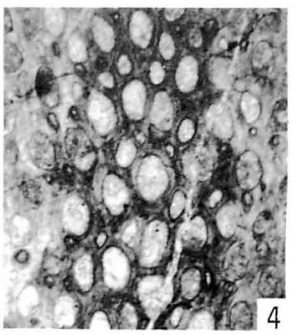
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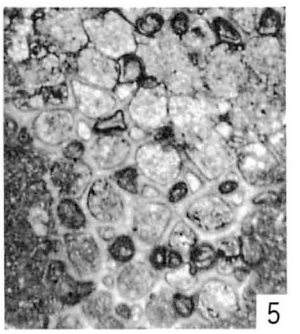
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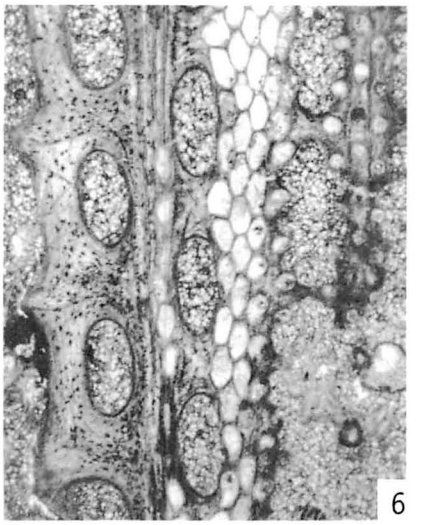
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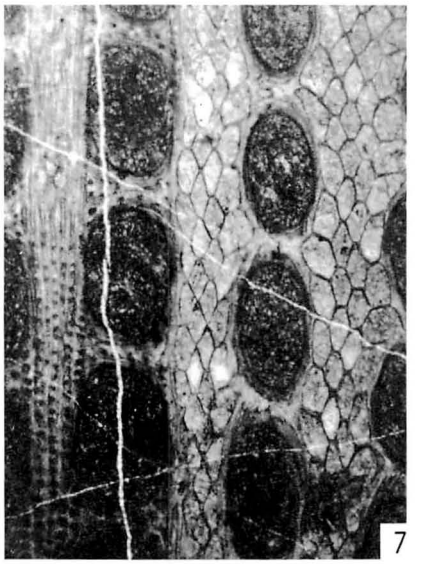
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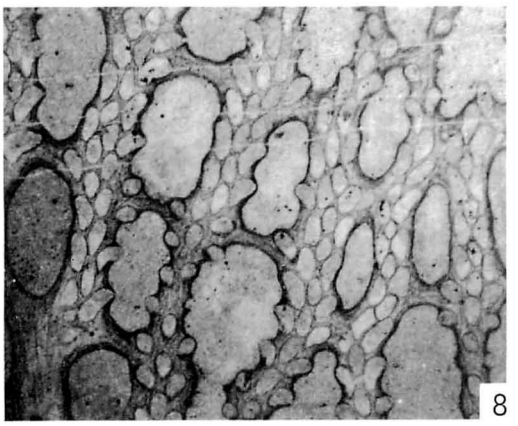
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old one. Width of branch ranging from 0.425 to 0.500 mm, 8 to 10 branches per 10 mm horizontally. Intervals between branches usually ranging from 0.750 to 1.250 mm occasionally even to 1.500 mm measured from center to center of branches. Fenestrule usually spherical or somewhat squeezed, but in case of fenestrule surrounded by long dissepiments, depressed arrow-head shaped in outline, width varying from 0.325 to 1.000 mm, length ranging from 0.250 to 0.325 mm, and 16 to 17 fenestrules per 10 mm length of branch. Dissepiment narrower than that of branch, ranging from 0.250 to 0.325 mm, in which zooecial tubes arranged in 2 intersecting longitudinal rows, bearing usually 3 to 5 but varying 2 to 9 zooecial tubes. Zooecial apertures arranged in 2 longitudinal rows which are divided by well developed carina, 21 to 22 per 5 mm length of one row, almost perfectly stabilized in position of aperture in relation to dissepiment, 3 apertures per fenestrule.

In tangential section, zooecial tube rhomboidal or somewhat deformed quadrilateral at lower level, kidney shaped to elliptical with irregular margin at middle level and circular near surface. Zooecial diameter near surface 0.100 to 0.110 mm. Intervals between zooecial apertures in longitudinal series from center to center ranging from 0.250 to 0.300 mm. One hemiseptum visible in some zooecial tubes at middle level of branch. Prominent nodes arranged on the carina, elongated elliptical in tangential section, their shorter and longer outside diameters ranging from 0.125 to 0.150 mm and 0.250 to 0.300 mm, respectively and intervals between them 0.450 to 0.600 mm measured from center to center. Shape of hollow in carina elongated elliptical with very strong notches. Also in a dissepiment, 1 to 4 nodes arranged in one row, circular in tangential section, about 0.100 to 0.120 mm in outside diameter, with star-like hollow. Stereom covering the reverse side rather thin, consisting of inner light-colored dense tissue and outer dark and coarse fibrous

Table 12. Measurements of *Septopora tarazi* SAKAGAMI, n. sp. (in mm).

Specimen no.	80038
No. of branches per 10 mm horizontally	8-10
No. of fenestrule per 10 mm length	16-17
No. of zooecia per 5 mm length	21-22
No. of nodes per 5 mm length	9-10
No. of zooecia per fenestrule	3
Width of branch	0.425-0.500
Interval between branches (center to center)	0.750-1.250
Interval between dissepiments (c. to c.)	0.625-0.675
Width of dissepiment	0.250-0.325
Diameter of zooecia near surface	0.100-0.110
Distance between zooecia (c. to c.)	0.250-0.300
Outside diameter of node (longer)	0.250-0.300
Outside diameter of node (shorter)	0.100-0.130
Distance between nodes (c. to c.)	0.450-0.600
No. of zooecia in dissepiment	3-9

tissue with 2 to 3 rows of capillaries, about 0.030 mm in diameter.

Meshwork formula.—8-10/16-17//21-22.

Measurements.—See Table 12.

Remarks.—The present species can be distinguished from *Septopora lineata* NIKIFOROVA which was described from the Armenian Dzhulfa and also from C-O horizon of the Abadeh Permian in the meshwork formula and microscopic characters. The thin stereom covering reverse side and the prominent nodes arranged in one row on straight carina are conspicuous characters of the present new species.

Horizon and Specimen no.—D-16 bed of Unit-3 in Section D. Reg. no. DESC-80038 (holotype).

Repository.—All of the specimens treated in this paper are preserved in the collection of the Department of Earth Sciences, Faculty of Science, Chiba University, Chiba City, Japan.

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Explanation of Plate 33

(All figures are in ×20)

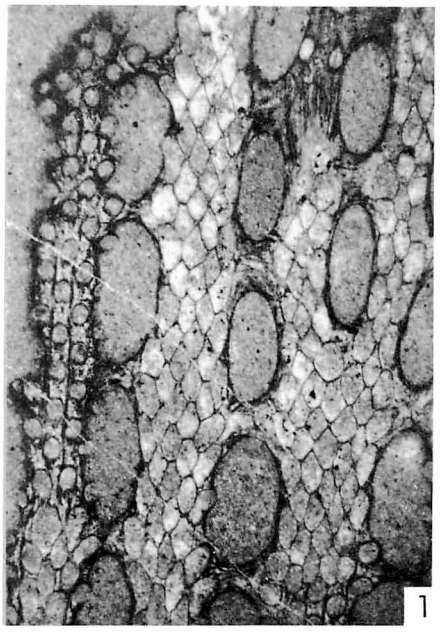
Figs. 1, 6. *Polypora abadehensis* SAKAGAMI, n. sp.
1, tangential section of zoarium, DESC-80028 (holotype). 6, showing the lower level of the same zoarium.

Fig. 2. *Polypora striata* SAKAGAMI, n. sp.
Tangential section of zoarium, DESC-80031a (holotype).

Figs. 3, 4. *Polypora?* sp. indet.
Tangential sections of zoaria, DESC-80034 and DESC-80035, respectively.

Fig. 5. *Septopora lineata* NIKIFOROVA
Tangential section of zoarium, DESC-80037.

Figs. 7, 8. *Septopora tarazi* SAKAGAMI, n. sp.
7, tangential section of zoarium, DESC-80038 (holotype). 8, showing the arrangement of nodes of the same zoarium.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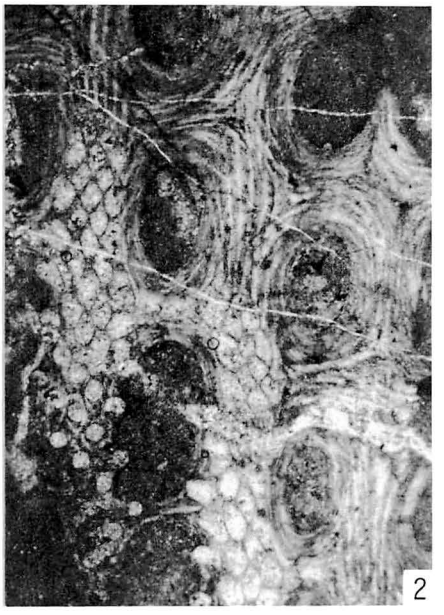
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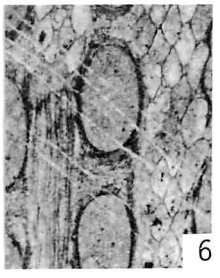
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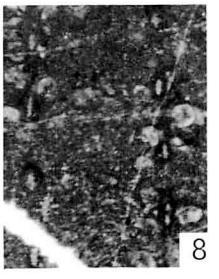
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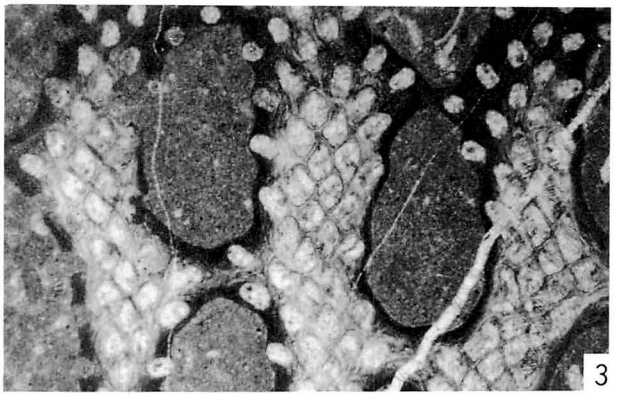
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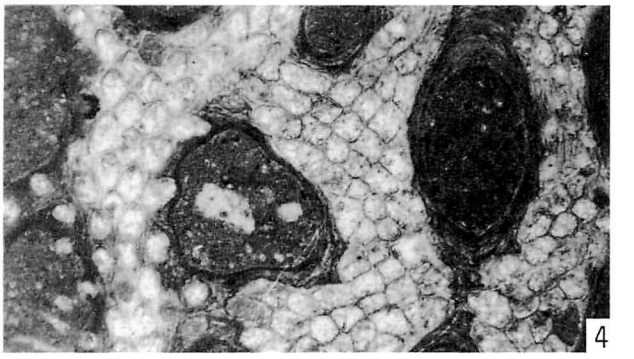
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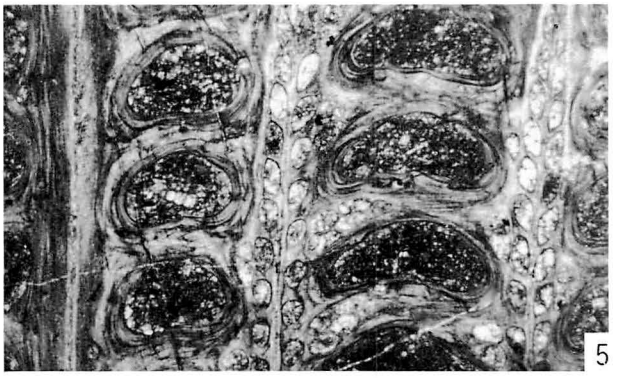
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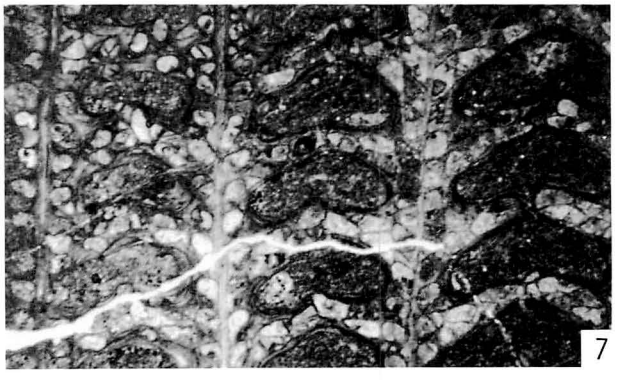
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イラン中部アバデー地域の二畳紀外肛類（こけ虫類）：二畳系と三畳系の境界問題に関連して，イラン中部アバデー地域の二畳紀こけ虫化石の生層序学的研究を行った。識別されたこけ虫化石はアルメニアズルファ地域の Gnishik-Khachik-Lower Dzhulfian 階から報告されたものと密接な類似性をもち，またパミール，ソルトレンヂ，カシミール，南シナ，チモールの二畳紀こけ虫化石とも共通種を含んでいる。4新種を含む15種すべてについて古生物学的記載を行った。

坂上　澄夫

Palaeontological Society of Japan Special Papers No. 17

Revision of Matajiro Yokoyama's Type Mollusca from the Tertiary and Quaternary of the Kanto Area

By Katsura Oyama. Reprinted May 30, 1980, 148 pp., 57 pls.
Price (postage and handling incl.) ¥6,000 or equivalent US dollars

This publication is a reprint of Dr. K. OYAMA's (1973) revision of the late Professor Matajiro YOKOYAMA's type and illustrated specimens of Mollusca from the Tertiary and Quaternary of the Kanto area (Tokyo and its vicinity). It is concerned not only with the systematics but gives also the locality records, geographic and bathymetric distribution and ecology of each species. The paper proved to be so valuable and indispensable for Late Cenozoic biostratigraphy and molluscan paleontology that it ran out of stock in five years. It has just been reprinted to meet readers' demand.

The Special Papers are on sale at the Society. Orders must be accompanied by remittance made payable to Dr. Tsugio SHUTO, Editor of the Special Paper, Palaeontological Society of Japan, c/o Department of Geology, Faculty of Science, Kyushu University 33, Fukuoka (Hakata) 812, Japan.

国内での販売価格と購入方法については巻末の案内をごらん下さい。

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 118, pp. 291-324, pls. 34-36, June 30, 1980

716. EARLY CRETACEOUS GASTROPODA FROM THE CHOSHI DISTRICT, CHIBA PREFECTURE, CENTRAL JAPAN*

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Abstract: This paper deals with a gastropod fauna from the Lower Cretaceous of Choshi district, Chiba Prefecture, central Japan. The following twelve species belonging to eleven genera are described: *Calliostoma? ojii* KASE, sp. nov., *Ataphrus* (s. str.) *nipponicus* KASE, sp. nov., *Hayamia rex* KASE, gen. et sp. nov., *Hayamia choshiensis* KASE, gen. et sp. nov., *Oolitica* sp., *Amberleya* (*Eucyclus*) *japonica* KASE, sp. nov., *Metriomphalus nagasakiensis* KASE, sp. nov., *Perissoptera elegans* KASE, sp. nov., *Pietteia cretacea* KASE, sp. nov., *Ceratosiphon densestriatus* KASE, sp. nov., *Vanikoropsis decussata* (DESHAYES) and *Eriptycha japonica* KASE, sp. nov.

The genus *Hayamia* is proposed as new. The operculum of *Hayamia rex*, preserved nearly *in situ* in the aperture, is characterized by the elliptical outline without a quadrangular process at the adaxial edge. The opercular feature of *Hayamia rex* is apparently identical with that of *Naticopsis*. This fact suggests that *Hayamia* has a close relationship to *Naticopsis* and evolved along a phylogenetic line independent from *Neritopsis*. *Pietteia cretacea* is the first record of occurrence of this genus from Cretaceous beds. Discrimination between the genus *Ceratosiphon* and *Tessarolax* is also presented.

It is noteworthy that the gastropod fauna of the Choshi Group includes several species closely related to or, in one case, identical with the species from the Barremian, Aptian or Albian of France and England.

Introduction

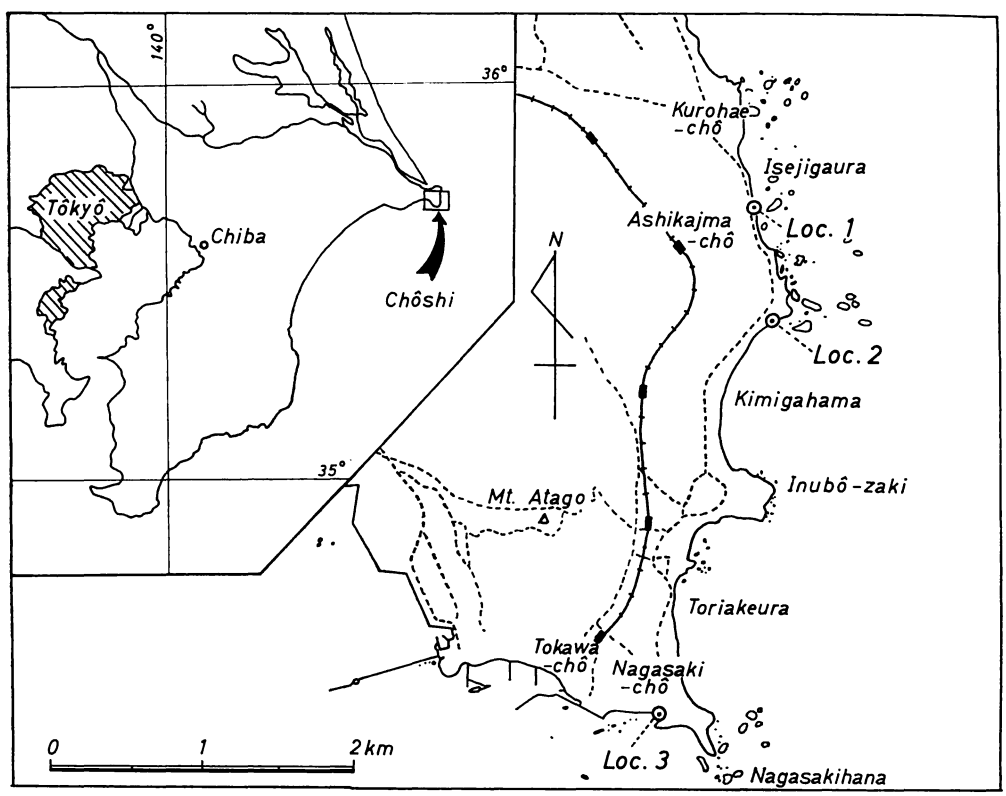
Aside from a faunal list and illustrations provided by SHIKAMA and SUZUKI (1972), little has been known on the gastropod fauna from the Lower Cretaceous of Choshi district, Chiba Prefecture, central Japan. Molluscan fossils have been considered to be rare and the fossils obtained are, in general, in the form of moulds and casts, so that paleontological studies on gastropods could not previously be undertaken on a firm basis. In 1977, however, five students of the Geology-

* Received February 5, 1980, read October 20, 1979, in Nagoya.

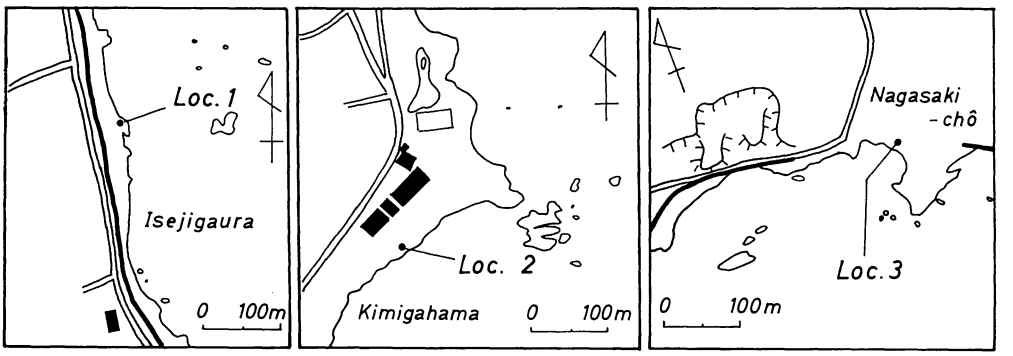
Astronomy Club, the University of Tokyo including the junior author found a large number of exceptionally well preserved invertebrate fossils at some localities. They entrusted identification of gastropods to the senior author. Supplementary collections were made by I. HAYAMI of the University Museum, the University of Tokyo and the senior author in 1977 and 1978. As a part of continuing studies on the Cretaceous gastropod faunas in Japan, the senior author herein describes twelve species of gastropods including two species which belong to a new genus of the Neritopsinae. The collections under discussion also include a number of bivalves which will be described separately by I. HAYAMI and T. OJI.

Geological Setting

The Lower Cretaceous strata of the Choshi disrict, named the Choshi Group by SHIKAMA and SUZUKI (1972), crop out narrowly along the eastern coast of the Choshi Peninsula. Previous interpretations of the stratigraphic sequence in this area vary greatly among different workers. This is probably because the exposures of Cretaceous rocks are limited in size and number, and because the contained fossils have not been sufficiently studied to serve as horizon markers and no key beds are found. Recently, OBATA



Text-fig. 1. Map showing the fossil localities in the Choshi district, Chiba Prefecture, central Japan.



Text-fig. 2. Map showing the fossil localities in the coast of Isejigaura, northern coast of Kimigahama and coast of Nagasaki harbour, Choshi City.

et al. (1975) described the stratigraphy of the Choshi Group, subdividing, from base to top, into the five formations, as follows:

1) Isejigaura Formation, the lowest unit of this group, composed of gray to blueish gray mudstone and alternating mudstone and gray fine- to medium-grained sandstone or siltstone. Barremian based on *Barremites* (*B.*) aff. *difficilis* (D'ORBIGNY) and *Crioceratites* cf. *emerici* (LÉVEILLÉ).

2) Ashikajima Formation, overlying Isejigaura Formation with unconformity. Base consisting of pebble- to cobble-sized conglomerate, following in upward sequence by brownish gray cross-laminated medium- to coarse-grained sandstone, alternating medium- to coarse-grained sandstone. Lower Aptian suggested by *Tropaeum* aff. *bowerbanki* (SOWERBY), *Australiceras* aff. *gigas* (SOWERBY) and *Dufrenoyia* aff. *dufrenoyi* (D'ORBIGNY).

3) Kimigahama Formation consisting of alternation of blueish gray mudstone and fine- to medium-grained sandstone. Trigoniid and other bivalves, plant fragments and amber sometimes occurring in calcareous concretions, and trace fossils very common. Lower Aptian based on *Cheloniceras* (s. str.) cf. *proteus* CASEY.

4) Nagasakihana Formation consisting of cross-laminated, medium-grained sandstone. Very poor in fossils except for some trace fossils and plant fragments. Lower Aptian based on *Cheloniceras* (s. str.) *meyendorffi* (D'ORBIGNY) from lower horizon.

5) Toriakeura Formation consisting of alternation of light gray mudstone and fine- to medium-grained sandstone, fault contact with underlying Nagasakihana and Kimigahama Formrtions, overlain by Middle Miocene Metogahana and Pliocene Naarai Formations. Mudstone with echinoderms, bivalves, ammonites, plant fragments and trace fossils. Lower Upper Aptian suggested by *Cheloniceras* (*Epicheloniceras*) sp.

Locality Guide

Loc. 1 [=Loc. 7306 in OBATA *et al.*, 1975]
Location: coast of Isejigaura, Ashikajima-cho, Choshi City [35°43′13″N, 140°43′19″E].
Stratigraphic position: near the base of the Isejigaura Formation by OBATA *et al.* (1975).
Age: Barremian.
Lithology and associate fauna: gray sandy siltstone with plant fragments and lenticular, highly calcareous concretions. Gastropods occur in the concretions together with bivalves and ammonites. The concretions are parallel to bedding. They are composed of micrite and contain a small amount of quartz grains. The delicate surface sculpture, such as crowded growth lines of *Amberleya* (*Eucyclus*)

japonica, is well preserved, but the shells are recrystallized to coarse-grained calcite.

Species: *Amberleya* (*Eucyclus*) *japonica* KASE, sp. nov. and *Oolitica* sp.

Collectors: H. MAEDA and T. OJI.

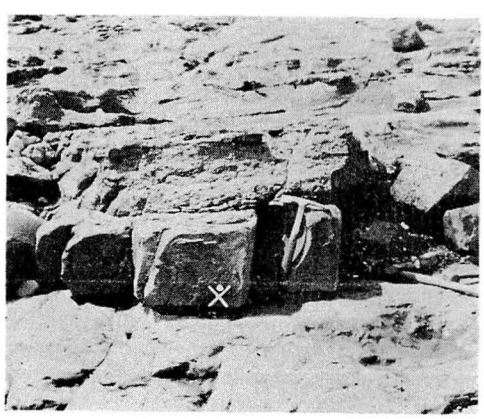
Loc. 2 [=Loc. 09 in SHIKAMA and SUZUKI, 1972; Loc. 7316 in OBATA *et al.*, 1975]

Location: northern coast of Kimigahama, Ashikajima-cho, Choshi City [35°42′54″N, 140°52′24″E].

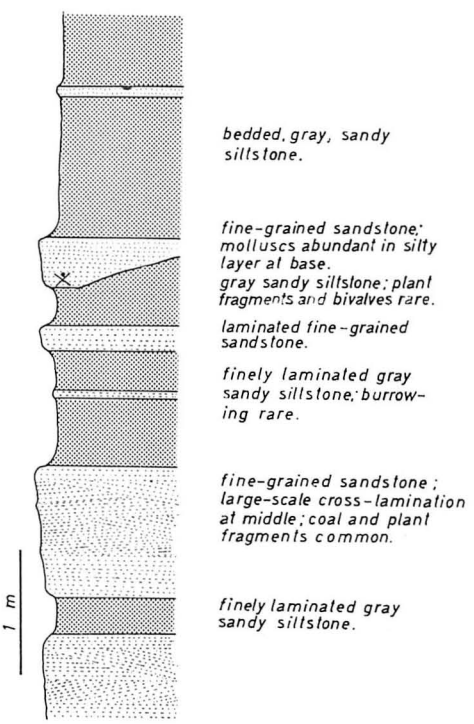
Stratigraphic position: about 50 m above the base of the Kimigahama Formation by OBATA *et al.* (1975).

Age: Barremian. One of the ammonites collected at this locality is assigned to the genus *Barremites*, suggesting a Barremian age (personal communication by Dr. I. OBATA). Previous to this report no fossil available for age determination was reported from the Kimigahama Formation exposed on the northern coast of Kimigahama. Further study must be done to solve the stratigraphic relation between the formations at Nagasaki and Kimigahama.

Lithology and associate fauna: alternation of laminated quartzose fine-grained sandstone and dark gray siltstone (Text-figs. 3, 4). The sandstone contains carbonitized plant fragments, coal, and is poor in fossils; the siltstone yields deformed molluscs such as *Nucula* sp., echinoderms, and carbonitized plant fragments. The gastropods described in this paper occurred in a silty layer of the basal part of a sandstone about 40 cm in maximum thickness, which abruptly thins out laterally. Microscopically, fossil bearing sediment is composed of 50 to 60 percent micrite, 40 to 50 percent angular quartz grains and a small amount of angular plagioclase grains and rounded chert grains. The fossils are aggregated in this layer and bivalves are the most dominant constituent, i.e. *Nanonavis* sp., *Nucula* sp., venerid, etc. Gastropods are common, and ammonites and asteroid echinoderms occur rarely. Delicate surface sculpture of these fossils and thin, long spines of aporrhaid gastropods are well preserved, although the shells are recrystallized to coarse-grained calcite. Many individuals of *Nucula* sp. and *Nano-*



Text-fig. 3. Photograph shows the fossil bearing sandstone at Loc. 2, northern coast of Kimigahama.



Text-fig. 4. Columnar section at Loc. 2, northern coast of Kimigahama.

navis sp. in this layer are articulated, suggesting that these fossils are nearly autochthonous in origin.

Species: *Calliostoma? ojii* KASE, sp. nov., *Ataphrus* (s. str.) *nipponicus* KASE, sp. nov., *Hayamia rex* KASE, sp. nov., *Hayamia choshiensis* KASE, sp. nov., *Perissoptera elegans* KASE, sp. nov., *Pietteia cretacea* KASE, sp. nov., *Ceratosiphon densestriatus* KASE, sp. nov., *Vanikoropsis decussata* (DESHAYES) and *Eriptycha japonica* KASE, sp. nov.

Collectors: I. HAYAMI, T. KASE, Y. KASE, H. MAEDA, S. MORIYA, T. OJI, T. TSUKUI and S. UMINO.

Loc. 3 [=Loc. 13 in SHIKAMA and SUZUKI, 1972; Loc. 7028 in OBATA *et al.*, 1975]

Location: coast of Nagasaki harbour, Nagasaki-cho, Choshi City [35°41'30"N, 140°51'54"E].

Stratigraphic position: about 50 m above the base of the Kimigahama Formation by OBATA *et al.* (1975).

Age: Lower Aptian.

Lithology and associate fauna: Gray calcareous sandy siltstone. Many molluscs were reported in this bed (see Table 5 in SHIKAMA and SUZUKI, 1972).

Species: *Metriomphalus nagasakiensis* KASE, sp. nov.

Collector: S. SAKUMA.

General Remarks of the Gastropod Fauna of the Choshi District

The Barremian to Lower Aptian gastropod fauna of the Choshi district consists of ten new, one already known and one indeterminable species, as follows:

Calliostoma? ojii KASE, sp. nov.
Ataphrus (*Ataphrus*) *nipponicus* KASE, sp. nov.
Hayamia rex KASE, gen. et sp. nov.
Hayamia choshiensis KASE, gen. et sp. nov.
Amberleya (*Eucyclus*) *japonica* KASE, sp. nov.
Oolitica sp.
Metriomphalus nagasakiensis KASE, sp. nov.
Perissoptera elegans KASE, sp. nov.
Pietteia cretacea KASE, sp. nov.
Ceratosiphon densestriatus KASE, sp. nov.
Vanikoropsis decussata (DESHAYES)
Eriptycha japonica KASE, sp. nov.

Of these species *Amberleya* (*Eucyclus*) *japonica* and *Oolitica* sp. are from the Barremian Isejigaura Formation at Loc. 1, and all the other species are from the Kimigahama Formation. The fossils from the Kimigahama Formation were mostly obtained at Loc. 2, but the material of *Metriomphalus nagasakiensis* was only collected at Loc. 3. Ten gastropod species were identified by SHIKAMA and SUZUKI (1972). However, the material from Loc. 3 is so fragmental that specific and generic identification is difficult, except for *Metriomphalus nagasakiensis*.

In Japan the Lower Cretaceous gastropods have not been sufficiently studied. Marine deposits of the Aridan (=Aritan, approximately Upper Neocomian) age bear some gastropods from the Outer Zone of the Southweat Japan, but most of them remain undescribed. The upper part of the Ishido Formation (lower Upper Barremian according to OBATA *et al.*, 1976) of the Sanchu area in central Japan consists of shallow marine sediments and contains several gastropod species that were described by YABE, NAGAO and SHIMIZU (1926) and revised taxonomically by HAYAMI and KASE (1977). Only one species, Aporrhaidae gen. et sp. indet. illustrated by MATSUKAWA (1977) from the Ishido Formation is related to *Ceratosiphon densestriatus* sp. nov., but they are distinguishable at the specific level. The Miyako Group (Upper Aptian to Lower Albian) of Northeast Japan is mainly composed of neritic reef sediments and contains numerous gastropods in calcareous sandstones. These were described and illustrated by NAGAO (1934) and HANAI, OBATA and HAYAMI (1968) and

were taxonomically revised by HAYAMI and KASE (1977), but still there are a large number of undescribed species. The two groups have no species in common, but only one genus *Ataphrus* (*Ataphrus*) occurs in both groups. This genus, however, is so long ranging and widely distributed that the occurrence of *Ataphrus* (*Ataphrus*) is not indicative of any direct relationship with the Miyako fauna. Further study is necessary to solve the question of whether the difference is due to a difference in age between the two groups or because different depositional environments are represented.

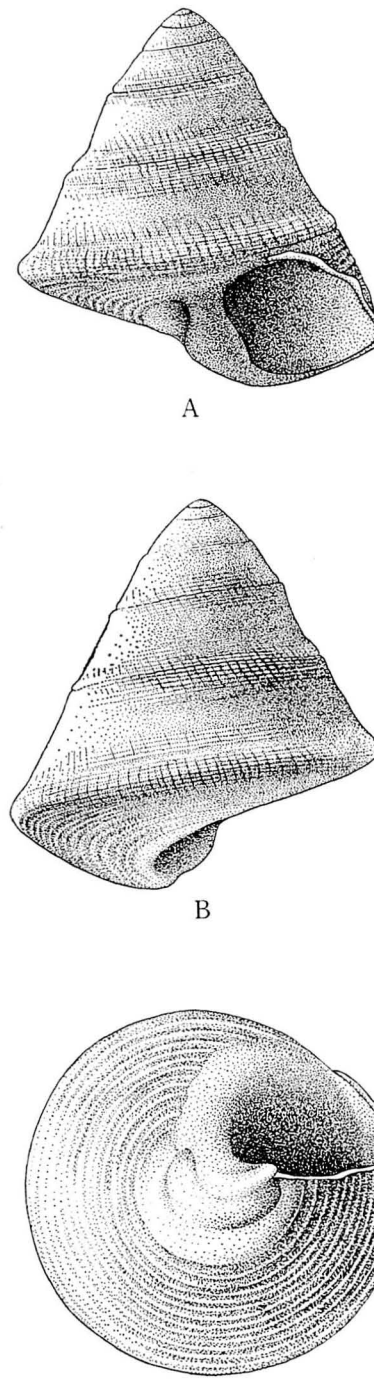
In contrast, the fauna of the Choshi Group contains the following characteristic gastropods which are identical with or closely related to the species from the Lower Cretaceous in western Europe:

The specimens of *Vanikoropsis decussata* (DESHAYES) are indistinguishable from those from the Gault of Cosne in France.

Hayamia rex sp. nov. is closely related to *Neritopsis spiralicrenata* COSSMANN from the Barremian of France.

Metriomphalus nagasakiensis sp. nov. and *Ceratosiphon densestriatus* sp. nov. seem to be related to *Turbo coquandi* PICTET and CAMPICHE and *Aporrhais ebrayi* de LORIOL from the Gault of St. Croix and Cosne in France, respectively.

Perissoptera elegans sp. nov. and *Ceratosiphon densestriatus* sp. nov. may be also intimately related to *Anchura* (*Perissoptera*) *marginata* (SOWERBY) and *Rostellaria retusa* SOWERBY from the Albian of England, respectively.



Text-fig. 5. *Calliostoma? ojii* KASE, sp. nov. (×7.4).

Repository

Specimens with the prefix NSM are

preserved in the Department of Geology, National Science Museum, Tokyo. Specimens with the prefix GIYU are preserved in the Geological Institute, Faculty of Education, Yokohama National University.

Systematic Description

(By Tomoki KASE)

Morphologic terminology in the present paper conforms to that adopted in the "*Treatise on Invertebrate Paleontology*" by KNIGHT *et al.* (1960, p. I129-I135). Synonymy and type-species of the genus and other information appearing in the *Treatise* are omitted unless otherwise mentioned.

Class Gastropoda

Order Archaeogastropoda

Superfamily Trochacea

Family Trochidae

Subfamily Calliostomatinae

Genus *Calliostoma* SWAINSON, 1840

Calliostoma? ojii KASE, sp. nov.

Pl. 34, Figs. 5-7; Text-fig. 5.

Material.—Holotype: NSM PM 15000, the largest specimen (Pl. 34, Figs. 7a, b). Paratypes: NSM PM 15001-15004.

Diagnosis.—Shell very small, trochiform with carinated basal periphery. Height almost equal to width. Incremental angle on penultimate and body whorls about 60°. Base weakly convex with a narrow and shallow medial depression. Depression smooth and covered by thin callus. Surface sculptured by spiral cords and collabral flat-topped ribs. Ribs strongest near sutures. Columella short, thick and lobed anteriorly.

Description.—Very small trochiform and anomphalous shell with height almost equal to width. Spire obtusely pointed, occupying a little less than two-thirds of total shell height. Protoconch consisting of about three depressed conical whorls, separated from each other by linear suture, and with almost straight or very weakly inflated whorl sides in early growth stage, but with very weakly concave sides in later stage. Penultimate whorl about three times wider than high. Body whorl wider than high with more distinctly concave side than those of spire whorls and sharply separated from base by a carinated periphery. Base broad and weakly convex in overall, but umbilical part around columella shallowly grooved and covered by a thin callus. Aperture subquadrangular in outline, prosoclinely inclined to shell axis and about 1.4 times as wide as high. Outer lip short, thin, sharp at its edge, nearly straight, and abruptly turned to weakly concave and wide basal lip with a sharp angulation. Columella short, thick, concave and more or less inclined to shell axis, coated by thick callus and lobed anteriorly. A narrow fissure sometimes present behind columellar lip. Parietal region coated by thin callus. Surface sculptured with fine spiral cords and flat-topped collabral ribs that cover whorl sides. Spiral cords distinct and somewhat crowded near suture. Collabral ribs somewhat imbricated anteriorly, distinct near suture and incised at basal periphery. Base sculptured by about 15 spiral cords that gradually become coarser towards umbilicus.

Remarks.—Five specimens are available for study. The holotype (Pl. 34, Figs. 7a, b) is the largest specimen, but the delicate surface sculpture of the whorl sides and base was damaged during prepara-

Table 1. Measurements in mm. [*Calliostoma? ojii* KASE, sp. nov.]

Specimen	Height	Width	Height of aperture
NSM PM 15000 Holotype	7.2	7.4	2.8
NSM PM 15001 Paratype	7.6	6.9	2.7
NSM PM 15002 Paratype	6.8	6.5	2.5
NSM PM 15003 Paratype	5.4	6.1	2.0
NSM PM 15004 Paratype	5.5	5.9	2.0

tion. The surface sculpture is better observed in one of the paratypes (Pl. 34, Figs. 6a-c).

The generic assignment of the present species is doubtful. The thick, inclined and anteriorly lobed columellar lip agrees well with that of the genus *Calliostoma*. This genus is very common in the Cenozoic and Recent. The genus ranges from the Lower Cretaceous to the present according to WENZ (1938) and KNIGHT *et al.* (1960). COSSMANN (1918) listed several Eocene species as the oldest forms, but he suggested that the certain record of the appearance this genus may range back to the base of the Jurassic or Triassic. The umbilical character of the present species, however, differs from that of *Calliostoma*; that is, the umbilical part of the present species is weakly depressed medially and smooth owing to the deposition of thin callus. The new species is probably separable from *Calliostoma* at the genus level, but a new genus name is not proposed here, because thorough revision of the Cretaceous trochiform gastropods is needed to define the delimitation of the genus *Calliostoma*.

The present species may also be related to the geuns *Proconulus* COSSMANN, 1918. However, *Proconulus* is typically characterized by having larger shell size, coeloconoid shell profile, convex base, and simple and weakly grooved columellar lip, and, therefore, is considerably different from the new species.

Africoconulus COX, 1965 (type-species: *Proconulus spinatus* DUBAR, 1948 from the Domerian of Morocco) has similar basal characters to the present species. The new species, however, cannot be referred to that genus owing to the almost straight whorl sides and simple ornamentation.

Calliostoma? ojii is probably congeneric with *Trochus rozeti* d'ARCHIAC, 1847 from the Cenomanian Tourtia beds of Belgium, because the shell outline and basal characters are quite similar. However, it is easily distinguishable from that species by the finer and more delicate ornamentation on the whorl sides.

Occurrence.—Known only from the type locality [Loc. 2].

Family Ataphridae

Genus *Ataphrus* GABB, 1869

Subgenus *Ataphrus* s. str.

Ataphrus (*Ataphrus*) *nipponicus* KASE, sp. nov.

Pl. 34, Figs. 3, 8-11.

Material.—Holotype: NSM PM 15007, a large specimen (Pl. 34, Figs. 11a, b). Paratypes: NSM PM 15005, 15006, 15008-15029).

Diagnosis.—A moderate-sized species of *Ataphrus* (*Ataphrus*) with a shell about 1.2 times wider than high in adult, broad and elliptical aperture and very fine numerous spiral threads on shell surface.

Description.—Moderate-sized, thin and anomphalous trochiform shell with width about 1.2 times height. Spire obtusely pointed and occupying about three-fifths

of total shell height, having weakly inflated and adpressed whorls. Teleoconch of about four, rapidly expanded whorls separated by very weakly impressed sutures. Protoconch smooth, depressed, composed of about one volution, and separated from teleoconch by a prosocline groove(?). Body whorl about 1.4 times as wide as high, weakly inflated above and broadly rounded at periphery with slightly convex base. Aperture broad, about 1.5 times as wide as high, strongly prosoclinely inclined to shell axis and elliptical in outline with almost continuous peristome. Outer lip long, arcuate and beveled with sharpened edge, and continues to a slightly concave basal lip with basal angulation. Parietal region smooth and concave, and coated by thick callus. Columellar lip long, slightly concave and strongly inclined to shell axis. Outer face of columellar lip broad and weakly depressed medially with an obtuse denticle facing towards aperture. Sculpture consisting of numerous and microscopic spiral threads over shell surface. Spiral threads coarser on basal periphery than on other part of shell surface. Growth lines prosocline and somewhat rugose.

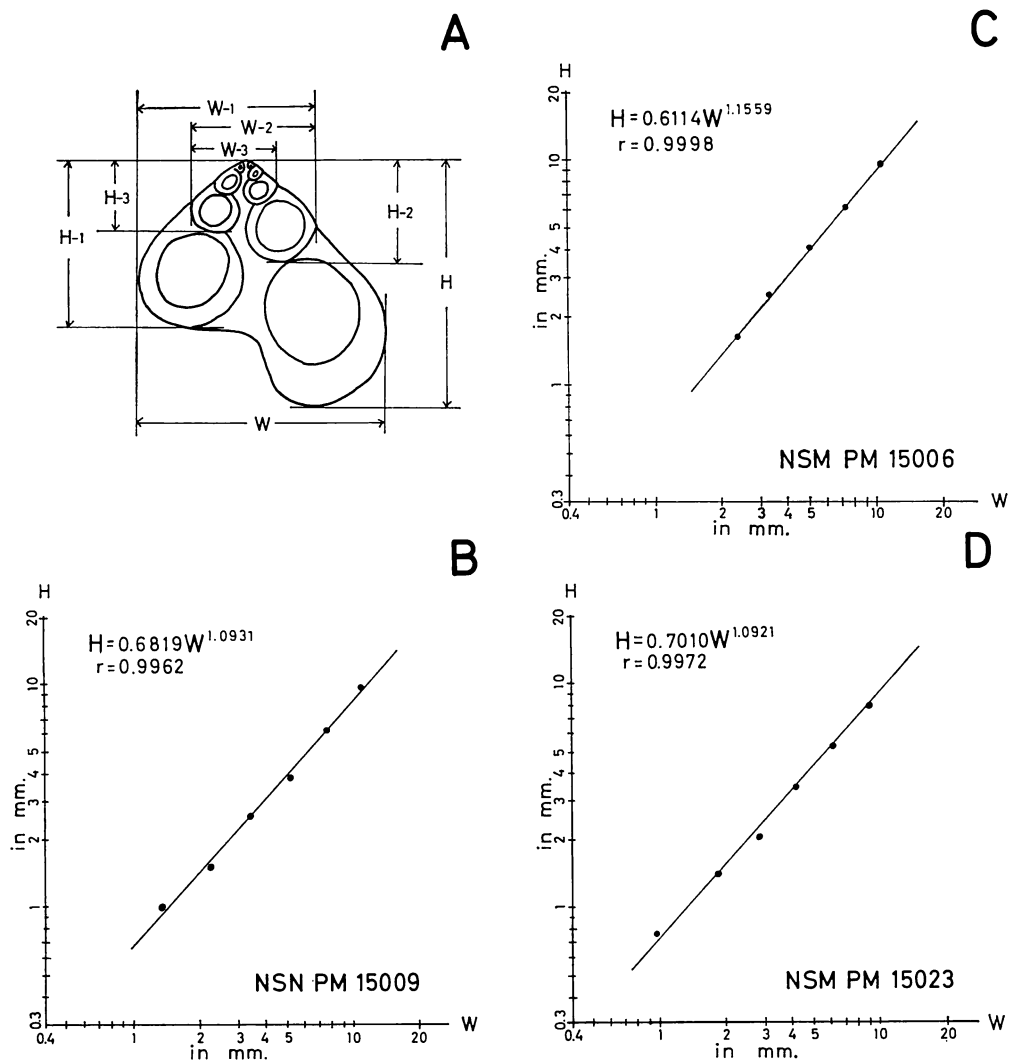
Remarks.—Twenty-five specimens are available for study. These specimens show complete shell outline, very fine surface ornamentation and delicate characters of apertural area.

Although the number of specimens in the present collection is not large enough to evaluate the variability of shell form, the ratios of W max./H and HA/H are rather constant among these specimens. Furthermore, the convexity of whorls, the apical angle and the shape of the aperture is rather uniform compared with other species of this group. Although the shell form is rather constant among the specimens of nearly the same size, smaller specimens seem to have larger ratio of W max./H than larger ones. Individual relative growth for the total shell height (H) against total shell width (W) in five specimens shows slightly positive allometry (Text-fig. 6). The characteristics of the protoconch are well shown in one of the paratypes (Pl. 34, Figs. 10a, b). It consists of about one whorl, but the boundary between the protoconch and teleoconch is not clearly observable; probably they are separated by a shallow groove.

This new species is similar to *Ataphrus* (*Ataphrus*) *yokoyamai* NAGAO, 1934 from the uppermost Aptian Hiraiga Formation of the Miyako Group of Northeast Japan. As noted by HAYAMI and KASE (1977, p. 36), *Ataphrus kitakamiensis* NAGAO, 1934 from the Miyako Group is regarded as a synonym of *A.* (*A.*) *yokoyamai*. According to NAGAO's description *Ataphrus* (*Ataphrus*) *yokoyamai* is apparently characterized by smooth shell surface, but some specimens collected near the type locality possess distinct spiral threads over the shell surface. Some specimens with smooth shell surface were also obtained from the same locality, but they were more or less abraded. The new species differs from *Ataphrus* (*Ataphrus*) *yokoyamai* by the smaller shell size, more conical shell outline, thinner test, broader aperture and much finer spiral threads.

Most of the Jurassic and Lower Cretaceous species belonging to *Ataphrus* (*Ataphrus*) possess an apparently smooth shell surface, and may be distinguishable from *Ataphrus* (*Ataphrus*) *nipponicus*. However, it is not necessarily known whether the smooth shell surface of these species is original or it is only due to unfavorable preservation as exemplified by *Ataphrus* (*Ataphrus*) *yokoyamai*.

The new species is quite similar to *Ataphrus adriaticus* PARONA, 1909 and also to *Ataphrus pillai* PARONA, 1909 from

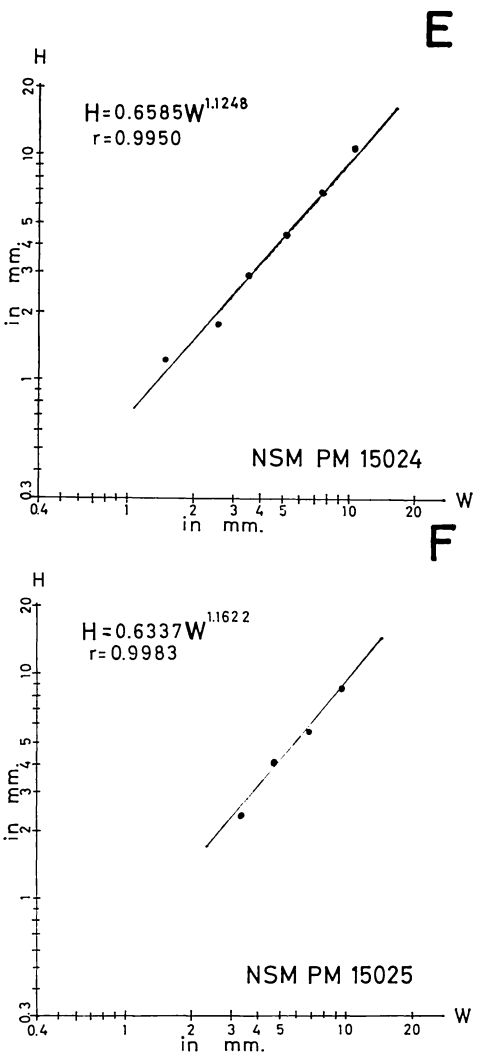


Text-fig. 6. A: Linear measurements of *Ataphrus* (s. str.) *nipponicus* KASE, sp. nov. adopted in the present study. (H: total shell height parallel to the axis of shell coiling; W: total shell width perpendicular to the axis of shell coiling). B—F: Double logarithmic diagrams for five samples of *Ataphrus* (s. str.) *nipponicus* KASE, sp. nov.

the "Albian" of Italy, especially to their small specimens. The new species, however, distinguishable from the two Italian species by its much smaller shell size, more strongly convex base, broader aperture and the presence of fine spiral threads on the shell surface.

Occurrence.—Known only from the type locality [Loc. 2].

Superfamily Neritacea



Family Neritopsidae

Subfamily Neritopsinae

Genus *Hayamia* KASE, gen. nov.

[=*Turbinopsis* PCELINCEV, 1963; non CONRAD, 1860]

Type-species.—*Hayamia rex* KASE, sp. nov. from the Barremian of Choshi district, central Japan.

Diagnosis.—Large-sized and relatively thin-shelled neritopsid with height almost equal to width and more or less protruded spire. Surface sculptured by numerous and more or less irregularly spaced spiral threads, in some species, also by costellae. Inner lip long, narrow and concave without a notch behind. No parietal tubercle. Operculum of naticopsid type, elliptical, lacking a quadrangular process at adaxial edge.

Remarks.—*Neritopsis* is one of the most common gastropods in the Jurassic and Cretaceous. WENZ (1938, p. 412) was aware of the difference of inner lip structure between living and Mesozoic species, stating "—in der Mitte einer Einbuchtung, die den Vorsprung des Deckels aufnimmt und bei den ältenen Formen wenig, bei den jüngeren starker ausgeprägt ist". Fortunately, the opercula of *Hayamia rex* are preserved in the apertures of three specimens at hand (Pl. 35, Fig. 10). Their orientation in the aperture are nearly the same among the three specimens; that is, the concave surfaces and the thick margins face the ventral and abaxial directions, respectively. This fact suggests that the opercula were entombed nearly *in situ* in the apertures.

Neritopsid opercula have been described by many authors from Mesozoic and Cenozoic rocks. Some earlier authors considered them variably as brachiopods, cephalopods, echinoderms, and so on (BRÖSAMLEN, 1909). Several specimens were described under *Peltarion* DESLONGCHAMPS and DESLONGCHAMPS, 1858, *Cyclidia* ROLLE, 1862, *Scaphanidia* ROLLE, 1862 and *Rhynchidia* LAUBE, 1870.

Three types of opercula were recognized on the basis of their morphological characters (Text-fig. 7). The first type, exemplified by Recent *Neritopsis radula* (LINNE), is characterized by a very solid, thick and trapeziform outline with a

Table 2. Measurements in mm. [*Ataphrus* (*Ataphrus*) *nipponicus* KASE, sp. nov.]

	Height	Maximum width	Minimum width	Height of aperture	Apical angle
NSM PM 15005 Paratype	9.6	11.7	10.0	5.7	122°
NSM PM 15006 Paratype	9.6	11.3	10.2	5.9	110°
NSM PM 15007 Holotype	9.5	11.3	9.1	5.6	102°
NSM PM 15008 Paratype	9.2	11.4	9.2	ca.5.7	118°
NSM PM 15010 Paratype	7.4	8.8	7.7	4.5	106°
NSM PM 15011 Paratype	7.3	8.7	7.6	4.4	114°
NSM PM 15012 Paratype	6.8	8.3	7.0	4.0	108°
NSM PM 15013 Paratype	6.4	8.2	6.7	3.7	111°
NSM PM 15014 Paratype	5.6	7.3	6.0	3.7	124°
NSM PM 15015 Paratype	4.4	5.2	4.2	3.2	109°
NSM PM 15016 Paratype	4.3	5.4	4.4	3.2	109°
NSM PM 15017 Paratype	3.9	5.1	4.2	2.9	120°

prominent process at adaxial side and with a well arched abaxial margin. The outer surface is even, smooth and covered by callus, and has a prominent quadrangular process. The inner surface is, on the contrary, convex, also smooth and covered by callus, and the quadrangular process is radially striated. *Cyclidia* described by ROLLE (1862) may also be included in this type. *Scaphanidia* described by ROLLE (1862) and *Rhynchidia* described by LAUBE (1870) may questionably be referred to this type. The second type is exemplified by *Neritopsis jurensis* (MÜNSTER) in BRÖSAMLEN (1909) from the Kimmeridgian of Germany. *Peltarion* DESLONGCHAMPS and DESLONGCHAMPS, 1858 seems to have been originally named for opercula of this type. The opercula of this type are characterized by the angularly elliptical outline and has a quadrangular process at the adaxial edge. The outer surface possesses fine concentric lamellae and some symmetrical and radial ridges. The wide abaxial part of the inner lip surface is covered by thick callus, its adaxial margin has chevron-shaped boundary, and the narrow adaxial part of the inner surface possesses fine lamellae which are nearly parallel to the adaxial margin. It is considered that opercula of this type are common in the Upper Triassic to Lower Cretaceous species which are of relatively small shell size and bear cancellated ornamentation. The first and second types are similar to each other in having a prominent process and in the structure of the outer and inner surfaces. The third type is represented by *Hayamia rex* and probably many large-sized and spirally striated species. The opercula of this type are quite different from those of the above-mentioned two types. The most distinct difference is the lack of the process at the adaxial edge, and, therefore, shows an elliptical outline. It is thin in the adaxial part but thick in the abaxial part. The outer surface of the operculum is coated by thick callus, concave, undulated at the middle and ornamented by both radial and concentric elements. The two parts are bordered by a chevron-shaped boundary. The convex inner surface is, on the contrary, smooth and covered by callus in the abaxial part, and is ornamented by

concentric lamellae in the adaxial part. An operculum of this type was also reported by HUDLESTON (1894) from the Bajocian of England, and rests *in situ* in the aperture of *Neritopsis bajocensis* D'ORBIGNY. The operculum of *Neritopsis deslongchampsii* BEAUDOUIN, 1868 from the Oxfordian of France may be referable to this type. *Peltarion moreausi* DESLONGCHAMPS, 1863 from the Oxfordian of France is regarded as an operculum of this type. The inner lip of *Hayamia rex* does not possess a prominent notch, into which, as seen in *Neritopsis radula*, opercular process fits. This fact is in harmony with the lack of such a process in the operculum of *Hayamia rex*. *Hayamia rex* is also similar to *Neritopsis bajocensis* in its larger shell size, comparatively thin shell, narrow labial area and numerous and irregualrly spaced spiral cords and costellae. It is interesting that the opercular feature of *Hayamia rex* is apparently similar to that of *Naticopsis*. This fact suggests that *Hayamia* has a close relationship to *Naticopsis* and evolved in a phylogeneric line independent of *Neritopsis*.

Hungariella KUTASSY, 1933 is close in having a similar shell outline but differs by possessing a more acute spire, tubercles on the parietal and columellar lips and a different type of surface sculpture. *Neritoptyx* OPPENHEIM, 1892 differs by possessing a prominent parietal tubercle.

PCELINCEV (1963) proposed the genus *Turbinopsis* (type-species: *Neritopsis multicostulata* PCELINCEV, 1931). *Turbinopsis* is probably considered to be asy nonym of *Hayamia*, but the genus name *Turbinopsis* is preoccupied by CONRAD (1863) for an unrelated cerithiacean gastropod.

The following species formerly described from the Jurassic and Cretaceous beds can be included in *Hayamia*, judging from the shell outline and surface sculpture:

Neritopsis mutabilis HAYAMI, 1960 from the Lower Lias of west Japan.

Neritopsis philea D'ORBIGNY, 1847 (d'ORBIGNY, 1852) from the Lias of France.

Neritopsis bajocensis D'ORBIGNY, 1852 from the Bajocian of France.

Neritopsis tricostata D'ORBIGNY, 1852 from the Bajocian of France.

Neritopsis baugierana D'ORBIGNY, 1852 from the Bathonian of France.

Neritopsis sulcosa D'ARCHIAC, 1843 (MORRIS and LYCETT, 1851) from the Bathonian of England.

?*Neritopsis striata* MORRIS and LYCETT, 1851 from the Bathonian of England.

Neritopsis inaequalicosta D'ORBIGNY, 1847 (D'ORBIGNY, 1852) from the Callovian of France.

?*Neritopsis deslongchampsii* BEAUDOUIN, 1868 from the Oxfordian of France.

Peltarion moreausi DESLONGCHAMPS, 1863 from the Oxfordian of France.

Neritopsis spiralicrenata COSSMANN, 1907 from the Barremian of France.

Neritopsis multicostulata PCELINCEV, 1931 (DRUSCHITS and KUDRYAVSTEV, 1960; PCELINCEV, 1963) from the Barremian of Crimea.

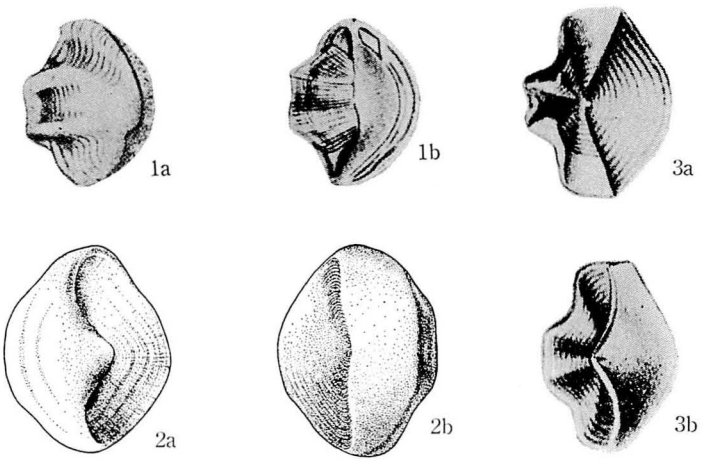
The generic position of these species, however, will be ensured when the opercular and inner lip features are clarified.

Hayamia rex KASE, sp. nov.

Pl. 35, Figs. 5-10; Text-fig. 7, Figs. 2a, b.

Material.—Holotype: NSM PM 15031, a large specimen (Pl. 35, Figs. 9a-c). Paratypes: NSM PM 15030, 15032-15039.

Diagnosis.—A large-sized and prominently shouldered species of *Hayamia* characterized by ovately naticiform shell outline, broad ramp and considerably protruded spire with width almost equal to height. Surface sculpture consisting



Text-fig. 7. Comparison and form of opercula in three neritopsid genera and subgenera. 1a, b: *Neritopsis* (s. str.) *radula* (LINNÉ), after WENZ (1938). (×1.0); 2a, b: *Hayamia rex* KASE, sp. nov. (×2.4); 3a, b: *"Peltarion" bilobatum* DESLONGCHAMPS and DESLONGCHAMPS, after KNIGHT *et al.* (1960). (×2.3).

of about a dozen strong spiral cords with much finer subordinate ones in their interspaces.

Description.—Large-size, thick-shelled and ovately naticiform shells with height almost equal to width and with spire about a fourth of total shell height in adult. Teleoconch distinctly shouldered and inflated, consisting of about two whorls, and separated from each other by impressed suture. Protoconch consisting of 1.5 smooth and naticiform whorls, and delimited from teleoconch by an indistinct line. Body whorl large, slightly wider than high and plumply inflated; sutural ramp of body whorl weakly inclined abaxially and somewhat concave. Aperture rather narrow, prosocline to shell axis, oval in outline with almost continuous peristome, and weakly angulated above and regularly rounded below. Outer lip thin and beveled, broadly rounded, but digitated in accordance with spiral cords, and merged into rounded

Table 3. Measurements in mm. [*Hayamia rex* KASE, sp. nov.]

Specimen	Height	Width	Height of aperture	Height of body whorl
NSM PM 15030 Paratype	—	39.1	29.5	—
NSM PM 15031 Holotype	33.9	32.4	25.1	31.9
NSM PM 15032 Paratype	29.4	30.1	22.4	28.9
NSM PM 15033 Paratype	29+	26+	22.5+	27+
NSM PM 15034 Paratype	21.9	24.4	19.3	21.3
NSM PM 15035 Paratype	23.1	22.5	20.0	22.3
NSM PM 15036 Paratype	12.7	13.9	11.2	12.6

basal lip without any angulation. Inner lip smooth and concave, and extended abaxially to opposite side of aperture forming a narrow labial area. Parietal lip smooth and covered by thin callus. Surface ornamented by a dozen round-topped and variably strengthened spiral cords, and by much finer subordinate cords in their interspaces. Growth lines distinct, more or less prosocline and somewhat rugose near aperture. Umbilicus absent except for a weak depression at corresponding place. Operculum calcareous, thick, symmetrical and elliptical in outline, lacking a quadrangular process.

Remarks.—Ten specimens are available for the present study. Four of them, illustrated in Plate 35, Figures 6-9, are nearly complete. The number of spiral cords and the width of their interspaces are variable among the specimens. The holotype possesses twelve spiral cords on the body whorl, but one of the paratypes (Plate 35, Figures 7a-c) has 16 spiral cords and those of the base are much finer and crowded. One or two fine subordinate spiral cords are sometimes intercalated between the spiral cords on the whorl sides. The height of the spire in proportion to the total shell height gradually increases with growth; that is, the body whorl abruptly abuts on the precedent whorl anteriorly, and, therefore, the suture line greatly increases its angle with the axis and runs obliquely downward across the face of the previous whorl. Similar change of shell form is also known in the Recent species *Neritopsis radula* (LINNÉ).

The new species is closely related to *Neritopsis spiralicrenata* COSSMANN, 1907 from the Barremian of France. DELPEY (1940) assigned *Neritopsis spiralicrenata* to the genus *Nododelphinula* COSSMANN, 1916 and referred it to *Nododelphinula neritopsoides* (BLANCKENHORN, 1890). COSSMANN's species, however, belongs to the genus *Hayamia*, because the labrum is nearly holostomous and it lacks an umbilicus in addition to the similar surface sculpture. The French species is of smaller shell size, has coarser crenulated spiral cords and much coarser and less numerous spiral threads between the spiral cords than *Hayamia rex*.

Occurrence.—Known only from the type locality [Loc. 2].

Hayamia choshiensis KASE, sp. nov.

Pl. 35, Figs. 3, 4.

Material.—Holotype: NSM PM 15040, a nearly complete specimen (Pl. 35, Figs. 4a-c). Paratype: NSM PM 15041.

Diagnosis.—A small species of *Hayamia* with distinctly shouldered body whorl, moderately protruded spire and obliquely elongated aperture. Surface sculptured by about 40 spiral cords with several subordinate ones, and by prosocline weak costellae on posterior part of body whorl.

Description.—Small and obliquely elongate turbiniform shells with moderately thick test. Height almost equal to width. Spire occupying about 0.3 of total shell height. Whorls well rounded, rapidly expanded and at least three in number including protoconch, and separated from each other by an impressed suture. Protoconch poorly known, consisting of smooth rounded whorls. Body whorl large, a little wider than high, with a wide and weakly concave sutural ramp near aperture. Aperture moderately wide, higher than wide, angularly circular in outline and slightly prosocline to shell axis with almost continuous peristome. Outer lip moderately thick, beveled and angularly convex. Surface ornamented by regularly spaced spiral cords with several subordinate ones in interspaces;

Table 4. Measurements in mm. [*Hayamia choshiensis* KASE, sp. nov.]

Specimen	Height	Width	Height of aperture	Height of body whorl	Apical angle
NSM PM 15040 Holotype	19.1	20.3	16.3	18.5	ca. 180°

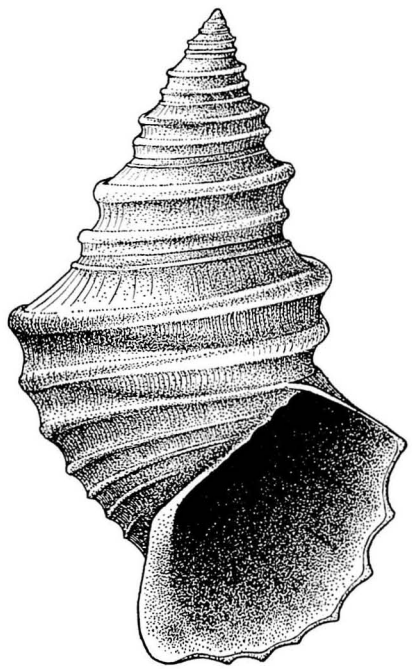
spiral cords narrower than interspaces, about 40 in number on body whorl, and becoming finer towards base; costellae distinct on posterior part of body whorl. Growth lines fine, distinct and prosocline. Operculum unknown.

Remarks.—Two specimens are available for study. The protoconch of the holotype is deformed and its delicate surface sculpture is more or less obliterated. The paratype (Plate 35, Figures 3a, b) lacks its outer lip, but clearly reveals the surface ornamentation which consists of fine, regularly spaced spiral cords and distinct prosocline axial costellae on the posterior part of the body whorl. As discussed in the precedent pages, this group changes its shell profile through growth. Judging from the condition of overlapping of the body whorl on the penultimate whorl, however, the holotype seems to be an adult.

The present species is related to *Neritopsis multicostulata* PCELINCEV, 1931 (DRUSCHITS and KUDRYAVTSEV, 1960; PCELINCEV, 1963) from the Barremian of Crimea. *Neritopsis multicostulata*, however, has larger shell size, indistinctly shouldered whorls, slightly thicker spiral cords, circular aperture, and distinct and more numerous axial costellae on each whorl.

Hayamia rex differs from *Hayamia choshiensis* by much larger shell size, circular aperture and different type of surface sculpture.

Occurrence.—Known only from the type locality [Loc. 2].



Text-fig. 8. *Amberleya* (*Eucyclus*) *japonica* KASE, sp. nov. (×1.2).

Suborder doubtful

Superfamily Amberleyacea

Family Amberleyidae

Genus *Amberleya* MORRIS and LYCETT, 1851

Subgenus *Eucyclus* EUDES-DESLONGCHAMPS, 1860

Amberleya (*Eucyclus*) *japonica* KASE, sp. nov

Pl. 34, Figs. 15, 16; Text-fig. 8.

Material.—Holotype: NSM PM 15042, a large specimen (Pl. 34, Figs. 15a, b). Paratype: NSM PM 15043.

Diagnosis.—A large and elongate species of *Amberleya* (*Eucyclus*) characterized by broad ramp and sculpture consisting of smooth and round-topped spiral cords.

Description.—Shell large-sized, moderately thick-tested, anomphalous and elongate turbiniform with height less than twice width. Spire conical with an acute apex being less than a half total shell height. Apical angle about 55°. Protoconch not preserved. Suture impressed. Whorls at least five in number. Spire whorls angulated at middle, concave over posterior half forming a broad ramp, peripherally flattened and bearing seven or more strong and round-topped spiral cords. Spiral cords gradually weakened anteriorly. Aperture subovate, subparallel to shell axis, acute above and roundly projected below. Outer lip thin at edge, obliquely straight above, angulated at middle and rounded below. Parietal lip vertical and thick. Growth lines distinct and rugose.

Remarks.—Two specimens are available for this study. The holotype (NSM PM 15042; Height 57 mm+; Width, 37.5 mm; Height of aperture, 26 mm+; Apical angle, ca. 55°) is poorly preserved and its apical part is slightly deformed, but the shell outline and surface sculpture are well shown except for the basal part. Spiral cords on the body whorl of the holotype cannot be counted precisely owing to poor preservation, but the number at least seven. Basal characteristics of this species are well revealed in another fragmental specimen which shows an anteriorly projected, rounded, basal lip lacking an anterior siphonal canal.

A number of species assigned to *Amberleya* (*Eucyclus*) reported from the Cretaceous strata of the world do not agree with the new species in shell size and surface sculpture. Among these species, *Amberleya dilleri* STANTON, 1895 from the Tithonian Knoxville beds of California is somewhat similar to the present species in having a smaller shell size (maximum height is less than 35 mm) and thinner granulated and crest-topped spiral cords. The present new species also somewhat resembles *Turbo faucignyanus* PICTET and ROUX, 1849 from the Aptian of France. But the French species has smaller shell size and wider shell outline than our species, and has a biangulated body whorl with much finer spiral cords on the base and ramp.

Occurrence.—Known only from the type locality [Loc. 1].

Genus *Oolitica* COSSMANN, 1893

Oolitica sp.

Pl. 34, Figs. 4a, b.

Remarks.—This species is represented only by a poorly preserved specimen (NSM PM 15044; Height, ca. 13 mm; Width, 10 mm; Height of aperture, 8.5 mm; Apical angle, ca. 80°). This species is characterized by littoriniform shell outline, broad and steeply inclined ramp, and six or more spinous and crest-topped spiral cords on the body whorl. The umbilical area is poorly preserved, having a wide and subelliptical aperture and discontinuous peristome. The shell surface is covered by prosocline and wrinkled growth lines. These features are common to the genus *Oolitica* COSSMANN, 1893. The fragmentary nature of the available material precludes placement in hitherto known species assignable to this genus.

Occurrence.—Loc. 1.

Family Nododelphinulidae

Genus *Metriomphalus* COSSMANN, 1916

Metriomphalus nagasakiensis KASE, sp. nov.

Pl. 34, Figs. 1, 2, 14.

1972. *Margarites* (?) sp., SHIKAMA and SUZUKI, *Sci. Rep. Yokohama Nat. Univ.*, sec. II, no. 19, pl. 6, fig. 15.
?1972. *Margarites* aff. *sachalinensis* NAGAO: SHIKAMA and SUZUKI, *Sci. Rep. Yokohama Nat. Univ.*, sec. II, no. 19, pl. 6, fig. 16.
1977. *Margarites*? sp., HAYAMI and KASE, *Univ. Mus. Univ. Tokyo, Bull.*, no. 13, p. 35.
?1977. *Margarites*? sp., HAYAMI and KASE, *Univ. Mus. Univ. Tokyo, Bull.*, no. 13, p. 35.

Material.—Holotype: GIYU-MM-104, a large specimen (Pl. 34, Figs. 14a-c). Paratypes: GIYU-MM-105-107.

Diagnosis.—A medium-sized species of *Metriomphalus* characterized by low spire, weakly impressed suture and ornamentation consisting of coarse tuberculated spiral cords.

Description.—Medium-sized, narrowly phaneromphalous and moderately thick turbiniform shells with height greater than width in small specimens but nearly equal to width in large ones. Spire small and low, comprising about half of total shell height. Whorls weakly inflated, at least 4.5 in number, rapidly expanded and separated from each other by weakly impressed suture. Protoconch missing. Body whorl large, as wide as high or slightly wider than high and weakly convex above, with rounded periphery. Base broad, weakly convex peripherally but concave at umbilical part. Umbilicus narrow and grading to base without angulation. Aperture subcircular, slightly higher than wide and inclined to shell axis with discontinuous peristome. Outer lip rounded and weakly crenulated in accordance with peripheral cords. Inner lip regularly con cave and subvertical with slightly reflected margin. Surface sculpture consisting of finely tuberculated spiral cords; number of spiral cords four on the spire whorls and about 14 on body whorl. Spiral cords of body whorl becoming thicker and more finely tuberculated towards umbilicus and slightly narrower than their interspaces. Sculpture in umbilicus not observed.

Remarks.—A number of specimens are available for study, but most are incomplete. The holotype (Plate 34, Figures 14a-c) is a large and comparatively well preserved specimen, which shows well the surface ornamentation of the adapertural part, but the characters of the umbilical and apertural areas are poorly known. Umbilical characters are well exhibited in one of the paratypes (Plate 34, Figures 2a, b). The variability of shell form cannot be appreciated because of the scarcity of well preserved specimens. However, the smaller specimens (e. g.

Table 5. Measurements in mm. [*Metriomphalus nagasakiensis* KASE, sp. nov.]

Specimen	Height	Width	Height of aperture
GIYU-MM-104 Holotype	12.0	11.6	7.0
GIYU-MM-105 Paratype	ca.9	8.9	4.3
GIYU-MM-106 Paratype	ca.8	7.5	ca.4
GIYU-MM-107 Paratype	—	9.0	5.0

Plate 34, Figures 2a, b) differ in shape from the larger ones in having a higher shell outline and biangulated body whorl. The surface sculpture, apertural and umbilical characters do not differ among these specimens. The observation of many specimens of various growth stages leads me to conclude that the angulation of the body whorl becomes weaker and rounded through the stages of growth.

The present species was once illustrated by SHIKAMA and SUZUKI (1972) under the name of *Margarites* (?) sp., one of the paratypes (Plate 34, Figures 2a, b) is the illustrated specimen (SHIKAMA and SUZUKI, 1972, pl. 6, fig. 15). They also illustrated one specimen from the same locality under the name of *Margarites* aff. *sachalinensis* NAGAO, 1939. Specimens of that species are, however, so poorly preserved that the specific as well as generic determination is difficult.

This species may be closely related to *Turbo coquandi* PICTET and CAMPICHE, 1864 from the Gault of St. Croix, Switzerland. COSSMANN (1915) assigned this species to the genus *Metriomphalus*. *Turbo coquandi* possesses larger shell size, deeply impressed suture, narrower aperture and more numerous spiral cords than the present new species.

Turbo goupilianus D'ORBIGNY, 1843 from the Cenomanian of France, is related to the new species, but is distinguished from it by the narrower aperture, finely tuberculated spiral cords, higher spire and more inflated whorls which are separated by deeply impressed suture.

Occurrence.—Known only from the type locality [Loc. 3].

Order Mesogastropoda

Superfamily Strombacea

Family Aporrhaidae

Genus *Perissoptera* TATE, 1865

Type-species. — *Rostellaria parkinsoni* MANTELL, 1822 from the Lower Albian of England. [original designation]

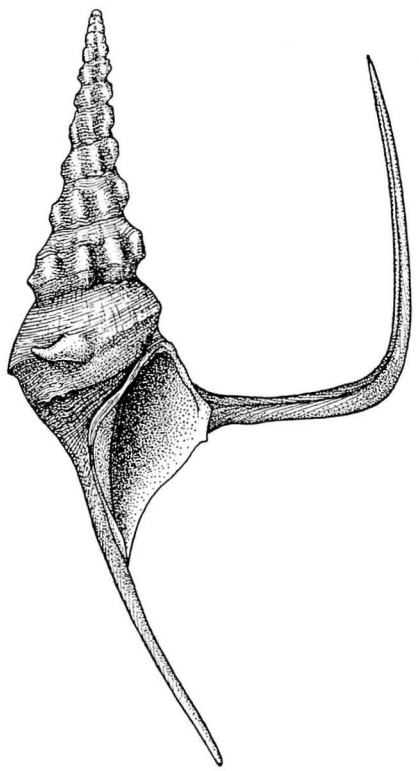
Perissoptera elegans KASE, sp. nov.

Pl. 36, Figs. 11-15.

Material.—Holotype: NSM PM 15045, a nearly complete specimen (Pl. 36, Fig. 14). Paratypes: NSM PM 15046-15049.

Diagnosis.—A medium- or small-sized species of *Perissoptera* characterized by only spirally ornamented body whorl and opisthocyrt sigmoidal axial ribs on spire whorls. Body whorl with a prominent keel. Simple and slender anterior digitation of extended outer lip projected obliquely downwards.

Description.—Medium- or small-sized and thick-shelled aporrhaid with highly turriculate spire attaining less than a third of total shell height. Incremental angle in neighbourhood of later whorls about 35°, while apical angle about 55°. Spire whorls ten in number including protoconch, regularly expanded in size, roundly convex, and separated from each other by impressed suture. Protoconch small, rounded, smooth, naticiform, consisting of about four whorls, gradually changing into ornate teleoconch without a dintinct boundary. Sculpture of spire whorls consistently composed of 13 in number on penultimate whorl, and their inclination against shell axis gradually becomes stronger through growth. Spiral cords fine and numerous (about 30 on penultimate whorl of holotype). Body whorl angularly inflated above, but abruptly becomes narrower anteriorly, forming a moderately long, pointed and nearly straight anterior siphonal canal. Body whorl sculpture consisting of spiral cords, but very weak sigmoidal axial ribs some-



Text-fig. 9. *Pietteia cretacea* KASE, sp. nov. (×1.7).

times occur, and axial ribs abruptly disappeared near boundary of penultimate and body whorls, where a prominent spiral round-topped keel appears. Aperture narrow and lenticular. Outer lip extended into a bifurcated spine. Posterior spine long and narrow, extending slightly downwards initially but gradually turning upward, regularly curved, and becomes almost parallel to shell axis at its posterior end. Posterior spine also curved ventrally. Anterior spine narrow, moderately long, extends obliquely downwards and encounters posterior spine almost right angle.

Remarks.—This species is represented by a large number of specimens collected at Loc. 2, but most of them are fragmental or immature, judging from the development of the outer ilp spines. Three well preserved specimens, illustrated on Plate 36, show the nearly complete shell outline, surface sculpture and the characteristic outer lip spine. The extended outer lip spine of these specimens indicates that these individuals are mature. The holotype (Plate 36, Figure 14) lacks the protoconch and posterior end of the posterior digitation of the bifurcated outer lip, but exhibits the apertural surface. This specimen possesses a complete anterior canal and the mode of the bifurcation of the outer lip spine is well observable. These features of the outer lip are considered as characteristic of *Perissoptera*. One of the paratypes (Plate 36, Figure 15), reveals the adapertural surface and possesses an almost complete outer lip spine and anterior siphonal canal. The mode of bifurcation of the outer lip spine is not different from that of the holotype. In another paratypes (Plate 36, Figure 13) the

Table 6. Measurements in mm. [*Perissoptera elegans* KASE, sp. nov.]

Specimen	Height	Width	Height of aperture	Incremental angle in neighbourhood of later whorls	Apical angle
NSM PM 15045 Holotype	45+	ca. 25	ca. 30	ca. 25°	—
NSM PM 15046 Paratype	44+	27+	29.7	ca. 35°	—
NSM PM 15047 Paratype	37+	25.5+	25+	ca. 30°	—
NSM PM 15049 Paratype	6.4	2.8	—	—	55°

anterior digitation of the outer lip spine is broken off, but the early whorls including protoconch are perfectly preserved.

The present species is very similar to *Anchura* (*Perissoptera*) *marginata* (SOWERBY, 1836), (GARDNER, 1875; COSSMANN, 1904) from the Albian of England, but differs from the European species by the smaller shell size, more flexed axial ribs, more prominent spiral keel on the upper part of the body whorl, and simple and narrower anterior digitation of the outer lip spine.

Anchura (*Perissoptera*) *hannai* ALLISON, 1955 from the middle Albian of Baja California is distinguishable from the present new species by the much smaller shell size, weakly prosocline axial ribs and the presence of short and wide anterior digitation which is differentiated into two parts.

Occurrence.—Known only from the type locality [Loc. 2].

Genus *Pietteia* COSSMANN, 1904

Type-species.—*Rostellaria humus* DESLONGCHAMPS, 1842 from the Bajocian of France. [original designation].

Diagnosis.—Medium- to large-sized aporrhaids with high and turriculate spire. Protoconch consisting of about two smooth whorls. Spire whorls angularly inflated at middle with prominent transverse ribs. Body whorl only spirally sculptured with a posterior prominent and anterior weak spiral carination. Anterior siphonal canal long. Inner lip covered by thick and well-delimited callus.

Remarks.—*Pietteia* corresponds to the second group of *Alaria* of PIETTE (1891), and was established by COSSMANN (1904) as a subgenus of *Dicroloma* GABB, 1868. WENZ (1938), on the other hand, placed *Pietteia* as a subgenus of *Anchura* CONRAD, 1860 together with *Dicroloma*. *Pietteia* differs decidedly from *Anchura* by the presence of a simple, narrow and long outer lip spine, posterior prominent and anterior weak spiral carinations on the body whorl, angulated spire whorls and presence of a rather long spine at the ramp angle of the body whorl. The presence of the long spine at the ramp angle of the body whorl is also found in certain species of *Dicroloma*. *Dicroloma*, however, is distinguished from *Pietteia* by some important points; that is, *Dicroloma* possesses a bifurcated outer lip spine, only spirally sculptured whorls, a prominent anterior spiral carination on the body whorl and the lack of thick and well-delimited callus on the inner lip. For these reasons, *Pietteia* is here accepted as a distinct genus.

Geological range of *Pietteia*, according to COSSMANN (1904), is from the Sinemurian to Sequanian. No Cretaceous species has been assigned to *Pietteia* except for one species, *Anchura* (*Pietteia*) *schweifurthi* (QUAAS, 1902) from the Maestrichtian of Egypt (ABBAS, 1963). However, the Egyptian species, according to the descriptions and illustrations by QUAAS (1902) and ABBAS (1963), cannot be assigned to *Pietteia* because of its different surface sculpture and lack of a spine on the ramp angle of the body whorl. The new species described in this paper, therefore, is the first record of true *Pietteia* from the Cretaceous.

Pietteia cretacea KASE, sp. nov.

Pl. 36, Figs. 4-10; Text-fig. 9.

Material.—Holotype: NSM PM 15050, (Pl. 36, Fig. 10). Paratype: NSM PM 15051-15055.

Diagnosis.—A large-sized species of *Pietteia* characterized by long outer lip spine and a long spine at ramp angle of

body whorl three-fourths volution back from outer lip. Aperture broad. Spire whorls with broad subsutural ramp and ornamented by eight to ten slightly prosocline raised axial ribs.

Description.—Shell larse-sized having high, evenly tapering and slightly coelconoid spire. Incremental angle in neighbourhood of earliest teleoconch about 20°. Spire attaining about one half of total shell height with eleven angularly inflated whorls. Suture impressed. Protoconch poorly known, consisting of about two small and smooth whorls. Each spire whorl with concave and steeply inclined broad ramp. Spire whorls sculptured by axial ribs and spiral cords. Axial ribs strong, weakly prosocline, round-topped, much narrower than their interspaces and ten in number on penultimate whorl but eight or less on early whorls. Axial ribs obscure on ramp, but abruptly appearing near ramp angle. Spiral cords very fine and regularly spaced, two of which prominent at middle position of whorl and becoming more or less tuberculated at intersections with axial ribs. Posterior carination continuing with outer lip spine and appearing near boundary between penultimate whorl and body whorl and gradually strengthened towards aperture. Several prominent spiral cords present below anterior carination. Outer lip spine thick, stout, and extending nearly horizontal at first but rather abruptly turned slightly backwards with pointed end. Aperture broad, elongate subovate, rounded posteriorly, and angulated anteriorly in harmony with siphonal canal. Outer lip rounded; posterior part of outer lip thick and opisthocyrt, and anterior part thin and sharp at its edge. Inner lip regularly concave with a well-delimited heavy callus. On body whorl a long and thick spine situated at the ramp angle three-fourths volution back from outer lip.

Remarks.—Five specimens are available for study. The two characteristic carinations on the body whorl are well seen on one of the paratypes (Plate 36, Figures 8a, b), although its apical part and anterior siphonal canal are broken. The long spine on the ramp angle in this specimen lacks a free end which presumably curves towards adapertural direction and seems to extend only a little judging from its termination. The presence of the spine on the ramp angle is also shown in the holotype and two specimens (Plate 36, Figures 5, 9), which bear the mark of spine at three-fourths volution back from the outer lip. The sculpture of the body whorl is well represented on the holotype and two of the paratypes (Plate 36, Figures 4, 5), comprising two prominent spiral carinations and several subordinate ones, and very fine spiral cords. The spine at the ramp angle of the body whorl are consistently present at three-fourths volution back from the outer lip.

Compared with *Anchura* (*Pietteia*) *hamus* (DESLONGCHAMPS, 1842) (PIETTE, 1891; WENZ, 1940) from the Bajocian of France, the new species is larger and has a longer

Table 7. Measurements in mm. [*Pietteia cretacea* KASE, sp. nov.]

Specimen	Height	Width	Height of aperture	Incremental angle in neighbourhood of the early whorls
NSM PM 15050 Holotype	48.5+	28.5+	21.5+	20°
NSM PM 15051 Paratype	32.5+	24.4+	16+	—
NSM PM 15054 Paratype	49.5+	37.3+	30.5+	—

outer lip spine, wider aperture, smaller spical angle and finer spiral cords.

Occurrence.—Known only from the type locality [Loc. 2].

Genus *Ceratosiphon* GILL, 1870

[=*Ornithopus* GARDNER, 1875; non HICHCOCK, 1848]

Type-species. — *Pterocera moreausiana* D'ORBIGNY, 1848 from the Neocomian of France. [original designation]

Diagnosis.—Moderately large-sized and short spindle-shaped aporrhaids with low spire. Whorls generally about seven in number and prominently angulated at middle with only spiral sculpture. Protoconch consisting of two or three, initial, smooth, naticiform whorls, and a succeeding rounded whorl with reticulated ornamentation. Body whorl bicarinated. Outer lip extended to three long, narrow and tapering spines, grooved internally with corresponding external ridges; posterior spine adnate to spire. Inner lip covered by a thin but widely spread callus. Anterior siphonal canal long and thin with (or without) a thin spine branching from neck to opposite side of aperture.

Remarks.—Several aporrhaid gastropods from the Cretaceous beds from Europe, which were listed by COSSMANN (1904, p. 57, 58) as members of *Tessarolax* GABB, 1864 are not typical for the genus as stated by STEWART (1926, p. 364). *Ceratosiphon* was established by GILL (1870) (STEWART, 1926) on the basis of *Pterocera moreausiana* D'ORBIGNY from the Neocomian of France as the type-species. Subsequently, GARDNER (1875) proposed the genus *Ornithopus* on the basis of *Rostellaria retusa* SOWERBY, 1836 as the type-species, but the generic name was preoccupied by HICHCOCK (1848) (COSSMANN, 1904) for a reptile. COSSMANN (1904), as followed by WENZ (1940), regarded *Ceratosiphon* as the junior synonym of *Tessarolax*, stating "***En ce qui concerne *Ceratosiphon* GILL, dont le type est *Pterocera Moreausiana* D'Orbigny, je ne puis apercevoir absolutment aucune différence sectnelle entre cette coquille et *Tessarolax*: l'absence de gibbosite opposée au labre n'est probablement que fortuire chez *P. Moreausiana*, le labre est peut-être un peu plus parmé que chez *T. distortum*, mais les digitations sont absolument semblables. Par son séquent, *Ceratosiphon* est synonym posterier de *Tessarolax*."

Since then, several aporrhaid gastropod species characterized by biangulated body whorl and five long and narrow spines mainly from the Lower Cretaceous in western Europe were regarded as *Tessarolax*. This is probably because of the incomplete preservation of the material of *Tessarolax distortum* and incomplete generic definition of this genus. In my opinion a prominent axial projection on the opposite side of the body whorl of the aperture in the genus *Tessarolax* is conservative of this genus. *Tessarolax*, in general, has larger shell size than *Ceratosiphon*, more numerous spire whorls, higher spire, thick deposition of callus over the shell surface and the anterior siphonal canal without a branching spine. The two, therefore, must be generically distinguished. *Tessarolax* is probably well represented in the Upper Cretaceous of North America, Japan and southern India. *Ceratosiphon*, on the other hard, previously was known only from the Lower Cretaceous and Cenomanian of western Europe.

The following species appear to belong to *Ceratosiphon*:

Pterocera moreausiana D'ORBIGNY, 1843 (GARDNER, 1875) from the Neocomian of France.

Rostellaria retusa SOWERBY, 1836 (GARDNER, 1875; COSSMANN, 1907) from the

Lower Albian of England.

Pterocera fittoni FORBES, 1845 from the Lower Aptian of England.

Rostellaria bicarinata DESHAYES in LEYMERIE, 1842 from the Albian of France. D'ORBIGNY (1843) described one aporrhaid gastropod species under the name of *Pterocera bicarinata* from the Albian of France. His figure has a higher spire than a type specimen of *Rostellaria bicarinata* DESHAYES and has a distinct projection on the opposite side of the body whorl of the aperture, and is very different from DESHAYES's figure.

Aporrhais histochila GARDNER, 1875 from the Albian Upper Greensand of England.

Aporrhais oligochila GARDNER, 1875 from the Cenomanian Gray Chalk of England.

Aporrhais ebrayi DE LORIOL, 1882 from the Gault of France.

?*Aporrhais* (*Tessarolax*) *gardneri* KEEPING, 1883 from the Upper Aptian of England.

Aporrhaid gen. et sp. indet., MATSUKAWA, 1977 from the upper part of the Ishido Formation (Barremian) of Sanchu area, central Japan.

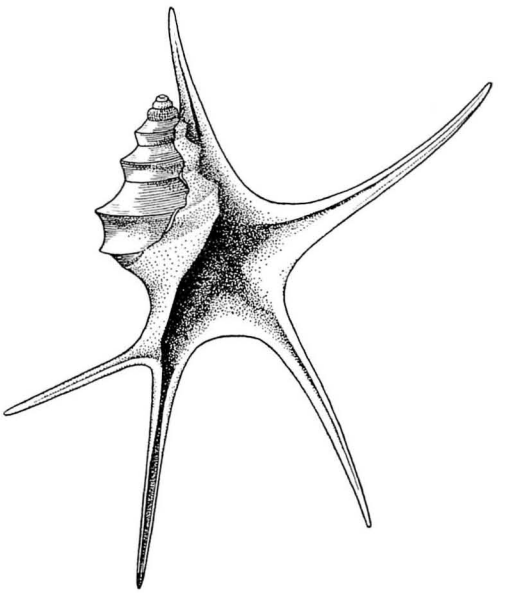
Ceratosiphon densestriatus

KASE, sp. nov.

Pl. 36, Figs. 1-3; Text-fig. 10.

Material.—Holotype: NSM PM 15056, a nearly complete specimen (Pl. 36, Fig. 1). Paratypes: NSM PM 15057-15062.

Diagnosis.—A large-sized species of *Ceratosiphon* characterized by a proportinally higher spire, prominently biangulated body whorl and impressed suture. Posterior spine extended slightly beyond spire. Anterior siphonal canal thin with a thin spine branching from posterior part at nearly a right angle. Surface sculptured by numerous very fine spiral threads.



Text-fig. 10. *Ceratosiphon densestriatus* KASE, sp. nov. (×2.5).

Description.—Shell large but thin-shelled with more or less abruptly tapered spire. Incremental angle in neighbourhood of body and penultimate whorls about 40° but apical angle about 90°. Volutions seven or eight in number. Protoconch of three smooth and well rounded naticiform whorls, followed by a fourth well rounded whorl bearing cancellated ornamentation consisting of six distinct and regularly spaced fine spiral cords and similarly strengthened opisthocyrt axial threads. Spire whorls regularly expanded, separated by impressed suture. Whorls abruptly changing from protoconch without distinct boundary. Second and third teleoconch whorls prominently angulated at middle with broad ramps and nearly vertical whorl sides. Surface sculpture of second teleoconch whorl consisting of three spiral cords on ramp and nine finer ones on the whorl side. Third teleoconch whorl with

much finer and numerous spiral cords or threads. Axial sculpture of these whorls much finer than that of first teleoconch whorl. Body whorl prominently biangulated at periphery, convex and anteriorly constricted, and ornamented by much finer and numerous spiral threads. Aperture wide and semilunar in outline. Outer lip with three extended outer lip spines. Posterior spine thick, adnate to spire and more or less extended posteriorly beyond spire; two other spines extended from two ridges of body whorl and moderately long for this group. Anterior siphonal canal thin and slightly curved with a thin spine branching from posterior part at nearly a right angle. Inner lip long and nearly straight with a thin callus that extends onto body whorl.

Remarks.—Six specimens are available for this study. The holotype is a nearly complete specimen and reveals well the shell characters of the apertural side, but the ends of the anterior spine of the outer lip and the thin spine branching from the anterior siphonal canal are not preserved. All other specimens are incomplete and fragmental, two of which illustrated in Plate 36 show the apertural and adapertural surface characters and the characteristic protoconch. The presence of a long and slender spine branching from the neck of the anterior siphonal canal is well preserved in the holotype and one of the paratypes (Plate 36, Figure 2a). Several other specimens, which lack anterior siphonal canal, evidently show the trace of the branching spine.

Aporrhais ebrayi DE LORIOL, 1882 from the Gault of Cosne, France is very similar to *Ceratosiphon densestriatus* in the shell outline and the arrangement of the outer lip spines and anterior siphonal canal, but possesses much coarser spiral sculpture, less prominent spiral angulations on the body and spire whorls and shorter posterior outer lip spine than *Ceratosipnon densestriatus*.

The new species is easily distinguishable from *Rotellaria retusa* SOWERBY, 1836 (GARDNER, 1875; COSSMANN, 1907) from the Albian of England by its higher spire, much finer spiral sculpture, impressed suture and shorter and slender outer lip spines.

Occurrence.—Known only from the type locality [Loc. 2].

Superfamily Hipponicacea

Family Vanikoroidae

Genus *Vanikoropsis* MEEK, 1876

Type-species.—*Natica toumeyana* MEEK and HAYDEN, 1856 from the Senonian of North Dakota. [original designation]

Vanikoropsis decussata (DESHAYES)

Pl. 35, Figs. 1, 2.

1842. *Littorina decussata* DESHAYES in LEYMERIE, *Mém. Soc. géol. France*, vol. 5, fasc. 1, p. 13, pl. 17, fig. 16.
1842. *Turbo decussatus* (DESEAYES): D'ORBIGNY, *Paléont. franç., terr. cret.*, vol. 2, p. 219, pl. 184, figs. 11-13 (non MONTAGU, 1815).
1850. *Turbo alsus* D'ORBIGNY, *Prodrome de Paléont.*, vol. 2, p. 130.
1863. *Turbo alsus* D'ORBIGNY: PICTET and CAMPICHE, *Matér. Paléont. Suisse*, ser. 2, p. 496.
1882. *Turbo alsus* D'ORBIGNY: DE LORIOL, *Mém. Soc. paléont. Suisse*, vol. 9, p. 31-33, pl. 3, figs. 16-20.

Material.—NSM PM 15063, 15064.

Diagnosis.—A very small species of *Vanikoropsis* characterized by having thin test and surface sculpture of narrow spiral ribbons and transverse ribs.

Description.—Shell very small, thin, phaneromphalus and elongate turbiniform

Table 8. Measurements in mm. [*Vanikoropsis decussata* (DESHAYES)]

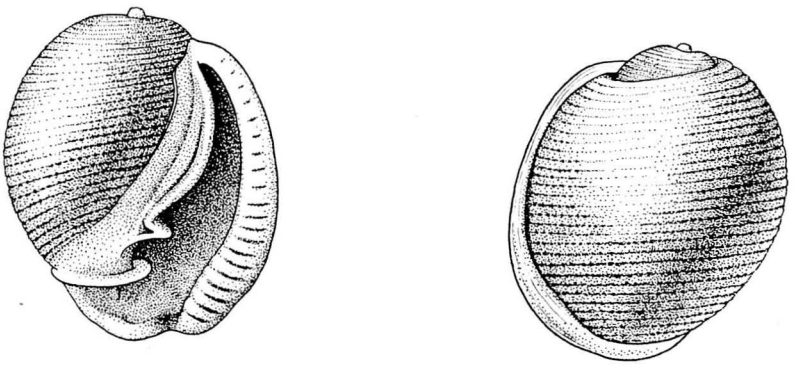
Specimen	Height	Maximum width	Minimum width	Height of aperture	Incremental angle in neighbourhood of penultimate and body whorls
NSM PM 15063	ca. 6.8	5.3	4.2	4.0	70°
NSM PM 15064	ca. 7.9	—	ca. 5.4	ca. 4.6	80°

with conical and accuminate spire. Spire occupied about two-fifths of total shell height. Whorls at least five in number and regularly expanded. Spire whorls moderately convex and separated by impressed suture. Body whorl large, slightly wider than high with regularly rounded whorl sides. Umbilicus widely open, deep and delimited from roundly convex base without any angulation. Aperture moderately wide, obtusely acute above and rounded below, and almost parallel to shell axis, with height about 1.4 times width. Parietal area with thin callus. Inner lip weakly arched over parietal and columellar area and well rounded below. Surface of spire whorls sculptured by five narrow ribbons and slightly prosocyrt transverse ribs, and tuberculated at their intersections. Transverse ribs 20 to 24 in number on penultimate whorl. Body whorl sculptured by narrow spiral ribbons and somewhat sigmoidal transverse ribs. Spiral ribbons wider on anterior half than those on posterior half and 18 to 20 in number. Transverse ribs gradually weakened towards base and also near aperture.

Remarks.—Two specimens are available for study. One illustrated specimen (Plate 35, Figures 1a-c) is well preserved and well exhibits the apertural features and delicate surface sculpture, but its protoconch is missing. The other illustrated specimen (Plate 35, Figures 2a-c) lacks the apertural part, and the shell surface is somewhat abraded. The crowded growth lines near the aperture, which are well observed in first specimen, are assumed to be a feature of maturity. The first specimen differs in shape from the second by smaller apical angle and more slender shell outline, but they must be conspecific, judging from the surface sculpture and umbilical character.

In every essential character the present specimens agree well with *Turbo alsus* (DESHAYES) sensu DE LORIOL (1882) from the Gault of Cosne in France. The shell size, ornamentation and elongate turbiniform shell outline are especially similar to those of the specimens from Cosne. That species was established by DESHAYES in LEYMERIE (1842) from the Gault of Aube in France. The present specimens have wider shell outline than those of Aube. The specimen illustrated by d'ORBIGNY (1842), on the contrary, has much higher shell outline than that of Aube, but is similar to those of Cosne. DE LORIOL (1882) stated that the discrimination of the specimens between Aube and Cosne is very difficult so far as the range of variation of the specimens from Cosne was examined.

Taxonomic position of the genus *Vanikoropsis* and assignment of several Jurassic and Cretaceous species to this genus were discussed by SOHL (1967). According to him, only two species, *Vanikoropsis toumeyana* (MEEK and HAYDEN) from the Maestrichtian of North Dakota and *Vanikoropsis nebrascensis* (MEEK and HAYDEN) from the Maestrichtian of Wyoming, Montana, South Dakota and Colorado, have been known, and several species once assigned to *Vanikoro* or *Vanikoropsis*



A B

Text-fig. 11. *Eriptycha japonica* KASE, sp. nov. (×8.7).

belong to other genera. Recently, HAYAMI and KASE (1977) assigned *Natica (Lunatia) ainuana* NAGAO, 1939 from the Coniacian or Santonian Upper Ammonite Bed (Upper Yezo Group) of south Saghalin to *Vanikoropsis*. The present species agrees well with the above-mentioned Upper Cretaceous species in shell outline, surface sculpture and umbilical feature, and is probably congeneric with them. However, it differs from the three Upper Cretaceous species by the much smaller shell size, thinner shell and sculpture consisting of spiral ribbons and transverse ribs.

Occurrence.—Loc. 2

Order Cephalaspidea

Subfamily Acteonacea

Family Ringiculidae

Genus *Eriptycha* MEEK, 1876

[=*Euptycha* MEEK, 1863; non HÜBNER, 1826]

Type-species.—*Auricula decurtata* SOWERBY, 1831 from the Turonian of Gosau in Austria. [original designation]

Diagnosis.—Large- to small-sized and low-spired ringiculid shell. Much thickened outer lip denticulate within. Columellar lip with one fold which sometimes bifid. Parietal lip much thickened by callus with a various-shaped prominent axial ridge. Surface sculptured by punctate spiral grooves. Anterior canal more or less defined.

Remarks.—Discrimination of the genus *Avellana* from the genus *Eriptycha* and some other Cretaceous ringiculid genera is somewhat controversial. This is partly because the characteristics of the inner lip structure of the genus *Avellana* are not clear. *Eriptycha* is very similar to *Avellana* in shell outline, surface sculpture and outer lip structure, but differs from the latter genus by the parietal lip which bears a strong axial ridge.

Eriptycha japonica KASE, sp. nov.

Pl. 34, Figs. 12, 13; Text-fig. 11.

Material.—Holotype: NSM PM 15065 (Pl. 34, Figs. 12a, b), Paratype: NSM PM 15066

Diagnosis.—A very small species of *Eriptycha* characterized by short spire

Table 9. Measurements in mm. [*Eriptycha japonica* KASE, sp. nov.]

Specimen	Height	Maximum width	Minimum width	Height of aperture
NSM PM 15065 Holotype	5.0	4.2	3.1	4.6
NSM PM 15066 Paratype	5.2	4.7	3.7	4.7

and cylindrical shell outline. Denticles along inner margin of outer lip weak and about 20 in number. Parietal axial ridge reinforced with a prominent V-shaped projection on lower part. Anterior siphonal canal deep and wide. Spiral grooves of body whorl about 30 in number.

Description.—Shell very small, low-spired and subelliptical in front view. Height slightly greater than width. Teleoconch regularly rounded and rapidly expanded with about 2.5 volutions. Suture impressed. Heterostrophic protoconch very small, pointed above teleoconch, and consisting of at least one smooth whorl. Body whorl very large, occupied about 0.9 of total shell height, with regularly rounded sides. Aperture narrow, constricted by prominent fold and ridge, narrowed and tapered posteriorly and broadened anteriorly with reversed comma-shaped outline. Outer lip long, almost parallel to shell axis, reinforced, moderately thickened by callus that is reflected out of aperture back onto body whorl. Inner surface of outer lip with about 20 weak denticles. Inner lip covered by well-margined callus, long, convex in posterior but strongly concave below and continues to outer lip forming a posterior canal. Parietal wall bearing a J-shaped strong ridge with a vertical bar as a ridge subparallel to posterior canal and its abaxial edge is prominently reinforced by callus. A prominent V-shaped projection is present on lower part of parietal wall. Columella with a strong and nearly horizontal fold which extended to aperture. Surface of body whorl sculptured by about 30 punctate spiral grooves that separeted by flat-topped spiral cords.

Remarks.—In this collection the present species is represented only by two specimens. The holotype is complete and shows the characteristic features of inner and outer lips. The paratype also shows the apertural features, but the shell surface is more or less abraded. The heterostrophic protoconch is well preserved in the holotype and consists of a smooth whorl, but its earlier whorl(s) seems to be submerged below the surface of the teleoconch.

Avellana minima NAGAO, 1934 from the Aptian Miyako Group of Northeast Japan is very similar to the new species in many essential points. Many well preserved specimens of *Avellana minima* collected near the type locality reveal that the much thickened parietal lip has a reinforced axial ridge in the upper part and a plication in the lower part, the columellar lip has an almost horizontal fold at its middle and the outer lip is denticulate internally. These features indicate that the two species are congeneric. *Avellana minima*, however, differs from the new species by the wider shell outline, smaller number of denticles on the outer lip (eight in number) and smaller number of spiral grooves (15 or 16 on the body whorl).

The new species resembles *Euptycha globata* STOLICZKA, 1868 from the Turonian or Coniacian of southern India, but differs from that species in the elliptical and much smaller shell, lower spire, one prominent V-shaped projection on the

lower part of the parietal wall and finer surface ornamentation.

Occurrence.—Known only from the type locality [Loc. 2].

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Explanation of Plate 34

Figs. 1, 2a, b, 14a-c. *Metriomphalus nagasakiensis* KASE, sp. nov.

1. Front view of a paratype (×2.0) from the Kimigahama Formation at Loc. 3. GIYU-MM-107.

2a, b. Front and back views of a paratype (×2.0) from the Kimigahama Formation at Loc. 3. GIYU-MM-106.

14a-c. Front, apical and back views of the holotype (×2.0) from the Kimigahama Formation at Loc. 3. GIYU-MM-104.

Figs. 4a, b. *Oolitica* sp.

Back and front views of a specimen (×1.5) from the Isejigaura Formation at Loc. 1. NSM PM 15044.

Figs. 5a-c, 6a-c, 7a, b. *Calliostoma? ojii* KASE, sp. nov.

5a-c. Front, back and basal views of a paratype (×3.0) from the Kimigahama Formation at Loc. 2. NSM PM 15003.

6a-c. Front, back and basal views of a paratype (×3.0) from the Kimigahama Formation at Loc. 2. NSM PM 15002.

7a, b. Back and front views of the holotype (×3.0) from the Kimigahama Formation at Loc. 2. NSM PM 15000.

Figs. 3a, b, 8a, b, 9a, b, 10a, b, 11a-c. *Ataphrus* (s. str.) *nipponicus* KASE, sp. nov.

3a, b. Apical and front views of a paratype (×2.5) from the Kimigahama Formation at Loc. 2. NSM PM 15017.

9a, b. Front and back views of a paratype (×2.5) from the Kimigahama Formation at Loc. 2. NSM PM 15011.

10a, b. Front and back views of a paratype (×2.5) from the Kimigahama Formation at Loc. 2. NSM PM 15012.

11a-c. Back, front and apical views of the holotype (×2.5) from the Kimigahama Formation at Loc. 2. NSM PM 15007.

Figs. 15a, b, 16. *Amberleya* (*Eucylus*) *japonica* KASE, sp. nov.

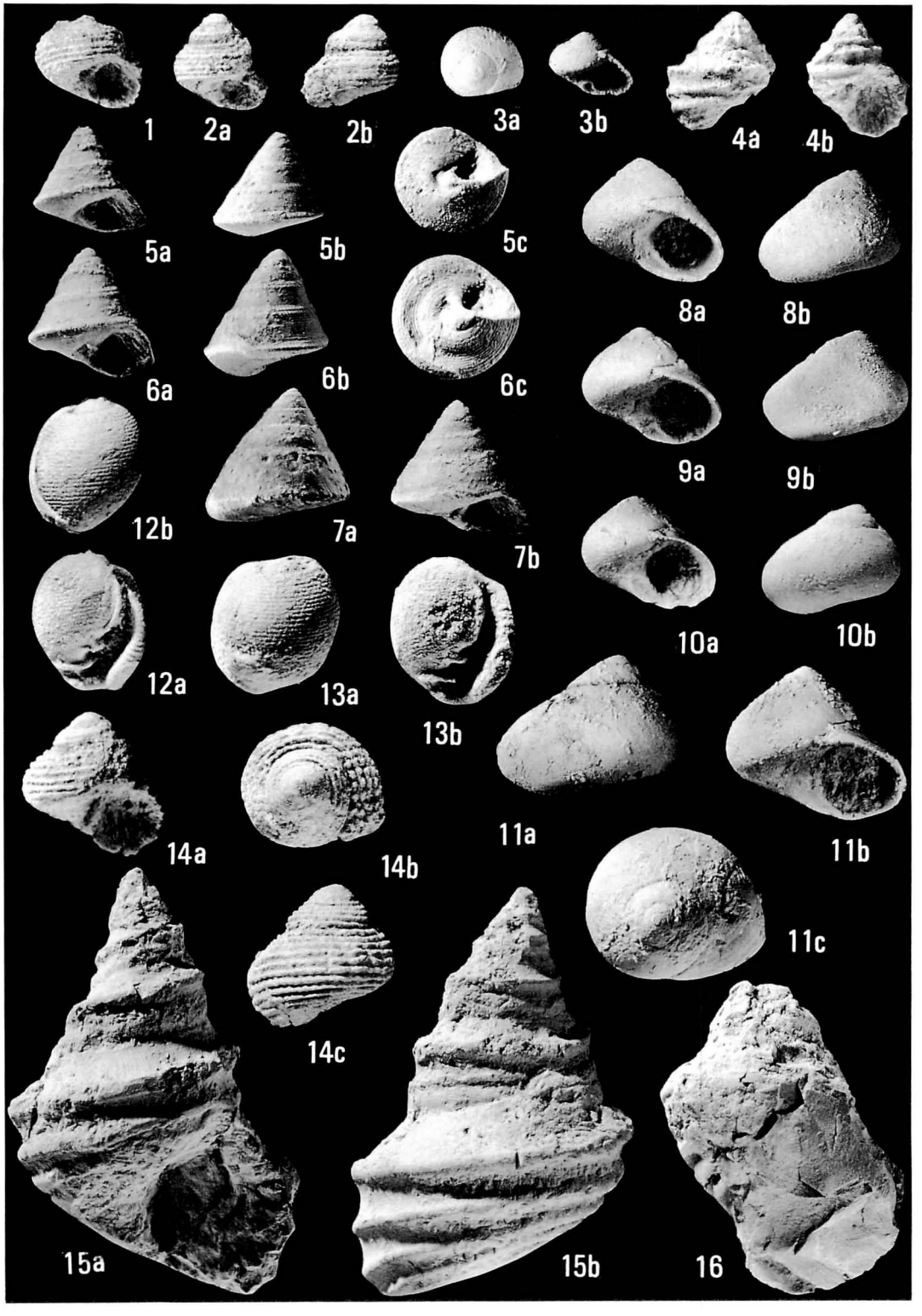
15a, b. Front and back views of the holotype (×1.0) from the Isejigaura Formation at Loc. 1. NSM PM 15042.

16. Front view of a paratype (×1.0) from the Isejigaura Formation at Loc. 1. NSM PM 15043.

Figs. 12a, b, 13a, b. *Eriptycha japonica* KASE, sp. nov.

12a, b. Front and back views of the holotype (×4.0) from the Kimigahama Formation at Loc. 2. NSM PM 15065.

13a, b. Back and front views of a paratype (×4.0) from the Kimigahama Formation at Loc. 2. NSM PM 15066.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Ashikajima-cho 海鹿島町　Choshi 銚子　Inubo-zaki 犬吠埼　Isejigaura 伊勢路ヶ浦
Kimigahama 君ヶ浜　Kurohae-cho 黒生町　Nagasaki-cho 長崎町　Nagasakihana 長崎鼻
Toriakeura 酉明浦

Explanation of Plate 35

Figs. 1a-c, 2a-c. *Vanikoropsis decussata* (DESHAYES)

1a-c. Front, apical and back views of a specimen (×4.0) from the Kimigahama Formation at Loc. 2. NSM PM 15063.

2a-c. Apical, front and back views of a specimen (×4.0) from the Kimigahama Formation at Loc. 2. NSM PM 15064.

Figs. 3a, b, 4a-c. *Hayamia choshiensis* KASE, gen. et sp. nov.

3a, b. Back and apical views of a paratype (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15041.

4a-c. Front, apical and back views of the holotype (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15040.

Figs. 5a, b, 6a, b, 7a-c, 8a-c, 9a-c, 10. *Hayamia rex* KASE, gen. et sp. nov.

5a, b. Ventral and dorsal surfaces of an operculum (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15039.

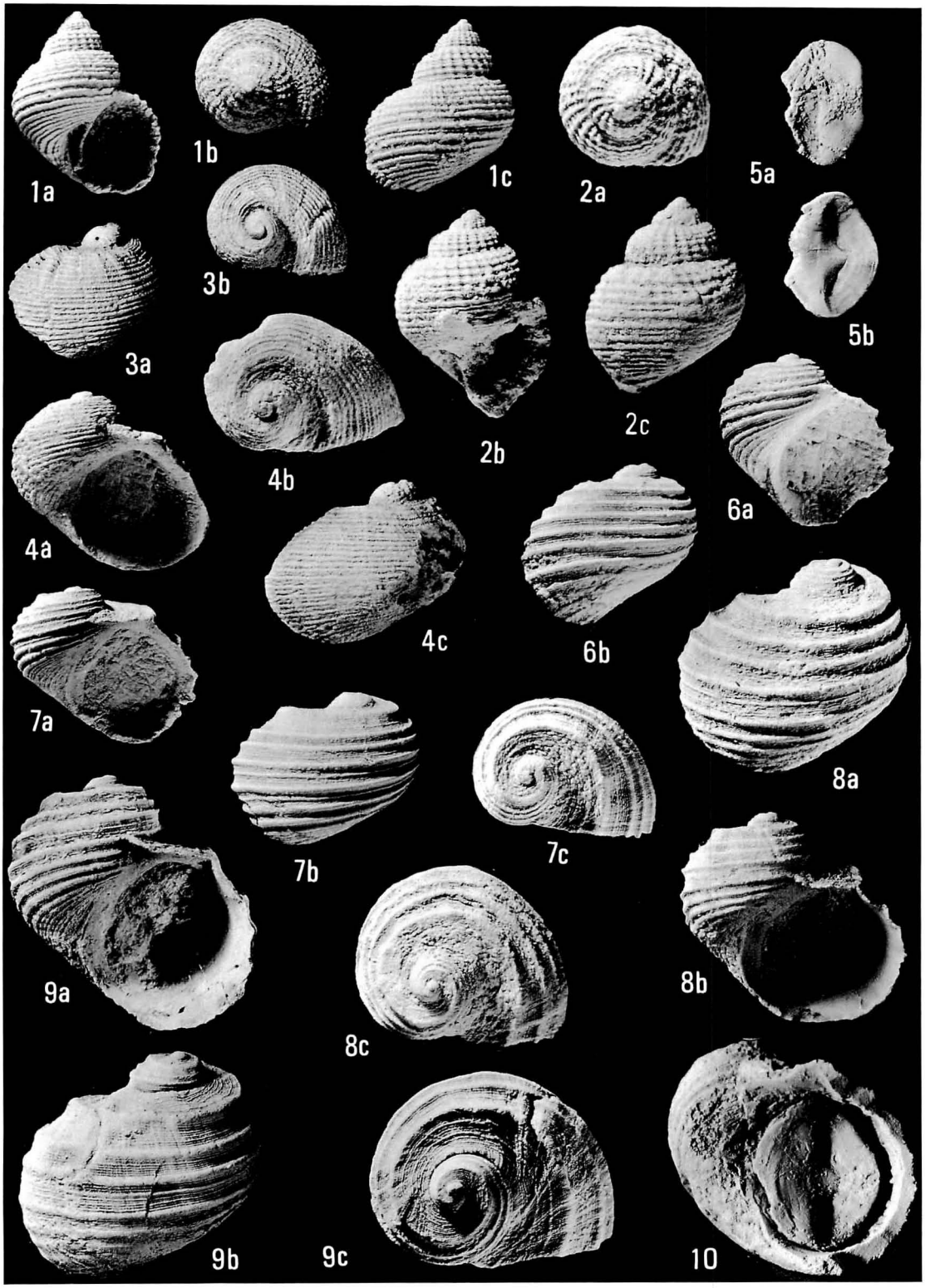
6a, b. Front and back views of a paratype (×1.2) from the Kimigahama Formation at Loc. 2. NSM PM 15034.

7a-c. Front, back and apical views of a paratype (×1.2) from the Kimigahama Formation at Loc. 2. NSM PM 15035.

8a-c. Back, front and apical views of a paratype (×1.2) from the Kimigahama Formation at Loc. 2. NSM PM 15032.

9a-c. Front, back and apical views of the holotype (×1.2) from the Kimigahama Formation at Loc. 2. NSM PM 15031.

10. Operculum preserved nearly *in situ* in the aperture (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15038.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千葉県銚子地方の前期白亜紀腹足類：

千葉県銚子地方の前期白亜紀層より得られた保存良好な軟体動物化石を検討した結果，10新種を含む11属12種の腹足類化石 (*Calliostoma? ojii* KASE, sp. nov., *Ataphrus* (s. str.) *nipponicus* KASE, sp. nov., *Hayamia rex* KASE, sp. nov., *Hayamia choshiensis* KASE, sp. nov., *Amberleya* (*Eucyclus*) *japonica* KASE, sp. nov., *Oolitica* sp., *Metriomphalus nagasakiensis* KASE, sp. nov., *Perissoptera elegans* KASE, sp. nov., *Pietteia cretacea* KASE, sp. nov., *Ceratosiphon densestriatus* KASE, sp. nov., *Vanikoropsis decussata* (DESHAYES) and *Eriptycha japonica* KASE, sp. nov. を識別・鑑定したので記載する。これらの中には，腹足類の系統分類学上，注目すべきいくつかの種が含まれている。*Hayamia*属は殻の外形，表面装飾，楕円形のフタを持つこと，および内唇の中央部に凹みを持たない点でNeritopsinae 亜科の他の属から区別され，さらに *Hayamia* 属のフタは *Naticopsis* 属のそれに類似する。以上の事実は，*Hayamia* 属と *Naticopsis* 属の親密な類縁関係が暗示され，*Hayamia* 属が *Neritopsis* 属とは異なった系列に沿って進化したことを暗示する。*Pietteia cretacea* は翼状に伸びた外唇に直交する棘を持つ特異なモミジソデの一種類で，従来本属はジュラ紀にのみ知られていたが，今回の報告により，前期白亜紀にも存在することが明らかになった。*Ceratosiphon* 属は COSSMANN (1907) 以来 *Tessarolax* 属のシノニムと見なされてきたが，両属が独立の属であることを示した。銚子層群産腹足類群の中には，フランスやイギリスのバレミアン，アプチアンあるいはアルビアンのものと共通，あるいは近縁な種が多く含まれている。

加瀬　友喜・前田　晴良

Explanation of Plate 36

Figs. 1, 2a, b, 3. *Ceratosiphon densestriatus* KASE, sp. nov.

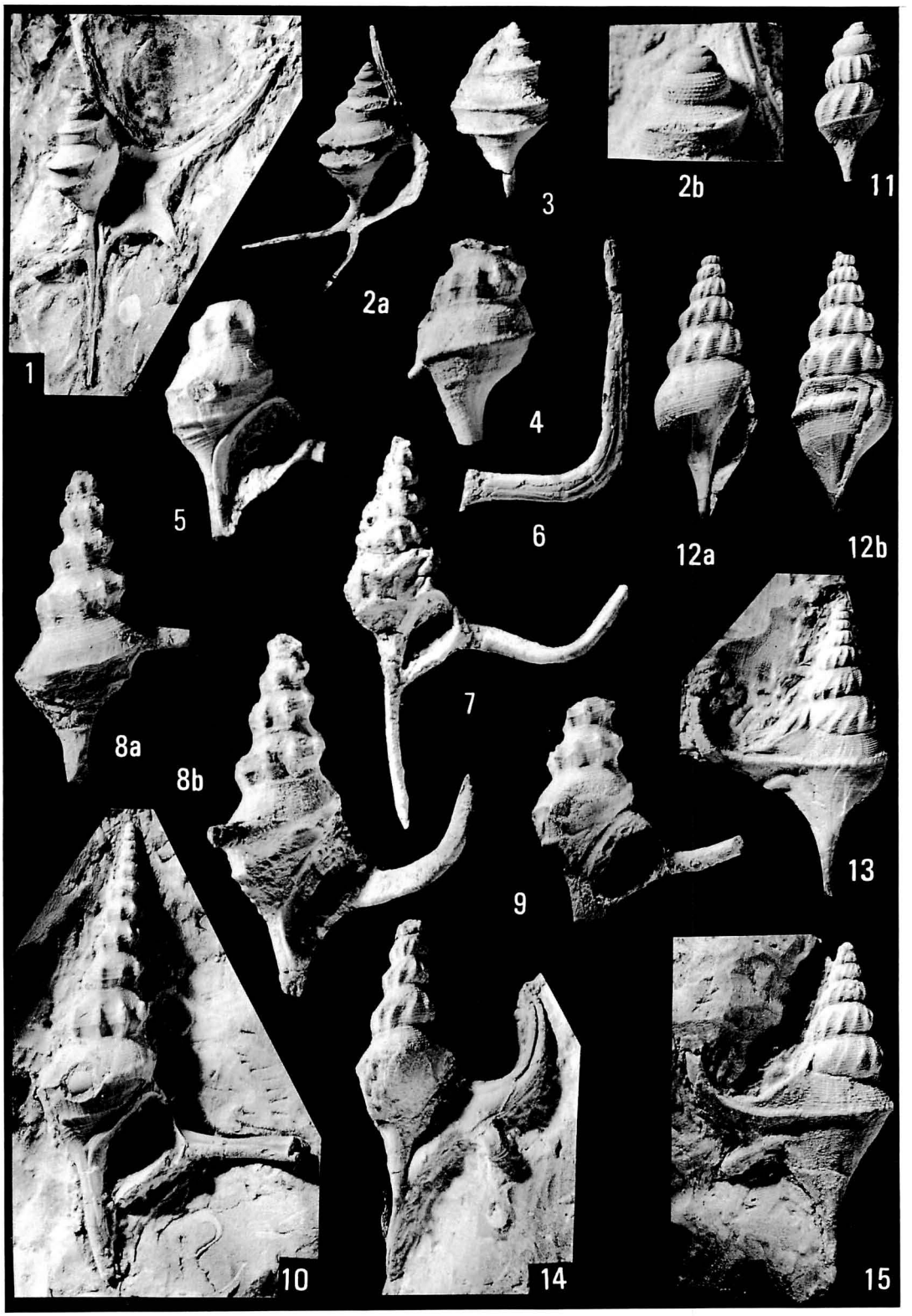
1. Front view of the holotype (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15057.
2a, b. Front view (×1.5) and enlargement (×4.5) of a paratype from the Kimigahama Formation at Loc. 2. NSM PM 15058.
3. Back view of a paratype (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15059.

Figs. 4-7, 8a, b, 9, 10. *Pietteia cretacea* KASE, sp. nov.

4. Back view of a paratype (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15053.
5. Front view of a paratype (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15052.
6. View of the outer lip spine of a paratype (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15056.
7. Front view of a paratype (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15054.
8a, b. Lateral and front views of a paratype (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15051.
9. Front view of a paratype (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15055.
10. Front view of the holotype (×1.5) from the Kimigahama Formation at Loc. 2. NSM PM 15050.

Figs. 11, 12a, b-15. *Perissoptera elegans* KASE, sp. nov.

11. Lateral view of a paratype (×4.0) from the Kimigahama Formation at Loc. 2. NSM PM 15049.
12a, b. Front and back views of a paratype (×1.2) from the Kimigahama Formation at Loc. 2. NSM PM 15048.
13. Back view of a paratype (×1.2) from the Kimigahama Formation at Loc. 2. NSM PM 15047.
14. Front view of the holotype (×1.2) from the Kimigahama Formation at Loc. 2. NSM PM 15045.
15. Back view of a paratype (×1.2) from the Kimigahama Formation at Loc. 2. NSM PM 15046.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Trans. Proc. Palaeont. Soc. Japan, N.S., No. 118, p. 325-338, pl. 37, June 30, 1980

717. CEPHALOPOD FAUNULE FROM THE CRETACEOUS YATSUSHIRO FORMATION (KYUSHU) AND ITS IMPLICATIONS*

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and

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Abstract. This is a report on the cephalopod faunule from the Cretaceous Yatsushiro Formation in southwestern Kyushu. It consists of 5 species from three localities, which are assigned to the middle part of the Yatsushiro Formation. One is a new species of *Heminautilus*, a peculiar nautiloid which deviates much in shell-form from *H. saxbii* (MORRIS), being apparently similar to certain species of *Paracenoceras*. Others are ammonites, *Brewericeras* n. sp., allied to *B. hulenense* (ANDERSON) from the Pacific Coast of North America, *Prolyelliceras*(?) sp., *Epileymeriella* aff. *hitzeli* (JACOB) and *Platiknemiceras* n. sp., allied to *P. gracile* (DOUVILLÉ). Palaeontological descriptions are given by the senior author. The faunule is interesting in that both the North Pacific and the Tethys Sea elements intermingled. The ammonites indicate the Lower Albian. As the Yatsushiro Formation contains land flora and some non-marine to brackish water molluscs in its lower and upper parts, the cephalopod faunule gives a key to correlate the fossils of different facies.

Introduction

As has already been described (MATSUMOTO, ed., 1954; MATSUMOTO and KANMERA, 1964), folded and thrust-faulted Cretaceous formations are exposed in the mountainous area to the south of Yatsushiro, Kumamoto Prefecture, Kyushu. One of them is the Albian Yatsushiro Formation, from which several cephalopod fossils were obtained. This paper is to report a result of our study on them. For the palaeontological descriptions one of us (T. M.) alone is responsible.

* Received February 18, 1980; read June 10, 1979 at Tatsunokuchi.

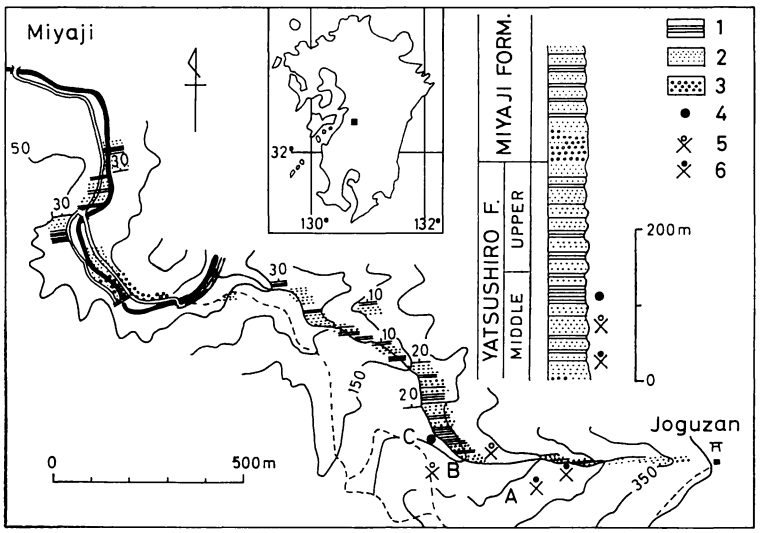

Fig. 1. Geological route map and the stratigraphic profile between Miyaji and Joguzan (prepared by Y. OHTA). 1: shale, 2: sandstone, 3: conglomerate, 4: locality of ammonites (*Brewericeras* n. sp. and *Prolyelliceras* sp.), 5: marine invertebrate fossils, 6: brackish water fossils. Inset is an outline map of Kyushu, indicating the location of the Yatsushiro Formation.

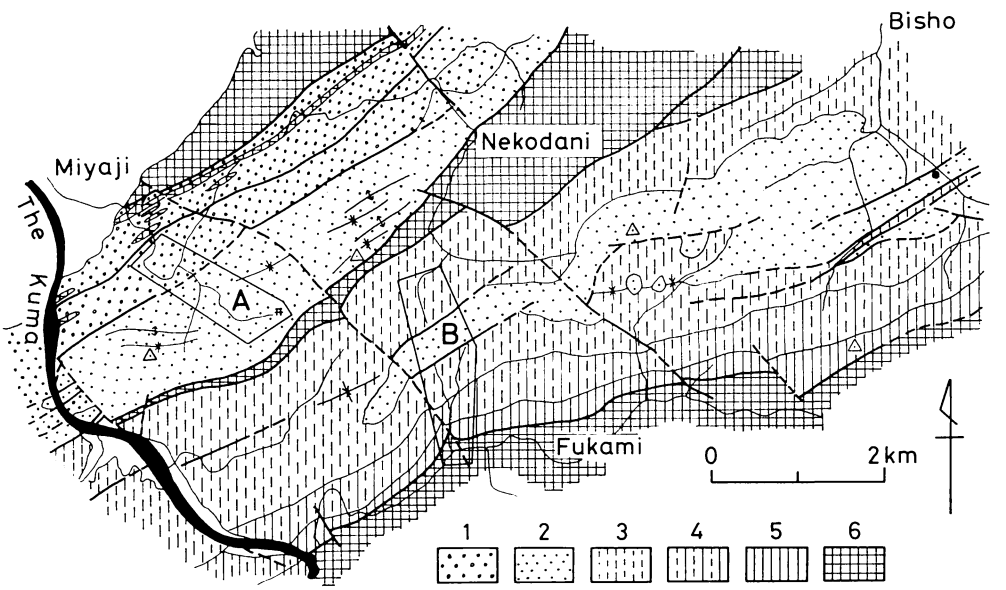

Fig. 2. Geological map of the Yatsushiro Formation and the surrounding rock units. (simplified from MATSUMOTO and KANMERA, 1964). 1: Miyaji Formation, 2: Yatsushiro Formation, 3: Hinagu Formation, 4: Hachiryuzan Formation, 5: Kawaguchi Formation (altogether Lower Cretaceous), 6: igneous, metamorphic and Palaeozoic rocks (undifferentiated), A: area of Fig. 1, B: area of Fig. 3, ●: locality of fossil nautiloid.

Geological Setting

As is clearly shown in the published geological map (MATSUMOTO and KANMERA, 1964) the Yatsushiro Formation is exposed in two tectonic belts, the Hinagu belt in the south and the Miyaji belt in the north, which are separated by a thrust zone of serpentinite (Fig. 2). In the Hinagu belt, the Yatsushiro Formation rests on the Aptian Hinagu Formation with a distinct unconformity, although the relation may be modified by later faulting in some places. The strata of the latter form a partly overturned syncline, whereas those of the former are in a normal syncline. In the Miyaji belt, the Yatsushiro Formation is disconformably overlain by the Miyaji Formation; there the strata incline northward with rather low angled undulations.

The Yatsushiro Formation itself is about 580 m in thickness and consists of a cyclic sequence of clastic rocks. It is subdivisible into three members, the Lower, Middle and Upper. In the Lower and Upper Members, conglomerate and coarse-grained sandstone predominate, with red beds, subordinate shale, carbonaceous seams and plant beds. In the Middle Member there are many intercalations of sandy shale and certain parts of the shale and nearby sandstone contain shallow marine (and partly brackish water) invertebrate fossils (molluscs, echinoids, corals etc.), in which ammonites and a nautiloid were rarely found.

In the Hinagu belt the lower three fifths of the Yatsushiro Formation are exposed, whereas in the Miyaji belt the upper half of the formation is exposed. Therefore the fossiliferous beds of the Middle Member are accessible in both belts, although beds of sandy shale are thinner in the northern belt. In Fig. 1, ammonite and some relevant fossil localities of the northern (i.e. Miyaji) belt is shown. Two other ammonites were obtained from a large block certainly fallen from the nearby exposure of the lower part of the Middle Member in the southern (i.e. Hinagu) belt at a locality indicated in Fig. 3. A nautiloid locality is about 6 km east of this ammonite locality within the same Hinagu belt (Fig. 2) and

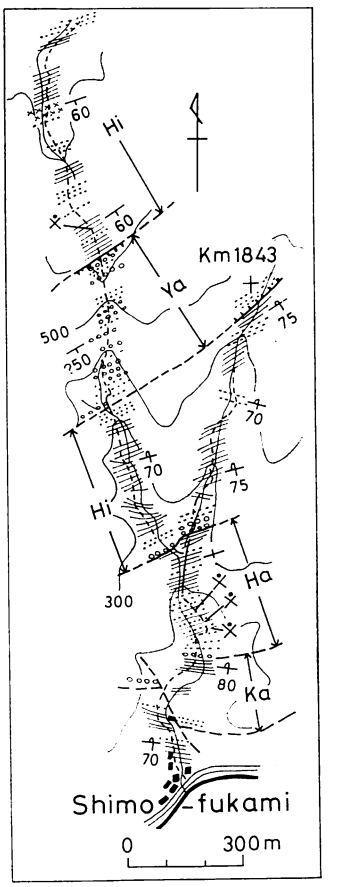

Fig. 3. Geological route map, north of Shimo-fukami (area B in Fig. 2) (prepared by K. KANMERA), showing the location of ammonite bearing large block (fall) by+ (loc. Km 1843). Formation names.—Ya: Yatsushiro, Hi: Hinagu, Ha: Hachiryuzan, Ka: Kawaguchi. Lithological symbols same as in Fig. 1.

assignable to the lower part of the Middle Member. The Yatsushiro Formation near these two localities are rather narrowly and incompletely exposed, owing to the faulting on both wings of the syncline. The cephalopod specimens described below are now kept in the Type Collections, Kyushu University (GK).

Palaeontological Descriptions

(by Tatsuro MATSUMOTO)

Class Cephalopoda

Subclass Nautiloidea

Order Nautilida

Familly Nautilidae D'ORBIGNY

Genus *Heminautilus* SPATH, 1927

Type species:—*Nautilus saxbii* MORRIS, 1848.

Remarks:—I depend primarily on KUMMEL (1956, p. 434) for the redefinition of this genus. There is, however, a questional point as to the relationship of *Heminautilus* with *Paracenoceras* SPATH, 1927 (type-species *Nautilus hexagonus* J. DE C. SOWERBY, 1826), as has already been discussed by SPATH (1924, p. 25) and conversely by KUMMEL (1956, p. 435). A single small specimen from the Yatsushiro Formation shows interesting features which may be involved in the same question.

Heminautilus akatsui MATSUMOTO, sp. nov.

Pl. 37, Fig. 1; Text-fig. 4

Material:—GK. H6909A, B, which consists of the internal (A) and external (B) moulds, obtained by Takeshi AKATSU in Dec. 1956, when he was a student of Kyushu University. This is the holotype.

Description:—The holotype is small, about 13.5 mm in diameter, but a part of the body-chamber (about 90°) is preserved. It is involute, showing a very small umbilicus (less than 1 mm).

Its shell-form is characteristic. The whorl in the late stage is subtrapezoidal in cross-section, having a rather flat venter, angular ventrolateral shoulders, generally convergent flanks, abruptly rounded umbilical shoulders and steeply inclined umbilical walls. The body-chamber is nearly as high as broad and broadest immediately above the umbilical shoulder. On the body-chamber alone there is a shallow median groove and the upper part of the flank is slightly concave below the keel-like ventrolateral shoulder, whereas the lower part is inflated.

In earlier growth-stage this characteristic shell form is not well displayed, namely the venter is more rounded, the ventrolateral shoulder is subrounded, the flanks are more gently rounded, converging towards the venter and the umbilical shoulders are gently rounded.

The surface of the internal mould is smooth. The outer surface of the shell, as impressed on the external mould, has numerous, dense, fine radial lirae and very fine longitudinal lirae, showing a finely reticulate ornamentation. The radial lirae are flexuous and rursiradiate on the ventral part. They are sometimes bifurcate or virgate on the upper part of the flank and also near the umbilical shoulder.

The septal suture in the late growth-stage has a well developed, broad but moderately deep lateral lobe, which passes to an asymmetric saddle on the ventrolateral shoulder and then to a very shallow lobe on the venter. At about the umbilical shoulder there is a small but distinct lateral saddle which passes to a concave

line on the umbilical wall. The suture of the immature stage has no ventral lobe, a shallower lateral lobe and a lower saddle at the umbilical shoulder. It is generally descending.

Position of the siphuncle is unknown, as I do not dare to cut this single specimen.

Occurrence:—In a silty very fine-sandstone exposed on the west side of a road, about 2 km south of Bishô, Toyô-mura, Yatsushiro-gun, Kumamoto Prefecture, together with some trigonians and other molluscs.

Comparison and discussion:—With respect to the shell-form this species is rather similar to certain species of *Paracenoceras* SPATH, 1927, such as *P. hexagonum* (SOWERBY) (see Fig. 5) and especially *P. prohexagonum* SPATH, 1935. Those two and many other species of *Paracenoceras* are mostly Middle or Upper Jurassic in age. The exception may be *Nautilus rhodani* ROUX (*in* PICTET and ROUX, 1847, p. 275, pl. 1, fig. 4) from the Albian of Switzerland, which was referred to *Paracenoceras* by SPATH (1927, p. 25) and KUMMEL (1956, p. 403). As its holotype is an internal mould, the ornamentation of its shell surface is not known. If there were

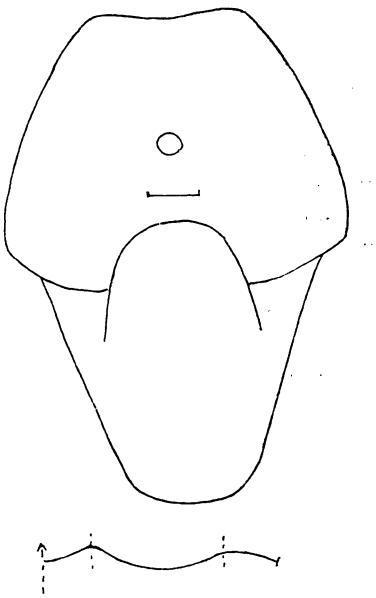

Fig. 5. *Paracenoceras hexagonum* (SOWERBY). Diagrammatic cross section and suture (after KUMMEL, 1956, figs. 18 and 20B). Bar indicates 10 mm.

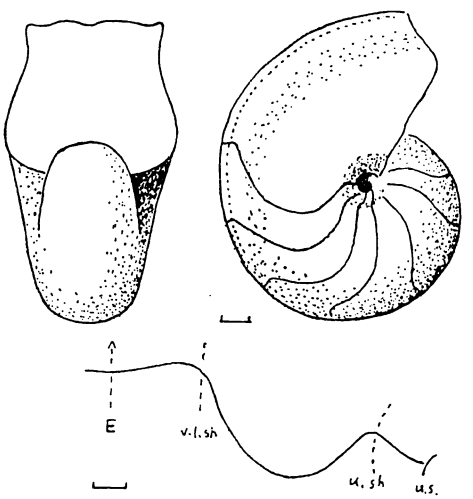

Fig. 4. *Heminautilus akatsui* MATSUMOTO, sp. nov. Diagrammatic sketch of holotype, showing frontal and lateral views and the last suture. Bar indicates 1 mm.

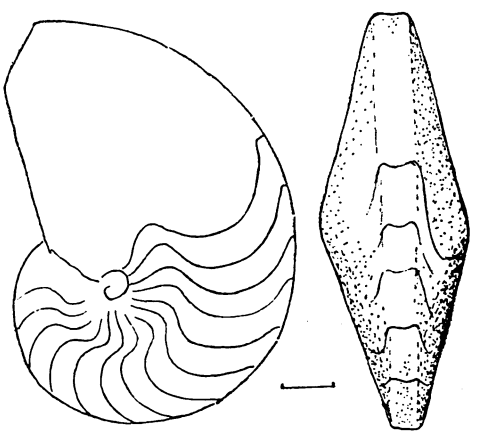

Fig. 6. *Heminautilus saxbii* (MORRIS). Diagrammatic two views of holotype represented by KUMMEL, 1956, pl. 10, figs. 1, 2. Bar indicates 10 mm (cited by permission).

radial ribs on the outer shell, it could be referable to *Paracymatoceras* SPATH, 1927 (type-species *N. asper* (OPPEL) ZITTEL, 1868) and would be allied to *P. tunghaicum* MATSUMOTO and AMANO, 1964, from the Lower Cenomanian (possibly uppermost Albian) of Kyushu. Anyhow, it is distinguished from the present species by its broader whorl, broader venter, and shallower lateral lobe without perceptible saddle at the umbilical shoulder.

The suture of *Paracenoceras* is, in most species, less strongly sinuous than that of *Heminautilus*, but some species, e. g. *P. rollieri* (LOESCH, 1914) (see JEANNET, 1951, fig. 29), has a moderately sinuous suture, which is somewhat similar to that of the present species. However, it cannot be overlooked that the suture of the present species in the late growth stage resembles that of *Heminautilus saxbii* (MORRIS) (see KUMMEL, 1956, pl. 10, figs. 1, 2) (also Fig. 6 of this paper), despite the difference in the degree of compression of the shell.

H. saxbii and other species of *Heminautilus* normally have a compressed shell, with high whorls and a flat or slightly concave, narrow venter. Therefore the present species much deviates from them in the shell-form, although the flanks are convergent as in those species of that genus.

Heminautilus was provisionally placed in the subfamily Paracenoceratinae SPATH, 1927 by SPATH (1927) with a query, but has been replaced to the subfamily Cymatoceratinae SPATH, 1927 by KUMMEL (1956), because the latter author recognizes the flexiradiate ribs in *Heminautilus* like those of *Cymatoceras*. In the present species, as clearly seen on the external mould of the holotype, there are fine radial lirae, which are rursiradiate on the outer part of the flank and show a sinus on the venter. The so-called ribs in *Cymatoceras* are not impressed on the internal mould and, therefore, should not be compared with the ribs of the Ammonoidea. They are better called thick lirae, if the terminology in the Ammonoidea is applied. In fact, I see on some undescribed examples of *Cymatoceras*, from the Upper Cretaceous of Hokkaido and South Saghalien, very fine lirae on the surface of the immature shell, which are developed into the rib-like thick lirae on that of the mature shell. That fine lirae on the immature shell show a finely reticulate ornament by the combination with very fine longitudinal lirae or striae. This ornament is essentially the same as that seen on the external mould of the holotype of the present species. On the other hand, *Paracenoceras* is smooth or has only growth-lines on the shell surface.

To sum up, I regard the present species as an atypical example of *Heminautilus*, despite its similarity to *Paracenoceras* in shell-form. It is still questionable whether the small holotype is immature or mature. For the reasons of its small size and finely reticulate ornament, I would presume it as being immature, but further material is needed to confirm the conclusion.

Subclass Ammonoidea

Order Ammonitida

Family Desmoceratidae ZITTEL

Genus *Brewericeras* CASEY, 1954

Type species:—*Ammonites brewer*i GABB, 1869.

Remarks:—This genus was defined by CASEY (1954, p. 112), who assigned it to the Desmoceratidae. On the basis of numerous specimens, JONES et al. (1965) reexamined this genus and *Leconteites* CASEY, 1954 (type-species *Desmoceras lecontei* ANDERSON, 1902) and suggested its possible derivation from the latter.

They referred the two genera to the Beudanticeratinae of the Desmoceratidae, although CASEY assigned *Leconteites* to the Cleoniceratinae of the Hoplitidae.

Brewericeras has been known characteristically from the upper part of Lower Albian in the Pacific Coast of North America. The species described below is the first record of this genus from Japan. It has some features which seem to support the opinion of JONES et al.

Brewericeras enorme MATSUMOTO, sp. nov.

Pl. 37, Fig. 2

Material:—A single specimen, GK. H6907, the holotype, found by Y. OHTA, who donated it to Kyushu University through T. MATSUMOTO.

Description:—The holotype is secondarily compressed and the original breadth of its whorl is difficult to estimate. The measurements (in mm) on the unrestored specimen are as follows: Diameter=102.0, whorl-height=50.0, Umbilicus=18.8 (0.18).

Presumably, the whorl was originally higher than broad, with a narrowly arched venter; the sharpened venter of the fossil is probably due to the secondary compression.

The umbilicus is fairly narrow, surrounded by a low but vertical wall and angular umbilical shoulder. The flank is flattened, especially on its inner half.

There are numerous, fairly crowded, falcate or sinuous ribs on the flank. In the last half whorl preserved, the ribs are mostly simple and distinct only on the ventral half of the flank; there are occasionally shorter ribs which are intercalated or branched on the ventrolateral part; on the inner half of the flank, weak lirae and faint extensions of a few ribs are discernible, which are prorsiradiate and nearly straight or sometimes gently curved. On the venter ribs are much weakened.

On the flank of the preceding half whorl several longer ribs arise from the umbilical shoulder and are flexiradiate on the main part of the flank, with bifurcalation or intercalation of shorter ribs. On the interval between the longer ribs there are several flexuous ribs of unequal length, which appear at various distances from the umbilical margin. The ribs are, therefore, fairly crowded on the outer half of the flank, numbering about 25 within a half whorl. They are much weakened on the venter.

The ornamentation of the next inner whorl is not well shown, but no strong ribs are perceptible on the inner half of the flank.

The suture is only partly seen at about the middle of the last whorl preserved; it shows typically desmoceratid pattern.

Occurrence:—The holotype was found at a locality indicated as C in Fig. 1, at the altitude of about 200 m on an ascending path from Miyaji to Mt. Joguzan. It was in a dark grey shale which is referred to the upper part of the Middle Member of the Yatsushiro Formation.

Comparison:—This species resembles the ribbed variety of *Brewericeras hulenense* (ANDERSON), as redefined by MCLEARN (1972), from the upper part of the Lower Albian of the Pacific Coast of North America, between California and Alaska (ANDERSON, 1938; JONES et al., 1965; MCLEARN, 1972; IMLAY, 1960; JONES, 1967), in its mode of ribbing of the last part as well as in its shell-form, but is distinct from that species in its characteristic ribbing of the middle growth-stage.

The last mentioned character reminds us of the ribbing of *Leconteites lecontei whiteavesi* JONES, MURPHY and PACKARD

(1965, p. F13, pl. 6, figs. 1-3, 4-9, 12-14). In that subspecies, as well as in typical *L. lecontei*, the intercalation and branching of the ribs persist to the late stage and the long ribs normally have bullae or tubercles at the umbilical shoulder; ribs are therefore, more numerous than in the present species, although there is variation in the rib density. The forms which were regarded as intermediate between *B. hulenense* and *L. lecontei* (JONES et al., 1965, pl. 11, figs. 7-12, 15-17) are not identical with the present holotype, in that some of the ribs in those forms have weak umbilical tubercles or bullae and also in that the irregularity of the ribbing by branching or intercalation and by intensity difference is manifested in the limited period of the growth-stage in our specimen.

To sum up, I would regard the described specimen from the Yatsushiro Formation as representing an atypical new species of *Brewericeras*.

Family Lyelliceratidae SPATH

Genus *Prolyelliceras* SPATH, 1930

Type species:—*P. peruvianum* SPATH, 1930.

Prolyelliceras(?) sp.

Pl. 37, Fig. 3

Material:—GK. H6908, an imperfect external mould of the right side of an ammonite.

Description:—This specimen has, on its outer whorl, fairly coarse radial ribs which start from the umbilical margin and have tubercles at the umbilical and the ventrolateral shoulders. There are regularly intercalated, weaker and shorter, secondary ribs. On the inner whorl, the ribs are finer, more numerous and more crowded, with longer secondaries, and have less prominent umbilical bullae and small ventrolateral tubercles. The ribs are nearly rectiradiate in the late growth-stage but gently sinuous in the earlier stage. No sign of lateral tubercles is perceptible.

Occurrence:—This specimen was obtained by Y. OHTA at a locality indicated as B in Fig. 1, in the fossiliferous sandstone stratigraphically about 40 m below the *Brewericeras*-bearing shale. *Nanonavis yokoyamai* (YABE and NAGAO), *Pterinella shinoharai* HAYAMI, *Neithea matsumotoi* HAYAMI, *Astarte subsenecta* YABE and NAGAO, *Nemocardium yatsushiroense* HAYAMI, trigonians etc. occur there.

Comparison:—Because of the imperfect preservation, this ammonite is hardly identified with precision. As the venter is not preserved, and accordingly the trituberculate character is not confirmed, the specimen is provisionally referred to the genus *Prolyelliceras* SPATH, 1930, with a query. The hitherto described species of *Prolyelliceras*, e. g. *P. peruvianum* SPATH, 1930 (see BENAVIDES-CÁCERES, 1956; RIEDEL, 1937), from the Albian of Peru and Colombia, and *P. radenaci* (PERVINQUIÈRE, 1907), from the Lower Albian of Tunisia and also Peru (see SOMMERMEIER, 1910), have no secondary ribs. *Lyelliceras cotteri* SPATH, 1930, from the Albian of Hazara, has secondary ribs but also lateral tubercles.

Genus *Epileymeriella* BREISTROFFER, 1947

Type-species: — *Parahoplites hitzeli* JACOB, 1908.

Remarks:—I follow CASEY (1957, p. 31) in assigning this genus to the subfamily Lymeriellinae BREISTROFFER, 1951 of the Lyelliceratidae.

Epileymeriella sp. aff. *E. hitzeli* (JACOB)

Pl. 37, Fig. 4

Compare:—

1908. *Parahoplites hitzeli* JACOB, *Mém. Soc. Géol. France, Paléont.*, vol. 15, no. 38, p. 48, pl. 8, figs. 1-3.

1954. *Leymeriella* (*Epileymeriella*) sp. cf. *hitzeli* (JACOB), CASEY, *Palaeontol.*, vol. 1, p. 57, pl. 9, figs. 5, 5a.

Material:—GK. H6906 A, B, a small fragmentary whorl, represented by an internal mould (A) and also an external mould (B).

Description:—The whorl is higher than broad, with height=12.0 mm and breadth =7.5 mm. The suture is indistinct.

On the flank there are numerous ribs which are curved forward on the ventrolateral part. Normally two ribs are branched from an umbilical bulla and there are, at least partly, still more branching or doubling on the ventrolateral part, as seen on the external mould. Occasionally, there is a simple rib which is accompanied by a constriction-like deeper interspace. Along the siphonal line there is a groove which interrupts the ribs, with their peripheral ends being disposed alternately.

Occurrence:—This specimen was obtained by K. KANMERA at loc. Km 1843, north of Shimo-fukami, Sakamoto-mura, Yatsushiro-gun, Kumamoto Prefecture. It came from the silty fine-sandstone of the Middle Member of the Yatsushiro Formation in the Hinagu belt (see Figs. 2, 3).

Comparison:—This ammonite was listed as *Hoplites* cf. *dentatus* (SOWERBY) by MATSUMOTO and KANMERA (1964), but this was a misidentification, because that species should be somewhat more inflated and have stronger umbilical tubercles.

Dr. R. I. KIRBY (personal communication, August 1979) told me that this specimen apparently resembles some specimens (e. g. Univ. Oxford Geol. K5615) which he provisionally calls *Anahoplites* (*Daghestanites*) cf. *daghestanensis* GLAZUNOVA, 1953 and Dr. J. A. JELETZKY (personal comm., Sept. 1976) suggested me that it looks similar to "*Anahoplites*" *haidaquensis* (WHITEAVES). The latter is, however, the type-species of *Pseudoleymeriella* CASEY, 1957, which is a trochleiceratid (see WIEDMANN, 1966). However, in view of the other ammonites associated with this specimen, it is more likely that the specimen is a species of Lymeriellinae, as Dr. J. W. KENNEDY (personal comm., Sept. 1976) suggested me. It indeed resembles *Epileymeriella hitzeli* (JACOB), from the Lower Albian of France, but has a groove instead of a smooth zone on the middle of the venter.

Family Engonoceratidae HYATT

Genus *Platiknemiceras* BATALLER, 1954

Type-species:—*Knemiceras* (*Platiknemiceras*) *bassei* BATALLER, 1954.

Remarks:—*Platiknemiceras* was clearly redefined by CASEY (1961), who ranked it up to an independent genus and listed a number of species in addition to *P. bassei*. They occur characteristically in the Albian and distribute in the Tethys region and its extensions in the Americas (from Texas to Peru). A species from Kyushu (Japan), described below, gives an addition to the distributional area of the genus.

Platiknemiceras caseyi MATSUMOTO, sp. nov.

Pl. 37, Fig. 5

Material:—A small specimen, GK. H6905, holotype, represented by an in-

ternal mould and also a part of the external mould. This species is dedicated to Dr. Raymond CASEY.

Description:—The holotype is about 27 mm in diameter, flatly discoidal, involute and very narrowly umbilicate. Its narrow venter is bicarinate.

There are sinuous, very low ribs on the flank, but they are much weakened and almost obsolete on the inner half. On the preserved last half whorl the ribs are rather rursiradiate on the middle part of the flank and then gently curved forward on the outer part. No tubercles are developed along the umbilical margin and in the middle of the flank, but the peripheral ends of the outer ribs from a train of clavi on the ventral keel.

The suture is incompletely exposed at whorl-height of 5.5 mm, a little more than one volution behind the preserved end of the shell. It consists of less numerous elements than in the suture of *Engonoceras* and the saddles are not so entire as in that genus.

Occurrence:—The holotype was obtained by K. KANMERA (in 1948) at loc. Km 1843b from a huge block of fine-sandy siltstone derived from the nearby exposure of the Middle Member of the Yatsushiro Formation. This locality is close to Km 1843 where *Epileymeriella* aff. *hitzeli* was found (see Figs. 2, 3).

Comparison:—This fossil was listed previously (MATSUMOTO ed., 1954; MATSUMOTO and KANMERA, 1964) as *Engonoceras* aff. *stolleyi* (BÖHM, 1898) on account of the resemblance in the much compressed shell-form and mode of ribbing on young whorls (see HYATT, 1903, pl. 23, figs. 7-8). However, it should not be referred to that genus, because its suture is not of the *Engonoceras* pattern.

The present species rather resembles *Platiknemiceras gracile* (H. DOUVILLÉ, 1916), from the Lower Albian of Egypt and adjacent areas. Its ventral keels are crenulated as in that species. Although the shell of *P. gracile* is described as being smooth, the figure in DOUVILLÉ (1916, pl. 16, fig. 9) seems to show weak ribs on the outer part of the flank in the middle growth-stage. There are, however, difference in the curvature of the ribs and the details of the suture. The suture of the present specimen resembles that of *Platiknemiceras* sp. as figured by CASEY (1961, p. 354, text-fig. 1e), although its elements are less numerous than in that species probably because of its immature stage.

To sum up, the present specimen represents a new species of *Platiknemiceras* which is characterized by sinuous low ribs on the outer part of the flank.

Implications of the Faunule

Despite the incomplete preservation and paucity of the fossils, the cephalopods described provide valuable information, as follows: (1) *Geological age*:—*Brewericeras hulenense* is an index of the Zone of *B. hulenense* in the Albian sequences of the Pacific Coast of North America. In the Haida Formation of British Columbia this species is associated with *Douvilleiceras spinigerum* (WHITEAVES) and we agree with MCLEARN (1972) and also with JONES et al. (1965) in referring the Zone of *B. hulenense* to the upper part of the Lower Albian in terms of the international scale. The close affinity of the described new species of *Brewericeras* with *B. hulenense* and also the fact that it has some characters which remind us of the ancestral *Leconteites* strongly suggest the middle or upper part of the Lower Albian for the Middle Member of the Yatsushiro Formation.

Prolyelliceras is considered to range from the Lower Albian to Middle Albian,

although no representative is known from northwest Europe. *Epileymeriella hitzeli*, to which our specimen is allied, occurs in the Zone of *Leymeriella tardefurcata*, which indicates the lower Lower Albian in France and England.

Most of the hitherto known species of *Platiknemiceras* occur in the Lower Albian, as explained by CASEY (1961). Our species, although new, would have no contradiction against the view to regard it as a Lower Albian ammonite.

Heminautilus is rather common in the Lower Cretaceous, from Barremian to Albian. Although the species described in this paper has some peculiar features, there is no discrepancy in regarding the age of its host rock as Lower Albian.

Summarizing the above, the age of the cephalopod bearing Middle Member of the Yatsushiro Formation is concluded as Lower Albian, probably the middle or upper part of the Lower Albian. Consequently, the allocation of the Yatsushiro Formation in the correlation chart of OBATA and MATSUMOTO (1976, fig. 2) should be removed slightly downward to accomodate its middle part (indicated by a solid circle) within the scale of K3b1.

(2) *Palaeobiogeography:—Brewericeras* has been known to typify the Albian northeastern Pacific province, from Alaska to Carifornia. Its occurrence in Kyushu (Southwest Japan), though represented by a rare species, should be noted for its expanded distribution around the North Pacific Ocean.

Knemiceras and *Platiknemiceras* are characteristic of the Tethys Realm (including the extensions to the Americas), being distributed widely in these tropical to subtropical equatorial seas (e. g. CASEY, 1961, fig. 2). Although very poorly represented, the occurrence of an example of this Tethyan element in Kyushu is noteworthy. The coexistence of *Platiknemiceras* n. sp. (aff. *P. gracile*) with *Brewericeras* n. sp. (aff. *B. hulenense*), together with *Prolyelliceras*(?) sp., *Epileymeriella* aff. *hitzeli* and *Heminautilus* n. sp., in the same Middle Member of the Yatsushiro Formation, exemplifies an interesting case of a lucky encounter of different faunal elements in the Japanese province. This would provide a key for the inter-regional correlation between different provinces.

(3) *Significance of cephalopod bearing interbeds:*—For some geological reasons Kyushu is endowed with favourable conditions in which marine beds are interfingered with non-marine ones. The Yatsushiro Formation is one of such examples. Plant beds occur in the Lower Member and also in the Upper Member, brackish-water or non-marine mollusca in the lower part of the Middle Member (as indicated by loc. A in Fig. 1) as well as in other members. These non-marine fossils are referable to the Albian (probably lower half of the Albian) on account of the cephalopod species from the main part of the Middle Member.

The fossil flora of the Yatsushiro Formation (mainly Lower Member) was studied by KIMURA (1978), who has shown that the Yatsushiro flora contains no angiosperms and that it generally resembles the Lower Cretaceous Ryoseki flora in the Outer Zone of Southwest Japan, but has certain species which are particular to it. Dr. KIMURA (personal comm., May 1979), furthermore, tells to one of us (T. M.) that the Yatsushiro and the so-called Ryoseki floras belong to the Wealden flora of the northern hemisphere distributed on the north side of the Early Cretaceous equatorial belt and that they are characterized by xenophytes of "arid edaphic condition". The plant fossils were transported from a land of such a condition to the Lower Cretaceous basins (one

of which was the Yatsushiro basin) and it should be noted that the Yatsushiro Formation contains red beds in its lower part. This may be generally in harmony with the presence of some Tethyan elements in the marine fauna. Marine bivalves which occur in the Middle Member were described by HAYAMI (1965-66), together with those from other Lower Cretaceous formations of Japan, and echinoids by TANAKA and OKUBO (1954). Colonial corals were identified by M. EGUCHI (cited in MATSUMOTO ed., 1954, p. 114). The environmental conditions during the time of the Yatsushiro Formation should be interpreted from the comprehensive study of these fossils as well as the sediments.

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Bishô 美生　Fukami 深水　Hachiryuzan 八竜山　Hinagu 日奈久　Joguzan 上宮山
Kawaguchi 川口　Miyaji 宮地　Nekodani 猫谷　Sakamoto 坂本　Shimo-fukami 下深水
Toyo-mura 東陽村　Yatsushiro 八代

白亜系八代層産頭足類相とその意義：　九州の八代層には白亜紀の動植物化石が産することは周知だが，その頭足類化石について記載がなかった。ここに5種を識別し，その産出地点と層位を明記し，松本が古生物学的記載を行なった。それらは (1) *Heminautilus akatsui**, (2) *Brewericeras enorme*,* (3) *Prolyelliceras* (?) sp., (4) *Epileymeriella* aff. *hitzeli*, (5) *Platiknemiceras caseyi** である (* n. sp.)。(1) は殻形は *Paracenoceras* に似るが，装飾と縫合線から *H.* 属とした。(2) は *B. hulenense* に似るが *Leconteites* 的の性状を一部に示す。(5) は *P.* 属（通例平滑）だが弱い肋がある。これらは八代層中部層に産し，菊石からはアルビアン下部が指示される。少数の標本ではあるが，従来本邦に未知の種であり，とくに (2) の北太平洋区要素と (5) のテチス海区要素とが (1) (3) (4) のような広域的の属とともにこの地区で出会っている事実は異る地理区間の対比上重要である。又非海生貝化石や植物化石の時代論に対しても有効な化石群である。　松本　達郎・勘米良亀齢・太田　喜久

Explanation of Plate 37

Fig. 1. *Heminautilus akatsui* MATSUMOTO, sp. nov. ..... Page 328
Holotype, GK. H 6909A, B. Two lateral (a, b) and ventral (c) views of internal mould (A) and surface ornamentation on replica (d) from external mould (B).

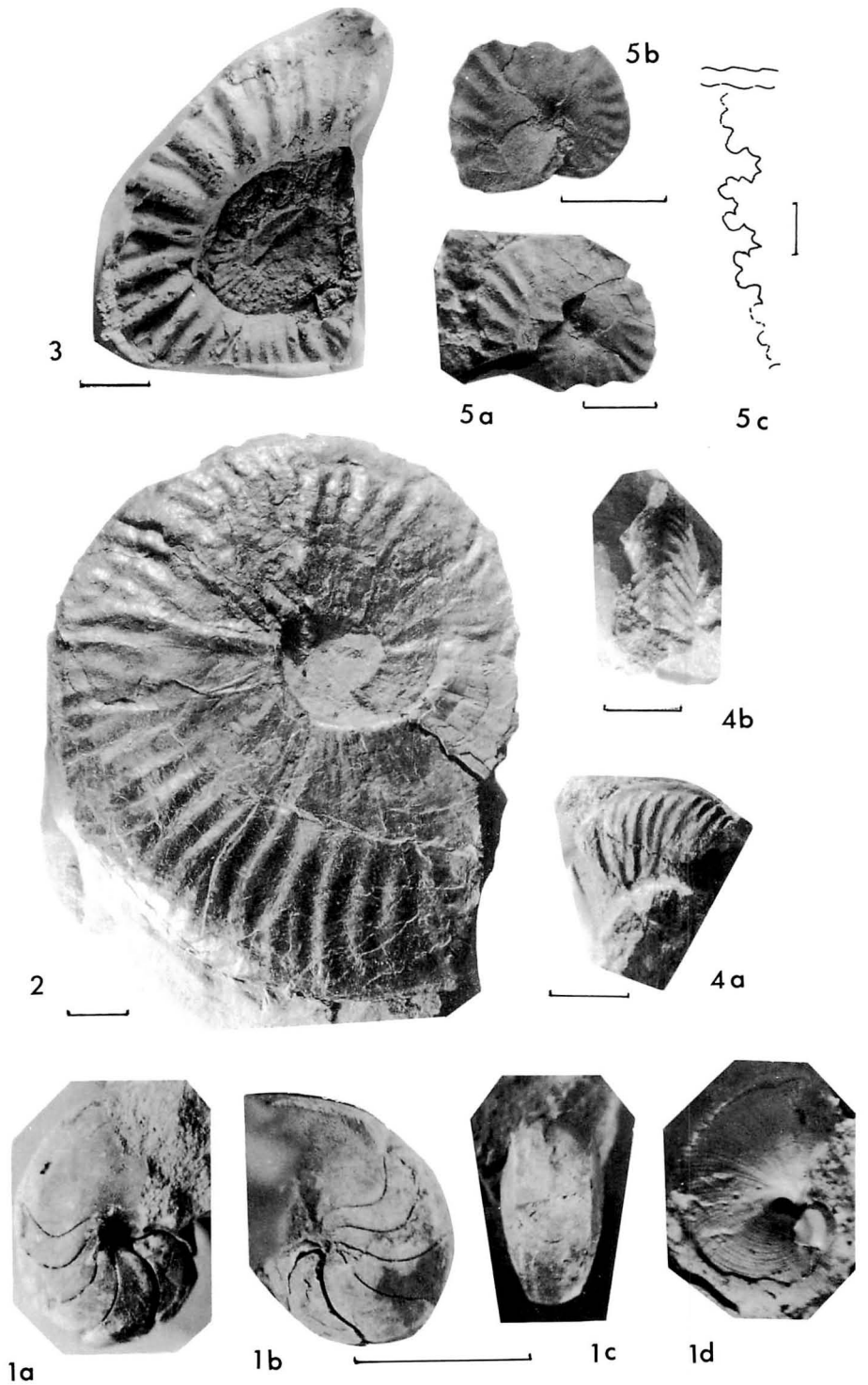
Fig. 2. *Brewericeras enorme* MATSUMOTO, sp. nov. ..... Page 331
Holotype, GK. H6907. Lateral view.

Fig. 3. *Prolyelliceras* (?) sp. ..... Page 332
Replica from GK. H6908. Lateral view.

Fig. 4. *Epileymeriella* sp. aff. *E. hitzeli* (JACOB) ..... Page 333
GK. H6906A (internal mould). Lateral (a) and ventral (b) views.

Fig. 5. *Platiknemiceras caseyi* MATSUMOTO, sp. nov. ..... Page 333
Holotype, GK. H6905A (internal mould). Lateral view of the preserved whole part (a) and that of a younger part (b); external suture of a young stage (at whorl-height=6 mm): two parallel wavy lines at the top are keels of a compressed venter, where suture is unexposed.

Bar indicates 10 mm in almost every figure, except 1 mm in Fig. 5c. Kyushu University photos (K. TANABE), without whitening.


3
5b
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1a
1b
1c
1d

行事予定

	開催地	開催日	講演申込締切
第126回 例会	富山大学	1980年10月10-12日	1980年8月10日
1981年総会・年会	東北大学	1981年1月23,24日	1980年11月23日

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

10月10,11日の富山例会ではシンポジウム「新第三紀における日本の海洋生物地理—中新世を中心として」(世話人：藤井昭二・土隆一) が予定されている。

お知らせ

○本年度より賞の委員会委員の半数改選にともない幹事が交代しました。1980年度中の各種の賞に関する問合せ，推薦依頼は小畠郁生（国立科学博物館地学部）にお願いします。その他の委員の役割分担と連絡先（本誌115号参照）には変更ありません。

○**特別号 No. 17 の OYAMA, K: Revision of Matajiro Yokoyama's type Mollusca from the Tertiary and Quaternary of the Kanto Area,** 148 pp. 57 pls. は昨年売切れとなり御迷惑をかけておりましたが，このほど誤植訂正の上再版されました。(定価4700円，送料300円)。購入申込は特別号の他の号と同じく特別号編集委員会首藤次男・柳田寿一（福岡市東区箱崎九州大学理学部地質学教室）(送金先：振替口座福岡19014；三和銀行福岡支店普通預金口座12172) にお願いします。郵送によらない直接販売は東京大学総合研究資料館（速水格気付）および国立科学博物館分館（藤山家徳気付）でも取扱っています。

◎ 文部省科学研究費補助金（研究成果刊行費）による。

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CONTENTS

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