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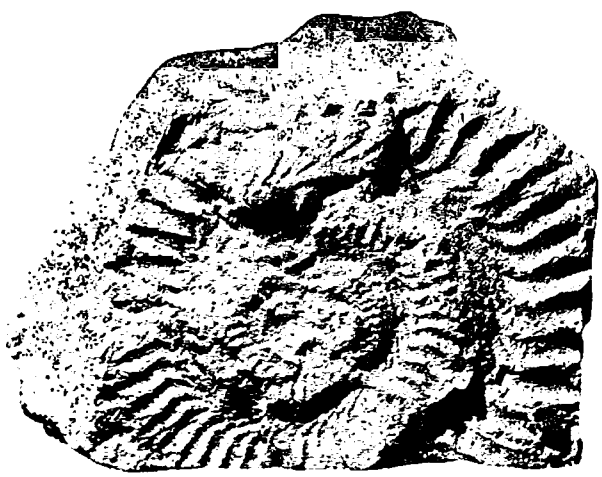

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477. BRYOZOA OF AKIYOSHI. PART 2. LOWER CARBONIFEROUS BRYOZOA FROM THE UZURA QUARRY

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秋吉の蘚虫。その 2。ウズラ採石場産下部石炭紀蘚虫：ウズラ採石場から採集した石灰岩中の蘚虫化石 8 属 13 種 (6 新種, 4 鑑定不能種, 1 既知種, 2 類似種) を識別記載した。この蘚虫動物群はソ連トルキスタン地方の同時代蘚虫群と密接な類似性を示しているが, ウズラから *Fenestella* 類が多数発見されれば, 更にその関連性の強まることが期待される。

坂 上 澄 夫

Introduction and Acknowledgements

Since the discovery of the *Millerella* zone in the Akiyoshi limestone by TORIYAMA, the fauna from the Uzura Quarry located about 1 km east of Yobara on the Ofuku plateau has been studied by MURATA (fusulinids, undescribed, 1961), YANAGIDA (brachiopods, 1962) and YAMAGIWA and OTA (corals, 1963). The writer found some bryozoans in the limestone blocks collected from the Uzura Quarry and there is the scope of the present article.

The writer is indebted to Drs. Juichi YANAGIDA of the Kyushu University and Masamichi OTA of the Akiyoshi-Dai Science Museum for their kind guidance to the Uzura Quarry, and to Professor Kotora HATAI of the Tohoku University for his kindness in reading this manuscript. The writer also wishes to express his thanks to Drs. G. G. ASTROVA and N. A. SHISHOVA of the Paleontological Institute, Academy of Science, U. S. S. R. for their kind advices on the Rhabdomesonid Bryozoa. This study was supported by a grant from the Scientific Research funds of the Ministry of Education of the Japanese Government.

All of the specimens described in the present paper are preserved in the collection of the Department of Geology, Hokkaidô Gakugei University, Hakodate.

* Received July 21, 1964; read Sept. 20, at Hiroshima 1964.

Remarks on the Bryozoan Fauna

The bryozoans from the Uzura Quarry were found in association with abundant specimens of brachiopods, whereas rarely with corals and others.

The following 13 species of Bryozoa which are distributed among eight genera were discriminated from the collection.

Fistulipora sp. indet. A
Fistulipora sp. indet. B
Pseudobatostomella cf. *P. granulosa* (NIKIFOROVA)
Stenopora pusilimonila SAKAGAMI, n. sp.
Leioclema uzuraensis SAKAGAMI, n. sp.
Saffordotaxis yanagidae SAKAGAMI,

n. sp.
Streblascopora antiqua SAKAGAMI, n. sp.
Streblotrypella astrovae SAKAGAMI, n. sp.
Septopora waberi NIKIFOROVA
Pennniretepora ofukuensis SAKAGAMI, n. sp.
Pennniretepora cf. *P. fragilis* CROCKFORD
Pennniretepora sp. indet.
Acanthocladia ? sp. indet.

Saffordotaxis yanagidae SAKAGAMI, n. sp. is very similar to *S. incrassata* (ULRICH) which was reported from the Keokuk group of the United States of America by ULRICH (1890) and the lower Viséan of U. S. S. R. by NEKHOROSHEV (1953) and TRIZNA (1958) but is not identical as mentioned in the description. *Streblotrypella astrovae* SAKAGAMI, n. sp. resembles *Hyphasmopora mukhini* NIKIFOROVA which was reported from the lower Carboniferous of Turkestan. *Pennniretepora ofukuensis* SAKAGAMI, n. sp. may be related to *P.* cf. *flexicarinnata* (YOUNG & YOUNG) which NIKIFOROVA recorded from the lower Carboniferous of Turkestan. The other species described as new can be distinguished from the previously known forms. *Septopora waberi* NIKIFOROVA described in this article coincides with the Russian specimens which were described originally from the lower Carboniferous to Turkestan and later from the Taruskian horizon (C^{tr}_1: upper Viséan), about 300 km south of Moscow by SHISHOVA (1952). *Pseudobatostomella* cf. *P. granulosa* (NIKIFOROVA) and *Pennniretepora* cf. *P. fragilis* CROCKFORD described in this work may be identical with the original species which were reported from the lower Carboniferous of Turkestan and the upper Viséan of the Riverleigh limestone of Queensland, respectively, but specific comparisons in detail were not possible. The other four indeterminable forms are compared with known forms but are not named because of their state of preservations or bad orientation of the specimens.

NIKIFOROVA (1926, 1933) described and illustrated 67 species of Bryozoa among which 33 species belong to the Family Fenestellidae from the lower Carboniferous of Turkestan. She (1933) mentioned that the Turkestan fauna, especially in the cryptostomatous Bryozoa, is closely related to the lower Carboniferous fauna of North America, England, and the Kuznetzk and Donetz basins in U. S. S. R. Although the fenestellid bryozoan fauna could not be found from the Uzura Quarry, a considerable number of species of the present fauna are considered to be very intimate or to have close relation with the Turkestan species whereas there are only a few species resembling those of Australia and the United States of America. The writer is in the opinion that the closer resemblance is to be expected between the Uzura fauna and the Turkestan fauna, should fenestellid bryozoans be found from the Uzura Quarry.

YANAGIDA (1962) described and illustrated 13 species of brachiopods and he stated that it constitutes a unique faunal assemblage allied to the upper Viséan brachiopods of Europe and to those of southern Asia and Australia.

The geological age of the bryozoan fauna described in the present article was determined to be the same as concluded from the brachiopods by YANAGIDA.

Systematic Descriptions

Genus *Fistulipora* M'COY 1850

Fistulipora sp. indet. A

Plate 44, Figure 2.

Zoarium attached to foreign substance, encrusting, composed of two or three layers, each layer varying in thickness from 0.5 mm to 1.0 mm. Zooecial tube straight from the proximal to distal ends, small and circular in tangential section. Diameter of zooecial tube about 0.16 mm to 0.19 mm. There are usually 6 zooecia in 2 mm in diagonal direction. Lunarium may be developed but indistinct. Interspaces between zooecial tubes 0.10 mm to 0.16 mm and filled with well developed and fine vesicular tissue which is regularly arranged in longitudinal rows. Detailed structures of vesicular tissue unobservable. In tangential section, vesicular tissue rounded polygonal and regular in size, and two to three rows of vesicles in interspaces between zooecial tubes. Diaphragms unobservable.

Remarks:—Although rather well oriented sections were obtained, detailed microscopic observation could not be done because of deposition of secondary materials. The comparison with the previously described species as well as naming are reserved until better preserved specimens are found.

Reg. nos. 13015-A, 13017.

Fistulipora sp. indet. B

Plate 44, Figures 1, 3.

A longitudinal section of a single fragment. Zoarium encrusting, 1.6 mm in the thickest part. Zooecial tube straight, becoming gradually larger from inner to outer in diameter, about 0.19 mm to 0.29 mm. Diaphragm lacking. Vesicular tissue well developed through the inner to outer. Vesicules small, fish-scale like and arranged irregularly. Interspaces between tubes at zoarial surface concave. Stereom not developed entirely.

Remarks:—The present form seems to resemble *Cyclotrype conferta* PERRY and GUTSCHICK which was described from the Amsden formation (upper Mississippian), southwest Montana, U. S. A. in the tangential section. However, the single fragmentary longitudinal section at hand is insufficient for specific decision.

Reg. no. 13024.

Genus *Pseudobatostomella* MOROZOVA, 1960

Pseudobatostomella cf. *P. granulosa* (NIKIFOROVA)

Plate 44, Figures 8, 10, 11.

Compare.—

1926. *Batostomella granulosa* NIKIFOROVA, *Izv. Geol. Kom., Tom XLV, no. 3*, pp. 188, 189, pl. 4, fig. 2; pl. 5, figs. 16-18.

A single thin section showing both typical transverse section and a longitudinal section. Zoarium a cylindrical stem, 1.3 mm in diameter measured on transverse section.

Thin sections:—Zooecial tube circular or oval in tangential section, its shorter diameter 0.160 mm to 0.208 mm. Mesopores present but rather rare, subangular to circular, their diameter 0.064 mm to 0.080 mm. Thickness of zooecial wall 0.048 mm to 0.064 mm. Acanthopore present, but its details unobservable. In the longitudinal section, zooecial tube curved gradually outward from immature region. Wall of immature region very thin and becoming gradually thick in mature region. Moniliform poorly developed at inner part of mature region

of wall. Diaphragms usually arranged in irregular interval in zooecial tube, their intervals ranging from 0.05 mm to 0.16 mm, about 2 to 4 in mature region of a tube, but in some tubes, diaphragms lacking entirely. Diaphragms in mesopores probably present but indistinct.

Remarks:—The present form coincides with *Pseudobatostomella granulosa* which NIKIFOROVA described under the generic name of *Batostomella* from the lower Carboniferous of Turkestan in the general characters. The detailed comparison between them, however, is not adequate because there is only one thin section at hand and NIKIFOROVA's original illustrations of the thin sections were drawn by hand.

Reg. no. 13011.

Genus *Stenopora* LONSDALE, 1844

Stenopora pusilimonila SAKAGAMI, n. sp.

Plate 44, Figures 4, 5, 9.

Two longitudinal but partly tangential sections. Zoarium a cylindrical stem.

Measurements (in mm):—

Specimen	13018-A	13032
Diameter of zoarium	2.1	1.6
Diameter of zooecium	0.160-0.224	0.141-0.224
Diameter of mesopore	0.048-0.096	0.064-0.112
Diameter of acanthopore	0.006	0.004-0.008
Thickness of zooecial wall	0.028-0.068	0.020-0.060
No. of diaphragms in zooecial tube	0-1	0-1
No. of acanthopores per zooecial tube	4-6	4-6

Tangential sections:—Zooecial tube oval or rounded polygonal in mature region, but angularly polygonal in immature region. Diameter of zooecium 0.194 mm in average, ranging from 0.144 mm to 0.224 mm (30 measurements on two specimens). Mesopore rather rare, subangular to circular, its average diameter 0.083 mm, ranging from 0.048 mm to 0.112 mm (10 measurements on two specimens). Acanthopores rather small, usually disposed at each point of intersection of zooecial wall but occasionally disposed at edge of zooecial wall and surrounded by concentric fibrous tissue, their inner diameter 0.006 mm.

Longitudinal sections:—Zooecial tube nearly parallel to growth trend in immature region, curved rapidly outward at the boundary between immature and mature regions, and straight and perpendicular to the surface in mature region. Moniliform poorly developed. Zooecial wall very thin in immature region and becoming thick in mature region. Usually one diaphragm disposed at proximal end of mature tube, but in some tubes no diaphragms observable.

Remarks:—There are some questions as to whether the present form can be included in the genus *Stenopora* because it has a diaphragm which is usually developed at the proximal end of mature tube, and poorly developed moniliform.

The present form differs from the already known species of *Stenopora* and its similar genera in the features described above.

Reg. nos. 13018-A (holotype), 13032.

Genus *Leioclema* ULRICH, 1882

Leioclema? uzuraensis SAKAGAMI, n. sp.

Plate 44, Figures 6, 7.

Zoarium lamellate, probably thin but its thickness unknown.

Tangential section:—Zooecia circular or rounded polygonal in mature region, but angularly quadrate, pentagonal or hexagonal in immature region. Diameter of zooecia 0.190 mm in average, ranging from 0.160 mm to 0.224 mm (32 measurements on typical tangential section of specimen No. 13022). Mesopores commonly present, one to two disposed usually between zooecial tubes, their average diameter 0.064 mm, ranging from 0.048 mm to 0.112 mm (9 measurements on specimen No. 13022). Acanthopores rather small, usually disposed at each point of intersection of zooecial wall, but occasionally disposed at edge of zooecial wall and projected to inner side of zooecial tube, and surrounded by dark colored concentric fibrous tissue. Their inner diameter less than 0.006 mm.

Longitudinal section:—Zooecial tube straight from immature to mature regions. Wall of immature region very thin and becoming gradually thick in mature region. Length of mature region of tube 0.32 mm to 0.64 mm measured on specimen No. 13013. Moniliform unobservable. Diaphragms arranged irregularly in zooecial tubes, their interval about 0.05 mm to 0.14 mm, 3 to 4 in mature region of a tube. Diaphragms in mesopores uncertain.

Measurements (in mm):—

Specimen	13013	13022	13027-A
Diameter of zooecial tube	0.144–0.244	0.160–0.224	0.208–0.240
Diameter of mesopore	—	0.048–0.112	0.064–0.112
Diameter of acanthopore	0.006	0.006	0.006
Thickness of zooecial wall	—	0.024–0.032	?
No. of zooecia per 2 mm	—	10	—
No. of diaphragms in zooecial tube	3–4	—	?
No. of acanthopores per zooecial tube	4–6	4–6	?

Remarks:—The acanthopores disposed usually at each point of intersection of the zooecial wall, diaphragms irregularly arranged in mature region of zooecial tubes and less developed moniliform may be the important characters of the present species. The present form can be distinguished from the previously described species by the features mentioned above.

Reg. nos. 13013, 13022, 13027-A (holotype).

Genus *Saffordotaxis* BASSLER, 1952

Saffordotaxis yanagidae SAKAGAMI, n. sp.

Measurements (in mm):—

Specimen	13006	13010	13014	13016	13021	13028	13031
Diameter of zoarium	1.0	1.1	0.9	0.8	0.9	1.1	1.0
Diameter of zooecium (shorter)	0.096-0.112	0.088-0.112	0.080-0.096	0.080	0.096-0.112	0.096-0.112	0.096-0.112
Diameter of zooecium (longer)	0.160-0.192	0.160-0.192	0.160-0.208	—	0.176-0.208	0.144-0.192	0.160-0.208
Zooecia per 2 mm of long. row	—	7	6.5	—	—	8	—
Outside diameter of acanthopore near surface	abt. 0.04	—	abt. 0.04	abt. 0.04	—	0.040-0.060	—
Angle of zooecial tube to central axis	30°-35°	30°-40°	30°-35°	30°	30°	30°	30°

Plate 45,[3] Figures 1-4.

Zoarium a cylindrical stem, attached on foreign substance such as pebbles and shells. Diameter of zoaria about 1 mm in average, ranging from 0.8 mm to 1.1 mm (7 specimens).

Longitudinal and tangential sections:—Zooecial tube arises from a central axis at angle of about 30° to 40° and curved gradually outward with outer surface of zoarium at an angle of about 70° to 90°. Zooecial aperture regularly arranged both in longitudinal and diagonal series, 6.5 to 8 zooecia in 2 mm longitudinal distance. Zooecial tube in tangential section near surface oval and its shorter diameter excluding zooecial wall ranging from 0.080 mm to 0.112 mm and longer diameter 0.144 mm to 0.208 mm. One kind of acanthopores (megacanthopores) surrounding zooecial tube regularly arranged in one row but occasionally arranged irregularly and their outside diameter ranging from 0.04 mm to 0.06mm. About 0.1 mm near surface of mature zone covered by dark and well laminated layer. Mesopore, diaphragm and hemiseptum lacking.

Remarks:—The present form is most similar to the type species of the genus: *Saffordotaxis incrassata* which was described originally under the generic name of *Rhombopora* from the Waverly group of Ohio, United States of America by ULRICH (1888), and later it was recorded by ULRICH (1890) from the Keokuk group of Kentucky, United States of America, by NEKHOROSHEV (1953) as a *confer* form from the lower Viséan of Kazakhstan and by TRIZNA (1958) from C_1^V (lower Viséan) of the Kuzunetz basin. The present form, however, can be distinguished from *S. incrassata* by the smaller diameter of the stem (0.8-1.1 mm instead of 1.2-1.8 mm), larger number of zooecial

aperture in longitudinal series (6.5-8 mm instead of 5) and fewer megacanthopores which surround zooecial tube.

The specific name is dedicated to Dr. Juichi YANAGIDA of the Kyushu University who studied the brachiopod fauna of the Uzura Quarry.

Reg. nos. 13006, 13010, 13014, 13016, 13021, 13028 (holotype), 13031.

Genus *Streblascopora* BASSLER, 1952

Streblascopora antiqua SAKAGAMI, n. sp.

Plate 45. Figures 5, 6, 13.

Zoarium a cylindrical stem. Diameter of zoarium about 0.9 mm in average, ranging from 0.8 mm to 1.2 mm (6 specimens). Diameter of central bundle 0.21 mm in average, ranging from 0.16 mm to 0.32 mm (6 specimens). Ratio of zoarial diameter to central bundle about 4.5 : 1 in average.

Longitudinal and tangential sections:— Zooecial tube arises from central bundle at an angle of 20° to 25°, straight in immature region and curved gradually outward in mature region. Number of tubes in central bundle 3 to 4 counted on 3 longitudinal sections. In tangential section of mature region, zooecial tube oval and its shorter diameter excluding zooecial wall 0.079 mm in average, ranging from 0.072 mm to 0.092 mm (12 measurements on one specimen) and its longer diameter excluding zooecial wall 0.147 mm in average, ranging from 0.128 mm to 0.176 mm (12 measurements on one specimen). Zooecial apertures regularly arranged and about 6 per 2 mm of longitudinal series. Mesopores of two or three rows with 2 to 3 in each row longitudinally. Total number of mesopores disposed between zooecial tubes in

Measurements (in mm):—

Specimen	13001	13002	13003	13008	13012-C	13018-B	13033
Diameter of zoarium	0.8	1.2	—	0.8	1.0	1.0	0.8
Diameter of central bundle	abt. 0.16	0.21	—	0.16	0.32?	0.21	0.21
Angle of zooecial tube to central bundle	20°-25°	25°	—	20°	—	abt. 20°	abt. 20°
No. of tubes in central bundle in longitudinal section	3	3-4	—	?	—	4	—
Diameter of zooccium (shorter)	0.096-0.112	—	0.072-0.096	0.096-0.112	0.112	0.096-0.112	—
Diameter of zooecium (longer)	0.144-0.176	0.176-0.208	0.120-0.176	0.144-0.160	—	0.160-0.192	0.160
No. of mesopore	—	—	5-8	—	—	5-8	—
Diameter of mesopore	—	—	0.016	0.020	—	0.016-0.024	—
Zooecia per 2 mm of long. row	—	abt. 6	6	—	—	—	—

one series varying from 5 to 8. Diameter of mesopore 0.016 mm to 0.024 mm. Superior hemiseptum poorly developed at posterior end of mature region, and inferior hemiseptum also poorly developed at opposite side of inner part of superior hemiseptum. Diaphragm occasionally located at lower part of immature zone of tube.

Remarks: — *Streblascopora* seems to occure more commonly in the Permian and Carboniferous rocks of Japan than in those of foreign countries. About 19 species including the present new species may belong to the genus, and of them 7 species (3 are from the Carboniferous, and 4 are from the Permian) were known from Japan. The present form is more similar to *S. delicatula* which SAKAGAMI described from several localities of the Japanese Permian than the Carboniferous species. However, the present form can be distinguished from *S. delicatula* by the simpler central bundle.

Reg. nos. 13001, 13002 (holotype), 13008, 13012-C, 13018-B, 13033.

Genus *Streblotrypella* NIKIFOROVA, 1948

Streblotrypella astrovae SAKAGAMI, n. sp.

Plate 45, Figures 7, 8.

Three sections which may be from one colony. Zoarium cylindrical and its diameter 1.1 mm in average, no branching observed.

Thin sections:—Zooecial apertures may be regularly arranged in longitudinal series. Zooecial tube arises from central axis and elliptical in longitudinal section near surface, with distinct peristome and its shorter and longer diameter 0.064 mm to 0.080 mm and 0.144 mm to 0.160 mm, respectively. Number of zooecia in 2 mm of longitudinal row 6 to 6.5 near surface. Interspace between zooecial tubes near surface in longitudinal series usually 0.11 mm to 0.23 mm. Wall of immature region thin, but becoming rapidly thick at inner part of mature region. Width of immature and mature regions 0.48 mm and 0.32 mm, respectively. Mesopores arranged in longitudinal series but not so regular and the inner diameter variable, ranging from 0.004 mm to 0.020 mm. Diaphragm and hemiseptum unobservable.

Measurements (in mm):—

Specimen	13026-A	13026-B	13026-C
Diameter of zoarium	1.2	1.0	1.1
Diameter of zooecium (shorter)	0.064-0.080	0.080	—
Diameter of zooecium (longer)	0.144-0.160	—	—
No. of zooecia per 2 mm of longitudinal row	6-6.5	—	—
Inside diameter of mesopore	0.004-0.020	0.016	—
Thickness of mature zone	—	?	0.32
Interspace between zooecial tubes	0.11-0.23	—	—

Remarks:— The present species resembles *Hyphasmopora mukhini* NIKIFOROVA (1933) which was described from the lower Carboniferous of Turkestan in the measurements except for the number of zooecia in 2 mm of longitudinal row (6-6.5 instead of 4.5 of the Russian form). Later, *H. mukhini* was described under the generic name of *Nikiforovella* by NEKHOROSHEV (in NIKIFOROVA's paper in 1948, personal communication from G. G. ASTROVA) and was also illustrated in the text-figure by SHULGA-NESTERENKO *et al.* (1960). The present species may be referred to the genus *Streblotrypella* by the zoarium having central axis and the arrangement of mesopores.

The specific name is dedicated to Dr. G. G. ASTROVA, a Russian Paleozoic Bryozologist who kindly helped me during my study.

Reg. nos. 13026-A (holotype), 13026-B, 13026-C.

Genus *Septopora* PROUT, 1859

Septopora waberi NIKIFOROVA

Plate 45, Figure 14.

1926. *Septopora waberi* NIKIFOROVA, *Izv. Geol Kom., Vol. 45, No. 3*, pp. 183, 184, pl. 4, fig. 9.

1952. *Septopora waberi* SHISHOVA. *Trudy Paleont. Inst. AN., SSSR.*, pp. 170, 171, pl. 5, fig. 1, text figs. 13, 14.

A single fragmentary tangential section. Zoarium composed of straight branches with dissepiments which usually bear 2 or 3 zooecia. Branches 0.40 mm to 0.45 mm wide and probably about 10 in 10 mm horizontal. Width of dissepiment 0.24 mm to 0.32 mm. Fenestrules elongated rectangular with rounded corners, their width and length about 0.40 mm and 1.12 mm (one measurement), respectively, and probably about 7 to 8 in 10 mm vertical length. Zooecial tube elongated pentagnonal at lower level of branch, kidney shaped at middle and

Table:—Showing the measurements of *Septopora waberi* for comparison of the present form with the Russian forms.

Specimens	The present form	NIKIFOROVA's form	ASTROVA's form
No. of branches in 10 mm horizontal	10	13-14	11-12
No. of fenestrule in 10 mm vertical	7-8	11	11
No. of zooecia in 5 mm	15	18	17-18
Width of branch	0.400-0.448	0.35-0.40	0.25-0.30
Diameter of zooecium	0.112-0.128	0.12-0.14	0.13
Width of dissepiment	0.240-0.320	0.20-0.25	0.25-0.30
Width of fenestrule	abt. 0.500	0.30-0.50	0.50-0.63
Length of fenestrule	1.12	0.70-0.75	0.60-0.65
Number of zooecia per fenestrule	3	3	3
No. of zooecia in dissepiment	2-3	2-3	2-3
Distance between zooecia	0.144-0.160	—	0.13-0.15

circular at upper levels, its diameter 0.112 mm to 0.128 mm; about 15 in 5 mm length of one row, usually 3 apertures per fenestrule. Occasionally, very large tubercles disposed in longitudinal interspace between zooecial tubes. Carina well developed, nearly straight. Nodes may be present but indistinct. Stereom covering the reverse side, developed rather fine striations along the length of branch.

Meshwork formula:—abt. 10/7-8//15.

Remarks:—*Septopora waberi* was described originally from the lower Carboniferous of Turkestan by NIKIFOROVA (1926) and later recorded from the Taruskian horizon (C_1^{tr}: upper Viséan) of the Nerutsch River, about 300 km south of Moscow by SHISHOVA (1952). The present form coincides with the Russian forms especially in the internal structure but the meshwork formulae are slightly different. The formula of the present form is, however, inaccurate in measurements because of there being only one ill-preserved specimen at hand.

Reg. no. 13004.

Genus *Penniretepora* D'ORBIGNY, 1849

Penniretepora ofukuensis SAKAGAMI, n. sp.

Plate 45, Figure 10.

Two tangential sections. Zoarium consists of broad, straight main branch, about 0.8 mm in width. Lateral branchlets 0.32 mm to 0.38 mm in width, extending alternately at an angle of 65° to 70° and intervals of 0.32 mm to 0.48 mm, with 6.5 to 7 branchlets in 5 mm. Zooecial tubes arranged in alternating longitudinal series, triangular with rounded corners at middle level of tangential section, about 13 to 14 in 5 mm length of one row, and spaced regularly in pairs per interval between lateral branchlets. Stereom covering the reverse side, developed rather coarse fibrous striations along the length of branch. Interspaces between striations 0.04 mm to 0.05 mm.

Measurements (in mm):—

Specimen	13007	13023
Width of main branch	0.80	abt. 0.80
Width of lateral branchlet	0.320-0.384	indistinct
Angles of lateral branchlet to main branch	65°-70°	abt. 70°
Intervals between lateral branchlets	0.320 0.480	indistinct
No. of branches it 5 mm	3.5-7	6.5-7
Diameter of zooecium near surface	abt. 0.100	0.120
No. of zooecia in one row of 5 mm	14	13-14
No. of zooecia per lateral branch	2	2

Remarks:—In the meshwork (number of lateral branchlets in 5 mm/number of zooecia in one row//number of zooecia per lateral branchlets), the present form is nearest to *P.* cf. *flexicarinnata* (YOUNG & YOUNG) in NIKIFOROVA's paper (1933),

namely the meshwork formula of the present form is 6.5-7/13-14//2 and NIKIFOROVA's specimen is 6-6.5/14//2. However, the present form can be distinguished from *P.* cf. *flexicarinnata* by the wider main branch and lateral branchlets (about two times of the latter form, respectively) and narrower intervals between the lateral branches.

Reg. nos. 13007 (holotype), 13023.

Penniretepora cf. *P. fragilis* CROCKFORD

Plate 45, Figure 9.

Compare :—

1947. *Penniretepora fragilis* CROCKFORD, *Proc. Linn. Soc. N.S.W., Voll. lxxii, Pt. 1-2*, p. 21, pl. 3, fig. 3, text-fig. 19.

A single tangential section. Zoarium consists of rather slender, straight main branch, about 0.4 mm in width. Lateral branchlet about 0.24 mm to 0.29 mm in width, extending alternately at angle of 70° and at intervals of 0.64 mm to 0.80 mm, with 5 branchlets in 5 mm. Zooecial tubes arranged in alternating longitudinal series, somewhat elongated triangular at lower and middle levels of tangential section, about 14 in 5 mm length of one row, and spaced regularly in pairs per interval between lateral branchlets. Diameter of zooecial tube near surface about 0.10 mm. Stereom covering the reverse side, composed of very fine fibrous tissue and two conspicuous striations observed along the length of branch.

Table:—Showing the measurements of the present form and *P. fragilis* CROCKFORD for comparison.

Specimen	The present form	*P. fragilis*
Width of main branch	0.37	0.28-0.50
Width of lateral branchlet	0.240-0.288	0.25-0.40
Angles of lateral branchlet to main branch	70°	45°-75°
Intervals between lateral branchlets	0.640-0.800	0.71-1.68
No. of branches in 5 mm	5	4.25
Diameter of zooecia near surface	0.10	0.10
No. of zooecia in one row of 5 mm	14	14
No. of zooecia per lateral branch	3	2-5

Remarks:—All measurements of the present form are covered by those of *Penniretepora fragilis* which CROCKFORD (1947) described from the Riverleigh limestone, the age of which has been determined from the coral fauna to be upper Viséan or probably slightly younger, of Queensland, Australia. However, specific comparison of the internal structure is not possible because the present material consists of only a single tangential section.

Reg. no. 13010.

Penniretepora sp. indet.

Plate 45, Figure 11.

A single tangential section. Zoarium consists of straight main branch, about

0.1 mm in width. Lateral branchlets about 0.4 mm in width, extending alternately at an angle of 60° and at intervals of 0.48 mm to 0.56 mm, with about 5 branchlets in 5 mm. Zooecial tubes arranged in 2 rows of slightly alternating intersection, elongated kidney-like shaped at lower and middle levels of tangential section. About 10 zooecia in 5 mm length of one row, and probably spaced in pairs per interval between lateral branchlets. Diameter of zooecial tube near surface 0.11 mm. Stereom covering the branch composed of very dark, rather coarse fibrous tissue, and conspicuous striations and granules not observed.

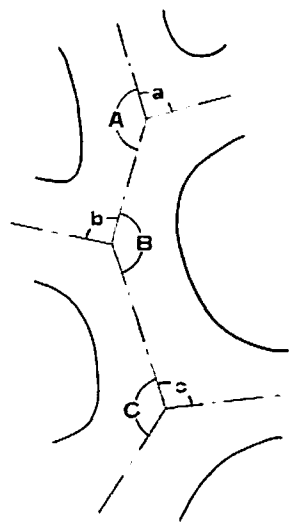
Remarks:—Because of the badly oriented specimens and insufficient material at hand, the species was left unnamed.

Reg. no. 13012-A.

Genus *Acanthocladia* KING, 1849

Acanthocladia? sp. indet.

Plate 45, Figure 12.



Text-figure. Diagramatic scheme of the branching system of *Acanthocladia*? sp. indet.

A, B, C: Angles of zigzag main branch, about 130° to 150°.

a, b, c: Angles of lateral branchlets to main branch, about 90° to 100°.

Four fragmentary tangential sections. Zoarium consists of zigzag main branch

Explanation of Plate 44

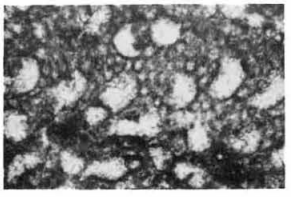
Figs. 1, 3. *Fistulipora* sp. indet. B
1, oblique tangential section, ×20, Reg. no. 13015-A, 3, longitudinal section, ×20, Reg. no. 13017.

Fig. 2. *Fistulipora* sp. indet. A
Longitudinal section, ×20, Reg. no. 13024.

Figs. 4, 5, 9. *Stenopora pusilimonila* SAKAGAMI, n. sp.
5, longitudinal but partly tangential section (holotype), ×20, Reg. no. 13018-A, 4, enlarged mature region of Fig. 5, 9, enlarged part of Fig. 5, showing the zooecial tube in tangential section, ×60, respectively.

Figs. 6, 7. *Leioclema uzuraensis* SAKAGAMI, n. sp.
6, typical tangential section (paratype), ×60, Reg. no. 13022, 7, oblique longitulinal section (holotype), ×20, Reg. no. 13027-A.

Figs. 8, 10, 11. *Pseudobatostomella* cf. *P. granulosa* (NIKIFOROVA)
10, longitudinal and transverse section (holotype), ×20, Reg. no. 13011, 8, enlarged part of Fig. 10, showing the mode of zooecial tube in the transverse part, 11, enlarged part of Fig. 10, showing the mode of zooecial tude in the longitudinal part, ×60, respectively.



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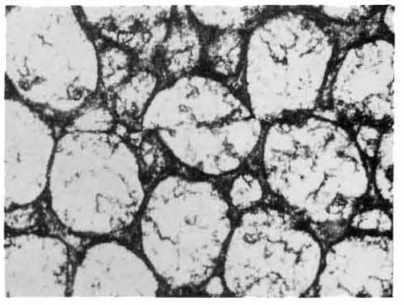

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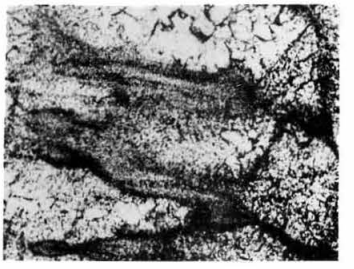

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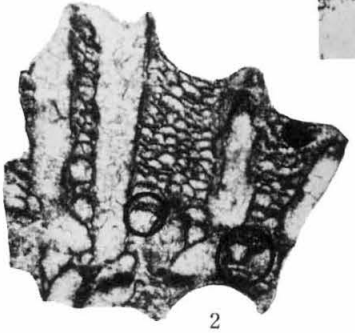

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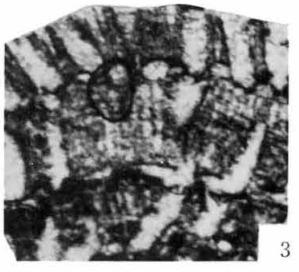

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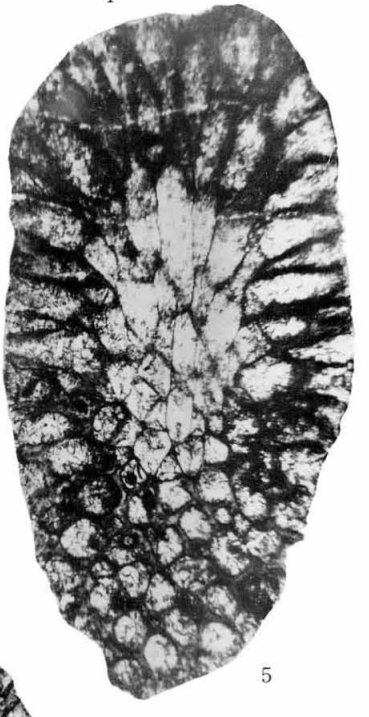

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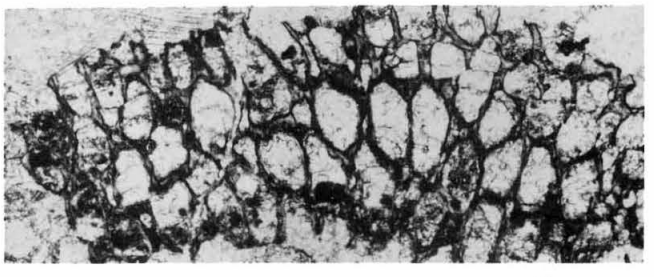

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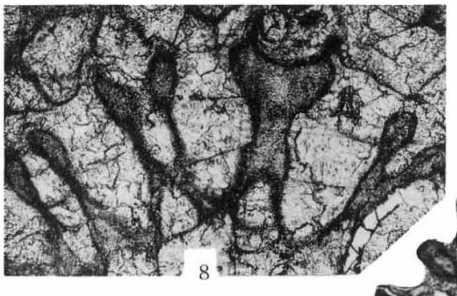

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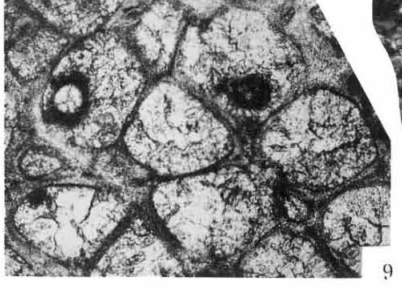

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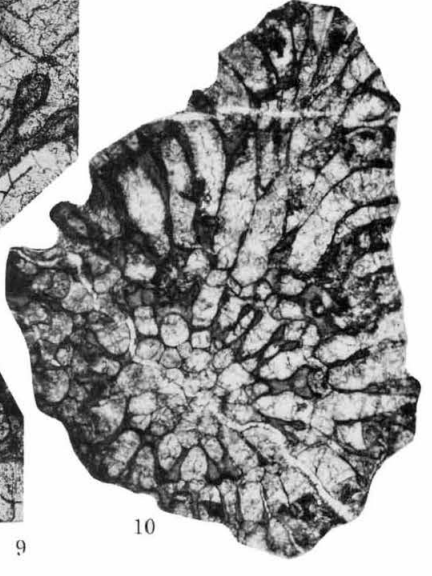

10

11

SAKAGAMI photo

Measurements (in mm):—

Specimen	13009	13025	13029
Width of zoarium	abt. 1.00	1.00	abt. 1.00
No. of row of zooecia	4	5	4
Diameter of zooecia near surface	0.160-0.176	0.144-0.160	0.160-0.176
No. of zooecia in 5 mm longitudinal	11-12	13	12-13
Diameter of spicule	?	0.06	0.06-0.08

(about 130°-150°) and about 1 mm wide. Width of lateral branchlets about as wide as in main branch, extending alternately at angle of about 90°-100°. Its diagramatic scheme is shown in the text-figure. Zooecial tube arranged in alternating longitudinal series, usually 4 rows on both main branch and lateral branchlet, rhomboidal at lower level, becoming oval to circular at middle and upper levels of tangential section, about 11 to 13 zooecia in 5 mm length of row. Stereom composed of less developed coarse fibrous striations and upper one rather light, coarse granules arranged in regular spaces. Inner diameter of granules about 0.006 mm and interspace between them about 0.02 mm.

Remarks:—So far as the present thin sections are observed, the present form may be included in the genus *Acanthocladia*. However, there is some doubt as to the generic identification because the thin sections at hand are fragmentary and the growth form of the zoarium seems to be similar to that of the genus *Anastomopora* (=*Reteporidra*).

Reg. nos. 13009-A, 13009-B, 13025, 13029.

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Explanation of Plate 45

Figs. 1-4. *Saffordotaxis yanagidae* SAKAGAMI, n. sp.
4, longitudinal but partly tangential section (holotype), ×20, Reg. no. 13028, 1, 3, showing the arrangements of acanthopores, ×60, Reg. nos. 13014, 13028, respectively, 2, showing the zooecial tube and wall in longitudinal section, ×60, Reg. no. 13010-A.

Figs. 5, 6, 13. *Streblascopora antiqua* SAKAGAMI, n. sp.
5, typical longitudinal section (holotype), ×20, Reg. no. 13002, 6, enlarged part of Fig. 5, showing the mode of wall in mature region, ×60, 13, transverse section, ×20, Reg. no. 13012-C.

Figs. 7, 8. *Streblotrypella astrovae* SAKAGAMI, n. sp.
7, oblique section (holotype), ×20, Reg. no. 13026-A, 8, enlarged part of Fig. 7, showing the arrangements of zooecial tubes and mesopores, ×60.

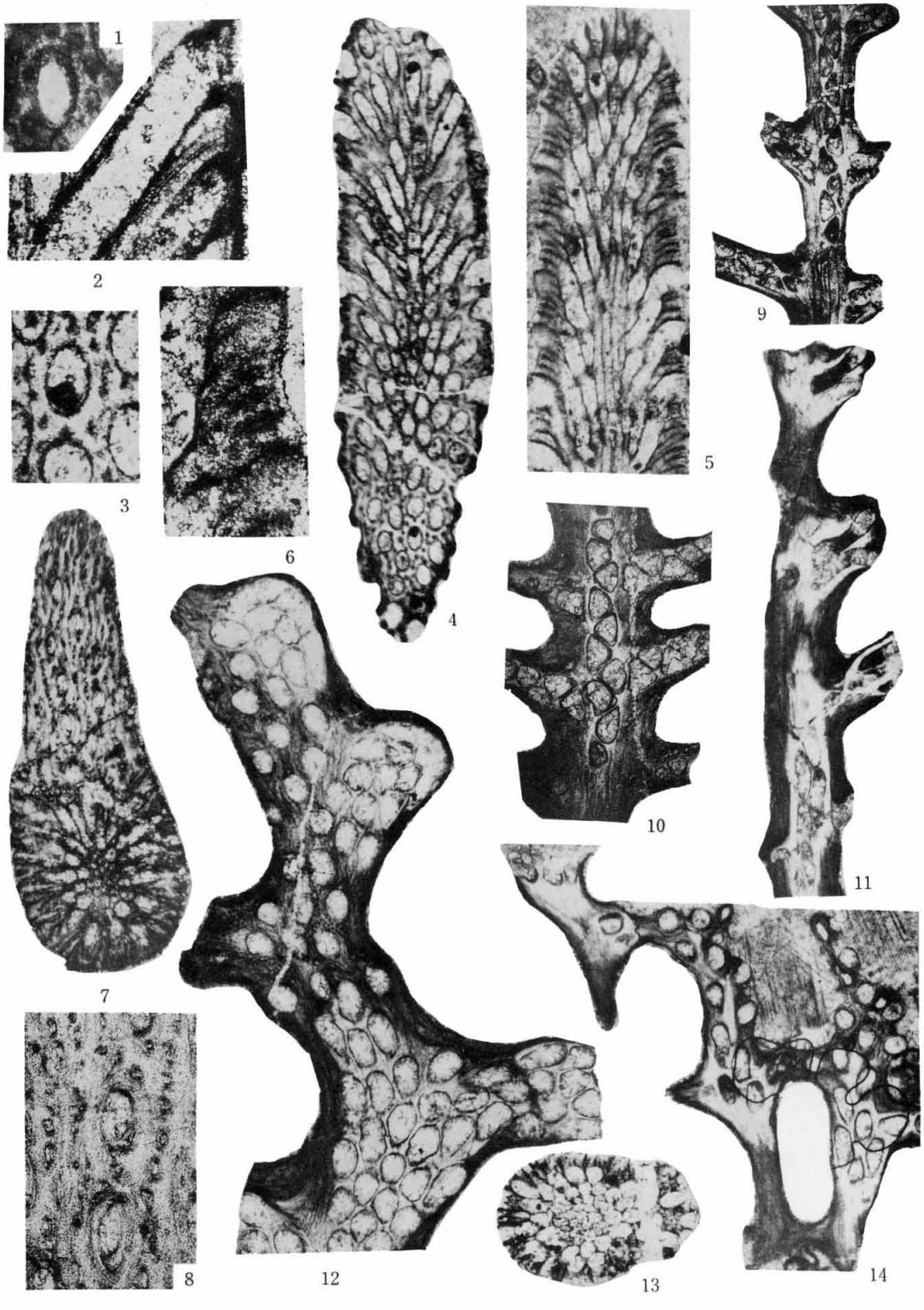
Fig. 9. *Penniretepora* cf. *P. fragilis* CROCKFORD
Tangential section, ×20, Reg. no. 13010-B.

Fig. 10. *Penniretepora ofukuensis* SAKAGAMI, n. sp.
Tangential section (holotype), ×20, Reg. no. 13007.

Fig. 11. *Penniretepora* sp. indet.
Tangential section, ×20, Reg. no. 13012-A.

Fig. 12. *Acanthocladia*? sp. indet.
Tangential section, ×20, Reg. no. 13029.

Fig. 14. *Septopora waberi* NIKIFOROVA
Tangential section, ×20, Reg. no. 13004.



SAKAGAMI photo

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 56, pp. 309-316, pl. 46, Dec. 20, 1964

478. SOME SOLITARY CORALS FROM OFF AOMORI PREFECTURE, JAPAN

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Institute of Geology and Paleontology, Tohoku University

青森県下北半島太平洋岸の現棲単体珊瑚について：下北半島太平洋岸の単体珊瑚 3 属 4 種，1 亜種について記載し，それらの生育深度，水温，底質について従来の日本の研究データとあわせて考察した。 森 啓

Introduction

The present work treats the Recent simple corals dredged from the continental shelf of the Pacific coast of Aomori Prefecture, Japan. The species here treated are all well known in Japan, and their distributions are also wide. Concerning the Recent simple corals from the continental shelf bordering Japanese Islands; Honshu, Shikoku and Kyushu, many works have been published. Especially YABE and EGUCHI (1942) described the materials dredged by the surveying ship "Soyo-maru" of the Imperial Fisheries Institute, Tokyo during 1922-1930. Their monographic work is an important one.

The study of the Recent simple corals is important for the interpretation of the fossil faunal composition, paleoecology and other features. Taking this oppotunity the writer treats the systematics of the simple corals dredged from the continental shelf, off Shimokita Peninsula, Aomori Prefecture as fundamental for further study.

The materials upon which this study is based were collected by the members of the Tohoku Regional Fisheries Research Laboratory, Fisheries Agency of Japan during their surveys on the fishing ground in the summer of 1954. Unfortunately, whether the specimens were alive or dead when they were collected, is not known, but it is thought that the majority lived in the area where they were dredged. On the other hand, neither holotype nor topotype specimens are accessible for direct comparison.

Concerning the four species and one subspecies here reported an attempt is made to compare them with the materials reported from other regions by YABE and EGUCHI (1932, 1936, 1937, 1941, 1942) and others.

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Acknowledgements

The writer takes this opportunity to express his deep gratitude to Professor Kotora HATAI of the Institute of Geology and Paleontology, Tohoku University for his kind suggestions and critical reading of the manuscript. Acknowledgement is due to Professor Motoki EGUCHI of the Department of Mining Engineering, Faculty of Technology, Tohoku University for his kind guidance and helpful criticism on the hexacorals. Deep appreciation is due to Professor Ikuzo HAMAI of Faculty of Fisheries, Hokkaido University for his donation of the important materials and valuable sugges-

tions. He is indebted to Mr. Kimiji KUMAGAI for his photographic works.

Studied Materials and Collected Localities

The stations where dredge operations were undertaken amount to 14, among which the hexa-corals here treated occured at five stations of which the depth ranges from 80 to 160 meters. From these stations, four species and one subspecies distributed among three genera were discriminated: they are:

Flabellum transversale MOSELEY
Flabellum transversale conicum YABE and EGUCHI
Deltocyathus orientalis DUNCAN
Heterocyathus japonicus (VERRILL)
Heterocyathus sp.

The distribution of the stations and the data for the coral-bearing dredgings are given in Fig. 1 and Table 1, respectively.

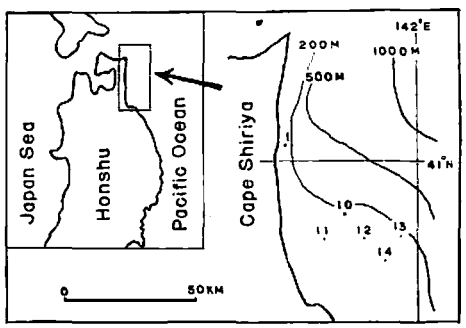

Fig. 1. Location of dredgings on the continental shelf of the Pacific coast, off Cape Shiriya, Aomori Prefecture.

Table 1. Station data for the coral-bearing dredging

Station No.	Date in 1954	Depth in meters	Surface temp.	Bottom temp.	Solitary corals
1.	August 25	80	21.60	15.07	*Flabellum transversale* *F. transversale conicum* *Deltocyathus orientalis* *Heterocyathus japonicus* *H.* sp.
10.	August 25	160	20.79	13.86	*Deltocyathus orientalis*
11.	August 25	70	20.70	16.06	*Flabellum transversale*
12.	August 25	90	20.60	14.72	*Flabellum transversale* *Deltocyathus orientalis*
13.	August 23	140	21.80	9.40	*Deltocyathus orientalis*
14.	August 23	90	21.80	13.65	*Deltocyathus orientalis*

Distribution of Species and Bionomic Note

All the species reported in this article are well known from the seas surrounding Japan. Some of them are widespread and have been recorded from the Riukiu Islands, Australia and East Indies, etc. They have also been reported as fossil from the Pliocene and Pleistocene rocks of Japan. The distributions of each species are given in the systematics.

The habitat of simple corals is controlled by the ecologic factors; temper-

ature, depth, substratum, etc. However, they are less restricted environmentally than the reef-building hermatypic corals.

As indicated in Table 1, the simple corals were dredged from an area where the surface-water temperature ranges from 20.60 to 21.80°C and the bottom-water temperature from 9.40 to 16.06°C. On the other hand, the distribution of the same species from the seas surrounding Japan were in areas having the following bottom - water temperature range (YABE and EGUCHI, 1942).

Flabellum transversale:
1.4-17.8°C
F. transversale conicum:
7.0-17.0°C
Deltocyathus orientalis: 4.3-23.3°C
Heterocyathus japonicus: 12.0-16.0°C

As mentioned, the range of temperature is fairly large, but the maximum development of these species in Japan is found in areas where the temperature is between 12°C and 19°C.

The depth from which the ahermatypic corals were dredged is in the range of 80-160 meters, off Shimokita Peninsula, Aomori Prefecture. In the seas around Japan, on the other hand, the depth range of each species is as follows.

Flabellum transversale: 17-344 meters
F. transversale conicum: 80-219 meters
Deltocyathus orientalis: 59-344 meters
Heterocyathus japonicus: 55-188 meters

The most favorable bathyenvironment of the four mentioned simple corals is between 80-200 meters in Japan, but abroad, the greatest known depth from which the simple corals have been recorded is 4914 meters for *Deltocyathus orientalis* and 522 meters for *Flabellum transversale.*

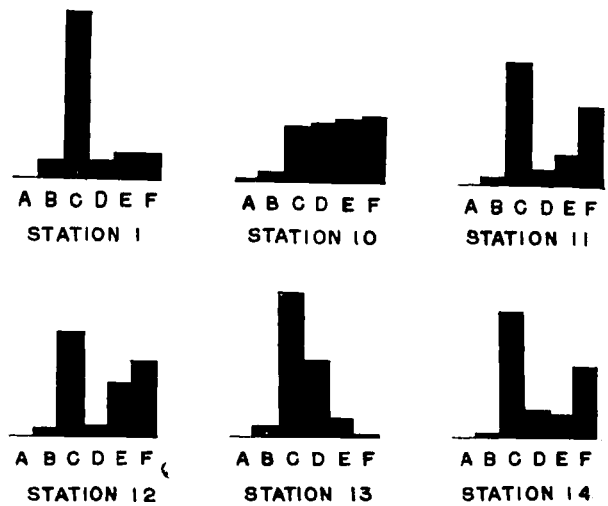

Fig. 2. Diagram showing the grain size of the sediments of each station. (%)
A: 0.05 (mm), B: 0.20-0.05, C: 0.50 0.20,
D: 1.00-0.50, E: 3.00-1.00, F: 3.00.

The histograms (Fig. 2) represent the various types of sediment from where the simple corals were dredged. Although the number of stations and coral specimens are insufficient to permit an analysis of grade preference, it is problematic whether the samples were dead or alive at the time of collection, but several inference can be drawn; there is a marked preference by *Flabellum transversale* and *Deltocyathus orientalis* to fine to medium grained sand or shells and for substrates where fine to medium grained sand and shells are the dominant constituents.

The silt and gravel-grade facies show smaller distribution compared with that of the sand and shells where *Flabellum transversale* and *Deltocyathus orientalis* were found. Concerning *Flabellum transversale conicum* and *Heterocyathus*

japonicus the data at hand are insufficient for drawing conclusions.

Among the illustrated three species and one subspecies, *Flabellum transversale*, *Deltocyathus orientalis* and *Heterocyathus japonicus* are well known as fossils from the Pliocene and Pleistocene rocks in Japan. The data presented in the present article are important for an interpretation of the paleoecology of the Pliocene and Pleistocene fossils of solitary corals, but detail discussions are not given in this work, because the treated materials are few and restricted. However, this is an important subject for further study on the solitary corals in Japan.

Systematics

Family Flabellidae BOURNE, 1905

Genus *Flabellum* LESSON, 1831

Flabellum transversale MOSELEY

Pl. 46, figs. 6, 7.

Flabellum transversale MOSELEY, 1881, *Sci. Exped. H.M.S. Challenger, Rep., Zool., 2, Vol. 7*, p. 174, pl. 6, figs. 6-6a; YABE and EGUCHI, 1932, *Imp. Acad., Proc., Vol. 8, No. 9*, p. 443; YABE and EGUCHI, 1942, *Tohoku Imp. Univ., Sci. Rep., 2nd Ser. (Geol.), Vol. 22, No. 2*, pp. 99-100, pl. 6, fig. 11; pl. 7, figs. 1-6, 8-10, 12; YABE and EGUCHI, 1942, *Ibid. Vol. 22, No. 2*, pp. 134-135, pl. 11, figs. 16-17.

Flabellum dens ALCOCK, 1902, *Siboga Exped. Monogr.*, 16a, p. 32, pl. 4, figs. 30-30a.

Flabellum inconstans MARENZELLER, 1904, *Wiss. Ergeb. deutsch. Tiefsee-Exped., Bd. 7*, p. 277, pl. 17, fig. 11.

Flabellum harmeri GARDINER, 1929, *Brit. Mus., Nat. Hist. Rep. Zool., 5, No. 4*, p. 122, pl. 1, figs. 19-20.

Dimensions (in mm):—

	1	2	3	4	5
Height of corallum	20.0	28.6	22.0	29.0	27(?)
Longer diameter of calice	20.0	32.0	29.0	25(?)	27(?)
Shorter diameter of calice	10.0	11.5	10.0	13(?)	11(?)
Edge angle	41°	60°	62°	46°	53°
Facial angle	23°	21°	23°	26°	23°
Number of septa	96	120	96	96	100

Remarks:—The present species was first recorded from Bass Straits, Australia by MOSELEY in 1881; it also occurs in the seas around Japan. *Flabellum dens* ALCOCK (ALCOK, 1902) originally recorded from the East Indies, *Flabellum inconstans* MARENZELLER (MARENZELLER, 1904) which was first reported from Australia and *Flabellum harmeri* GARDINER have been included into *Flabellum transversale* MOSELEY by YABE and EGUCHI (1942). This view is accepted by the writer.

Among the specimens here treated, three specimens have the septa of the 5th cycles complete and in regular hexameral plan. In this respect, they resemble *Flabellum transversale conicum* YABE and EGUCHI (1942), but can be distinguished from the latter by having more compressed corallum. They are considered to be of forms intermediate between the typical species and the subspecies *conicum*.

The present specimens are more or less similar to *Flabellum rubrum* (QUOY and GAIMARD), but the latter has more characteristic crescent-shaped basal scar. Recently, Donald F. SQUIRES (1963) published a detailed study concerning *Flabellum rubrum* and in it he included various species into the synonymy of it.

But at present, the writer accepts the view of YABE and EGUCHI (1942) concerning the relation between *Flabellum transversale* and *Flabellum rubrum*.

Although the specimens measured above are not excellently preserved and somewhat different from the typical one, their features fall in the range of variation of *Flabellum transversale* MOSELEY.

Occurrence:—St. 1, 80 m; St. 11, 70 m; St. 12, 90 m.

Geographical distribution: — This is one of the widely distributed species. Besides the Japanese seas, it has been recorded from the East Indies and the Bass Strait, Australia. As fossil, the species has been recorded from the Pliocene and Pleistocene sediments of Chiba, Shizuoka and Kanagawa Prefectures. The chronological range of the species may be from Pliocene to Recent.

Flabellum transversale conicum YABE and EGUCHI

Pl. 46, fig 3.

Flabellum transversale conicum YABE and EGUCHI, 1942, *Tohoku Imp. Univ., Sci. Rep., 2nd. Ser. (Geol.), Vol. 22, No. 2*, pp. 100-101, pl. 7, figs. 8, 10; YABE and EGUCHI, 1942, *Ibid., Vol. 22, No. 2*, p. 135, pl. 11, fig. 18.

Dimensions (in mm):—

Height of corallum	11.5	9.2
Longer diameter of calice	11.5	7.0
Shorter diameter of calice	5.5	5.7
Edge angle	60°	—
Facial angle	24°	28°
Number of septa	56	48

Remarks:—Of two measured specimens the smaller one agrees well with the type of *Flabellum transversale conicum*, but the other (larger one) is somewhat different. According to YABE and EGUCHI (1942) the most characteristic feature distinguishing *Flabellum transversale conicum* from *Flabellum transversale* is that the septa are of the regular hexameral arrangement in *Flabellum transversale conicum*, whereas they are irregular in *Flabellum transversale*.

One of the specimens here mentioned has 56 septa and is more or less similar to *Flabellum transversale*, but the general shape of the corallum closely resembles this subspecies. This may be a type transitional between *Flabellum transversale* and *transversale conicum*.

Occurrence:—St. 1, 80 m.

Geographical distribution:—This subspecies has been known from the seas around Japan and the distribution is relatively restricted compared with *Flabellum transversale*.

Family Caryophylliidae GRAY, 1847

Subfamily Caryophylliinae GRAY, 1847

Genus *Heterocyathus* Milne EDWARDS and HAIME, 1848

Heterocyathus japonicus (VERRILL)

Pl. 46, fig. 4.

Stephanoseris japonica VERRILL, 1866, *Essex Inst., Proc., Vol. 6*, pl. 47 (fide YABE and EGUCHI, 1942)

Stephanoseris lamellosa VERRILL, 1866, *Ibid.*, p. 51 (fide YABE and EGUCHI, 1942)

Stephanoseris carthausi FELIX, 1913, *Palaeontogr., Vol. 60*, p. 32, pl. 27, figs. 9-9b; MAKIYAMA, 1926, *Geol. Soc. Tokyo. Jour., Vol. 33*, p. 5.

Heterocyathus (Stephanoseris) carthausi FELIX, SAKAKURA, 1935, *Geol. Soc. Tokyo. Jour., Vol. 42*, p. 189.

Heterocyathus japonicus (VERRILL), YABE and EGUCHI, 1942. *Tohoku Imp. Univ., Sci. Rep., 2nd Ser., Vol. 22. No. 2*, p. 127, pl. 11, fig. 6.

Remarks:—This species was first described by VERRILL as *Stephanoseris japonica* from Kagoshima Bay, Kyushu, Japan. The present species is more or less similar to *Heterocyathus aequicostatus* Milne EDWARDS and J. HAIME in general appearance, but differs in having indistinct pali, the costae alternating in size, and the thinner costae are colored darker than the thicker one. Because of the above mentioned characters and by having perforated septa, the present specimen is identical with *Heterocyathus japonicus* (VERRILL).

Occurrence:—St. 1, 80 m.

Geographical distribution:—This species has been reported from the seas surrounding Japan and as fossil it is known from Chiba Prefecture, Taiwan and Java. This species and *Heterocyathus aequicostatus* are the most widely distributed species in the Genus *Heterocyathus* in Japan.

Heterocyathus sp.

Pl. 46, fig. 5.

Remarks:—The general outer shape of the corallum of the present specimen resembles *Heterocyathus japonicus* (VERRILL), but it cannot be identified with it, because the calice of the specimen examined is ill preserved.

Occurrence:—St. 1, 80 m.

Genus *Deltocyathus* Milne EDWARDS and HAIME, 1848

Deltocyathus orientalis DUNCAN

Pl. 46, figs. 1, 2.

Deltocyathus orientalis DUNCAN, 1876, *Zool. Soc. London, Proc.*, p. 431, pl. 38, figs. 4-7; YABE and EGUCHI, 1932, *Imp. Acad., Proc., Vol. 8, No. 8*, p. 388; YABE and EGUCHI, 1932, *Ibid., Vol. 8, No. 9*, p. 442; YABE and EGUCHI, 1937, *Tohoku Imp. Univ., Sci. Rep., 2nd Ser. (Geol.), Vol. 19, No. 1*, pp. 131-135, pl. 20, figs. 1-10; YABE and EGUCHI, 1942, *Ibid., Vol. 22, No. 2*, pp. 125-126.

Deltocyathus lens ALCOCK, 1902, *Siboga Exped., Monogr., 16a*, pp. 19-20, pl. 2, figs. 16-16a; UMBGROVE, 1925, Geological and Petrological and Palaeontological Results of Exploration carried from September 1917 till June 1919 in the Island of Ceram by L. RUTTEN and W. HOLZ, 2nd. Ser., *Paleont., No. 1*, p. 4, pl. 1, figs. 8-10.

Remarks:—Fifty-eight specimens of this species were examined. They are in varied stages of growth and vary in size; the largest specimen at hand is 8.3 mm in diameter, 5.8 mm in height and has 48 septa, and the smallest one is 4.0 mm in diameter, 1.9 mm in height and 36 septa.

This species is one of the well known deep water corals from Japan, and among the coral specimens here reported, those of the present species are most common.

Occurrence:—St. 1, 80 m; St. 10, 160 m; St. 12, 90 m; St. 13, 140 m; St. 14, 90 m.

Geographical distribution:—This species is well known from the seas around Japan, the Philippines, East Indies and the Mediterranean Sea. Among the solitary corals recorded from Japan, this is one of the predominant species. As fossil, this species has been recorded from the Pliocene and Pleistocene rocks of Chiba and Kanagawa Prefectures and of the Riukiu Islands.

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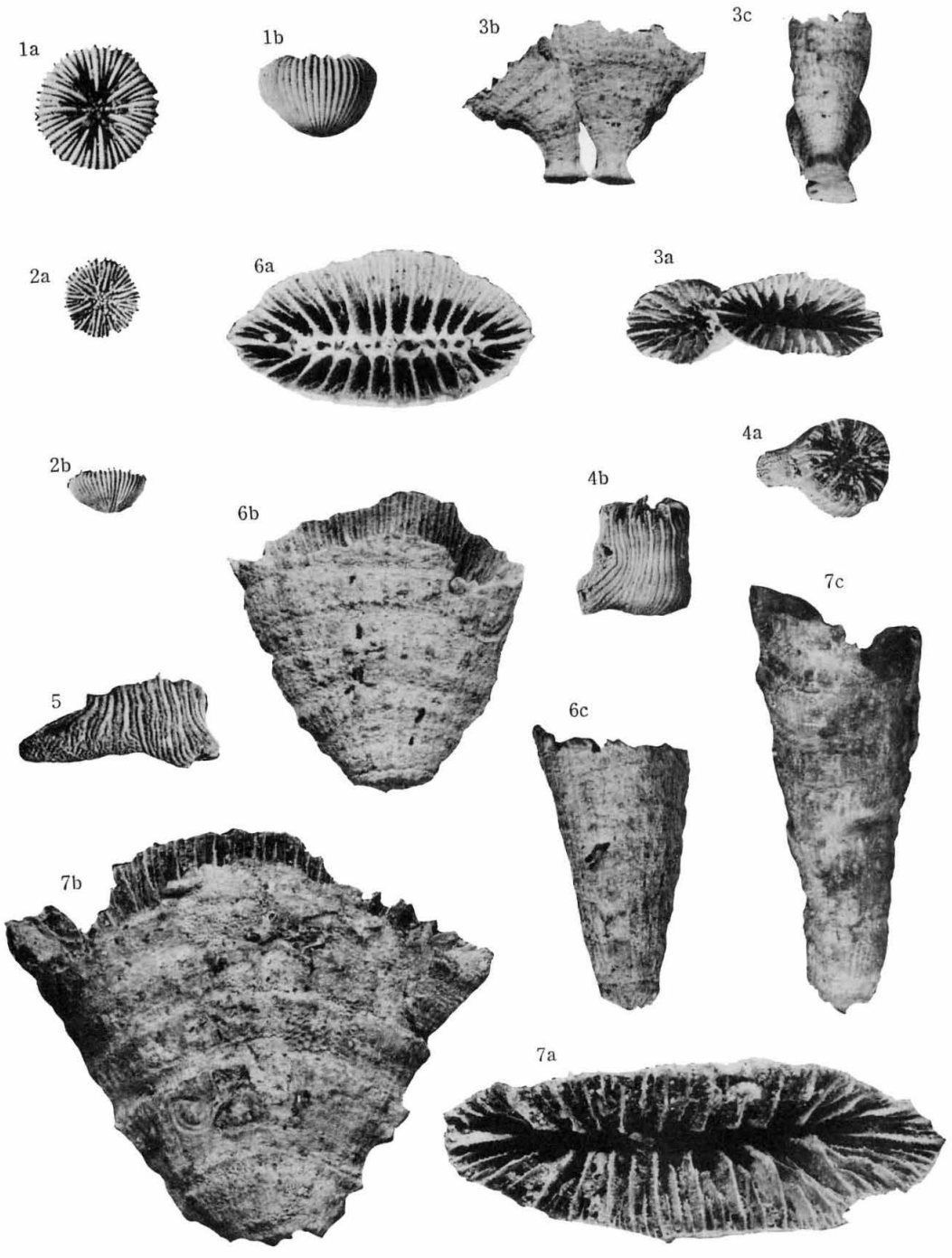
Shiriya 尻 屋

Explanation of Plate 46

(All figures in × 2.3. a: calicular vew. b: lateral view. c: edgewise view)

Figs. 1-2: *Deltocyathus orientalis* DUNCAN. Loc. St. 1 IGPS coll. cat. no. 85718.
Fig. 3: *Flabellum transversale conicum* YABE and EGUCHI. Loc. St. 1. IGPS coll. cat. no. 85717.
Fig. 4: *Heterocyathus japonicus* (VERRILL). Loc. St. 1. IGPS coll. cat. no. 85719.
Fig. 5: *Heterocyathus* sp. Loc. St. 1. IGPS coll. cat. no. 85967.
Figs. 6-7: *Flabellum transversale* MOSELEY. Loc. St. 1, 12. IGPS coll. cat. no. 85716.



KUMAGAI photo

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 56, pp. 317-321, pl. 47, Dec. 20, 1964

479. A RUDISTID FROM THE CRETACEOUS DEPOSITS OF RYOSEKI, KOCHI PREFECTURE, JAPAN

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高知県領石の白亜紀層からの Rudistid：古白亜紀目比原層久礼田砂岩部層の上部から産した厚歯二枚貝 *Monopleura* sp. について記載した。 斎藤靖二

Introduction and Acknowledgements

Rudistids which are an aberrant type of sessile pelecypods are common and widely distributed in late Mesozoic deposits of the world. They have various shapes and generally are confined to the tropical and semi-tropical facies of the Cretaceous. These highly specialized or aberrant bivalves have a short vertical range and a wide distribution, therefore they may render valuable aid in the correlation and determination of stratigraphic units in the Cretaceous. Rudistids, however, are extremely rare in the Cretaceous rocks of the Japanese Islands and the species hitherto known are only two, *Praecaprotina yaegashii* (YEHARA) and *Toucasia carinata orientalis* NAGAO. The writer describes one rudistid which was collected by Dr. Kunihiro ISHIZAKI from the Cretaceous deposits of Ryoseki, Kochi Prefecture, Shikoku during his geological survey in 1958. Since no rudistids have been known from the area and the genus discussed in present work may be the first record from the Cretaceous of Japan, it is thought to be of no small importance to describe the present specimen.

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Here the writer wishes to express his sincere gratitude to Professor Kotora HATAI of the Institute of Geology and Paleontology, Faculty of Science, Tohoku University for his kind guidance and advice throughout this work. He also thanks Dr. Kunihiro ISHIZAKI of the same Institute for information with regard to the stratigraphy of the area. Thanks are expressed to Mr. Kimiji KUMAGAI for taking the necessary photographs.

Geological and Paleontological Notes

According to PALMER (1928) the distribution of rudistids is represented with a band that extends almost around the earth and that with the exception of the detour around northern Africa, roughly parallels the present equator and lies in the area of warm water. Although the Japanese Islands are geographically remote from the northern limit of distribution, there have been reported the occurrences of rudistids by YABE and YEHARA (1913), YEHARA (1920), YABE and NAGAO (1926) and NAGAO (1932, 1933).

The species already described are *Praecaprotina yaegashii* (YEHARA) and *Toucasia carinata orientalis* NAGAO.

The former was first discovered by YEHARA from the Cretaceous deposits of Miyako, Iwate Prefecture, northeast Japan and regarded as belonging to *Plagioptychus* (YABE and YEHARA, 1913). In a later publication with its detailed description YEHARA (1920) assigned it to *Horiopleura* and called it *H. yaegashii*. Later, YABE and NAGAO (1926) proposed a new generic name and ascribed it to their *Praecaprotina* n. gen. The latter is from the thin lens of the *Orbitolina* Limestone, exposed along the Ishikari-River, between Ponmoshiri and Shimanoshita, Province of Ishikari, Hokkaido and its detailed description was given by NAGAO (1932, 1933).

Concerning the classification of the rudistids many workers have studied to arrange them into sections. FISCHER (1887) divided them into five families; Chamidae, Monopleuridae, Caprinidae, Hippuritidae, and Radiolitidae. This classification was modified by later workers and two families were added; Diceratidae, and Caprotinidae. When PALMER made a study on the rudistids of southern Mexico in 1928, he summarized them into five groups in so far as resemblance is evidence of relationship. They are Diceratidae-Chamidae Group, Monopleuridae-Caprotinidae Group, Caprinidae, Radiolitidae, and Hippuritidae. Recently, DECHASEAUX (1952) divided the rudistids except *Diceras* into the type fixed by the left valve and the type fixed by the right valve. The former is represented mainly by the Diceratidae and includes *Heterodiceras*, *Requinia*, *Toucasia*, etc. The latter is divided into five forms, which are namely, the ancient type without accessary cavities, the type with accessary cavities, the type with palliar canals, Hippuritidae, and Radiolitidae.

The specimen treated in this article was collected by Dr. Kunihiro ISHIZAKI of the Institute of Geology and Paleont-

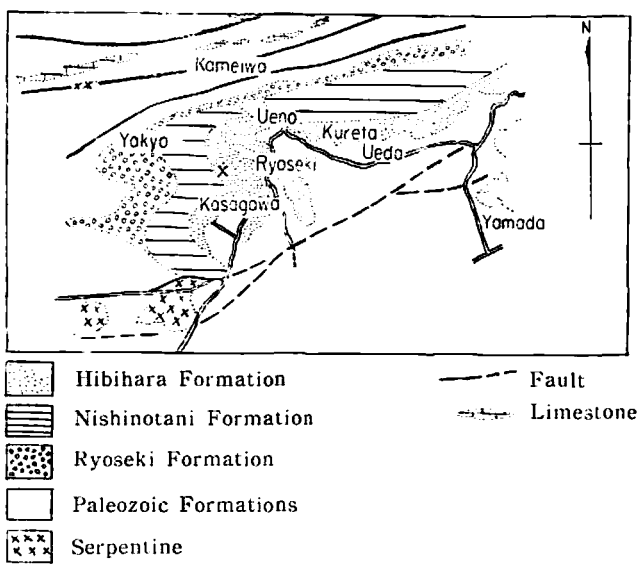

Fig. 1. Index map showing the fossil locality (after ISHIZAKI, 1960)

ology, Faculty of Science, Tohoku University, from the Cretaceous deposits at Okuminodani, west of Ryoseki, Kureta-Cho, Nangoku City, Kochi Prefecture, Shikoku (fig. 1).

According to ISHIZAKI (1960) the so-called Chichibu terrain in the area, although mainly composed of Paleozoic formations, also includes Mesozoic sediments mainly of the lower Cretaceous. These Cretaceous deposits are classified into three formations, namely, the Ryoseki, the Nishinotani, and the Hibihara in ascending order. The present specimen was collected from the upper part of the Kureta sandstone member of the Hibihara formation which is of Miyakoan age. From the same locality, he collected such fossils as *Trigonia* sp., *Exogyra* sp., *Astarte* sp., *Cerithium* sp., and an Echinoid spine.

The specimen at hand can be easily distinguished from the two genera of rudistids already reported from Miyako and Ishikari in only superficial aspect. So far as the external characters are concerned, the present specimen resembles the species of *Hippurites*, *Radiolites*, *Durania*, and *Monopleura* in having the operculate upper valve and much deeper lower valve ornamented with vertical ribs. However, the present specimen differs from *Hippurites* in the absence of two deep siphonal grooves in addition to the ligamental groove which are well shown on the surface or in cross section. The present specimen also differs from *Hippurites*, *Radiolites*, and *Durania* in the ligament. Although those three genera are characterized by the ligament being shifted to a subcentral position, and by the elongate teeth being modified for vertical motion of the upper valve, on the contrary the specimen at hand is considered to have a ligament situated along the hinge. The present specimen has no accesssary cavities and as stated below, many of its features are in common with the genus *Monopleura* MATHERON. Although the specimen in poorly preserved and the literature on *Monopleura* not abundant, the present specimen may be considered to be new to science.

Description

Family Monopleuridae FISCHER, 1887

Genus *Monopleura* MATHERON, 1842

Monopleura sp.

Pl. 47, figs. 1-7.

Description:—Two valves very inequivalve, and unfortunately broken away at attachment of the lower valve. The lower valve may have been conical in shape, being much deeper than the upper, and in cross section from transversely ovate to rounded subquadrate. Shell-wall rather thick especially on the dorsal side. Exterior of lower valve with longitudinal ribs at regular intervals approximately of 1.75 mm apart, ornamented by fine vertical striae, besides fine growth lines appear as rings They are more or less distinct. Ligament internal, ligamental groove not seen externally but in cross section appearing as a shallow concavity. Upper valve ovate in outline, somewhat convex or operculate with eccentric umbo situated on the dorsal margin. Surface with distinct concentric growth lines. Shell structure obscure. Body cavity occupies most of the interior. Vertical tooth and muscle scars not visible. Hinge plate known only by inference, but no elongate teeth modified for vertical motion. No

accessary cavities or no vertical canals.

Dimensions:—The present specimen is about 65.0 mm long and with the diameter of 35.0 mm to 44.5 mm.. but was originally much longer.

Remarks:—The present material is referred to the genus *Monopleura* because of its general resemblance to that genus, though a well developed tooth of the lower valve or two teeth of the upper valve could not be observed. This specimen belongs to the Monopleuridae-Caprotinidae Group of PALMER (1928) which is characterized by the general cone or funnel shape of the lower attached valve, the presence of one vertical groove (the ligamental groove) on the surface, and by the comparatively small upper valve which may be flat or somewhat convex. This group is usually ornamented with vertical ribs and includes the genera, *Caprotina, Chaperina, Polyconites, Horiopleura, Monopleura*, etc. *Monopleura*, as pointed out by DECHASEAUX (1952), differs from the other genera in the absence of accessary cavities.

Comparing this specimen with *Monopleura trilobata* (D'ORBIGNY) in the collection of the Institute of Geology and Paleontology, Tohoku University, it is found that the former is distinguishable from the latter by the vertical ribs of the lower valve and by the lack of ribs on the upper valve that radiate from the ligament. This specimen is similar to *Monopleura salazari* PALMER from Soyatlan de Adentro, Jalisco, Mexico in outline of the shell, but differs from the latter in the absence of deep horizontal growth stages. *Monopleura imbricata* MATHERON which is another species re-

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Explanation of Plate 47

Figs. 1-7: *Monopleura* sp. (IGPS coll. cat. no. 85769) ×1. Loc. Okuminodani, west of Ryoseki, Kureta-Cho, Nangoku City, Kochi Prefecture.

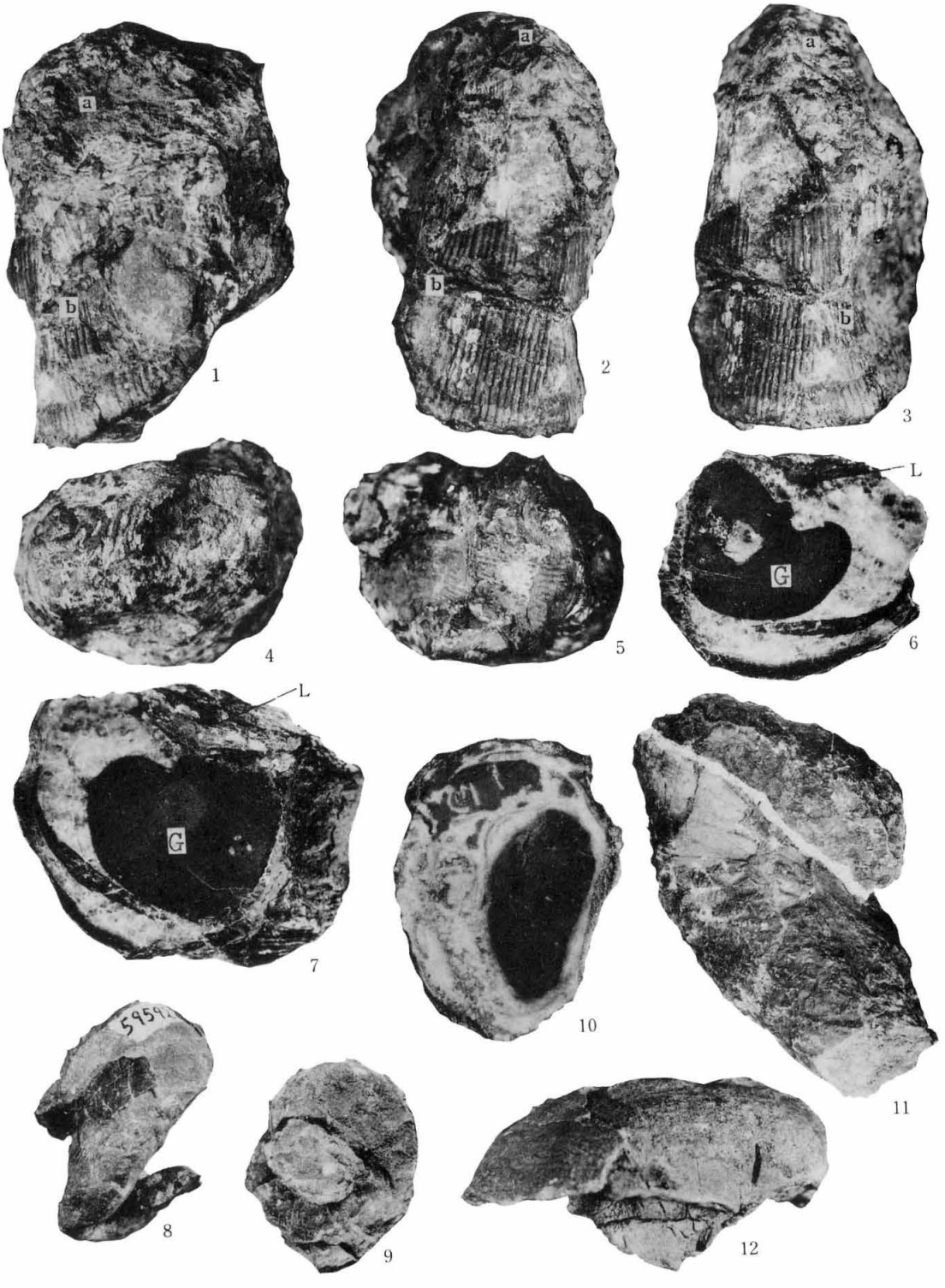
1. Posterior view. a: Lower valve. b: Convex lenticular operculate upper valve.
2. Side view.
3. Surface of lower valve ornamented with vertical ribs.
4. Upper valve ornamented with concentric ribs.
5. Area of attachment of the lower valve.
6-7. Cross section of the specimen, cut slightly below upper valve. (view of interior of the lower valve).
   L: Ligamental groove.
   G: Body cavity.

Figs. 8-9: *Toucasia carinata orientalis* NAGAO. A topotype specimen collected by W. HASHIMOTO (IGPS coll. cat. no. 59592). ×1

8. Lateral view.
9. View from bottom or of lower valve.

Figs. 10-12: *Praecaprotina yaegashii* (YEHARA).

10. Polished specimen of lower valve previously described by YABE and NAGAO (1926) from the *Orbitolina* Limestone of the lower course of the Sorachi-River, Sorachi-gun, Hokkaido (IGPS coll. cat. no. 22324). ×1
11. Lateral view of a specimen collected by W. HASHIMOTO from Shimanoshita, Ashibetsu, Sorachi-gun, Hokkaido (IGPS coll. cat. no. 58586). ×0.7
12. An upper valve collected by F. SAITO from Hiraiga, Miyako, Iwate Prefecture (IGPS coll. cat. no. 35442). ×0.5



KUMAGAI photo

sembling the present one superficially and with the lower valve ornamented by vertical ribs, is different in having radial ribs on the upper valve and a few deep horizontal growth stages. The present specimen lacks the radial ribs usually found on the surface of the upper valve of the Genus *Monopleura*. As the cardinal teeth of the present specimen remain unknown, further comparison is not possible.

Occurrence:—The upper part of the Kureta sandstone member of the Hibihara Formation at Okuminodani, Kureta-Cho, Nangoku City, Kochi Prefecture (IGPS coll. cat. no. 85769).

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Kureta	久礼田	Ryoseki	領石
Nishinotani	西ノ谷	Shimanoshita	島ノ下
Okuminodani	オクミノ谷		

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 56, pp. 322-331, pl. 48, Dec. 20, 1964

480. *YABEICERAS* (CRETACEOUS AMMONITES) FROM FUTABA, NORTHEAST JAPAN*

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and

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Geological Institute, Chiba University

東北日本双葉産ヤベイセラス（白亜紀アンモナイト）：上部白亜系浦河統下部階に属する双葉層下部の礫岩層から産した *Yabeiceras orientale* TOKUNAGA and SHIMIZU の完模式標本は，東京空襲の時に残念ながら焼失したとみなされる。そこで原産地からさらに標本を得ようと努力してきた。数年前に小畠は小型の幼殻を得ていた。最近前田の引率した巡検旅行中に，佐藤が幸にも成年殻の化石を採集した。これらについてくわしい古生物学的記載を行ない，*Yabeiceras* の類縁関係について論述する。同属の幼年殻は *Forresteria* に似た点がある。また *Eboroceras* BASSE, 1946 は *Yabeiceras* TOKUNAG and SHIMIZU, 1926 のシノニムである。*F.* も *E.* も従来 Barroisiceratinae に入れられている。記載した標本は九州大学に保管する。

1965 年に矢部長克先生は数えの 88 歳になられます。謹んでお祝いし，この小著を先生に献げます。　松本達郎・小畠郁生・前田四郎・佐藤輝夫

Introduction

TOKUNAGA and SHIMIZU (1926) described a number of Cretaceous fossils from the Futaba Formation in the Joban coalfield, about 200 km to the north-northeast of Tokyo. This was an admirable contribution to our knowledge in that the Upper Cretaceous deposits were recognized on the evidence of fossils underneath the coal-bearing Tertiary of the Joban area and that some of the described species were entirely new to science. *Yabeiceras*, an interesting ammonite genus, was established on that occasion.

The original type specimens described by TOKUNAGA and SHIMIZU (1926), most of which must have been preserved at the Waseda University, Tokyo, together with other fossils from the Joban area, are judged to have been burnt up by a fire of World War II, 1944, except for a few specimens which have been for some reason deposited at the Tohoku University, Sendai. This judgement is based on the replies given to the writers from the Faculty Members of Waseda University, Tohoku University and the University of Tokyo and also Dr. H. YABE.

The holotype, by monotypy, of *Yabeiceras orientale* TOKUNAGA and SHIMIZU

* Received August 20, 1964; read Sept. 20, 1964.

(1926, p. 201, pl. 22, fig. 7; pl. 27, fig. 1a-c), the type-species of *Yabeiceras* TOKUNAGA and SHIMIZU, 1926 (originally designated in p. 199), and the type-specimens of other two species, *Y. kotoi* and *Y. himuroi*, of the same genus were probably destroyed. This regrettable situation has given to palaeontologists some difficulty in the appropriate determination of the systematic position of the genus as well as in the correct identification of the species.

The two senior authors (T. M. and I. O.), therefore, have endeavoured to get specimens of *Yabeiceras* from the type-locality, upper reaches of Sakurazawa in Oriki, where Lower Member of the Futaba Formation is exposed. Although bivalves occur there in abundance, ammonites are quite rare. Only a small, probably immature specimen of *Yabeiceras orientale* and a few heteromorpha have been collected there.

In summer 1963, the third author (S. M.) conducted a departmental excursion to the Futaba area. After six days field work by a group of thirteen students, an adult ammonite which was unfamiliar to them was finally acquired at the same locality by the last author (T. S.), a student. The specimen was brought to the Department of Palaeontology, National Science Museum, Tokyo and shown to the second author (I. O.), who told him its significance. It was developed from the rock matrix and cleaned in a laboratory of Chiba University and then donated to Kyushu University for further palaeontological study.

This paper contains the description and illustration of the two specimens. Before going further the writers wish to acknowledge the debt of gratitude to Prefessor Emeritus Hisakatsu YABE, Professors Kotora HATAI, Sadajiro TSUCHIDA and Dr. Masafumi MURATA for giving them information about whereabouts of TOKUNAGA and SHIMIZU's types, and to Mr. C. W. WRIGHT in London for his critical reading of the typescript. Dr. Itaru HAYAMI took photographs at Kyushu University and Miss Tomoko MIYAZAKI assisted in preparing the manuscript.

Description

Yabeiceras orientale TOKUNAGA and SHIMIZU

Pl. 48, Figs. 1a-c, 2a-e;
Text-figs. 1a-d, 2a-e, 3.

1926. *Yabeiceras orientale* TOKUNAGA and SHIMIZU, *Jour. Fac. Sci., Imp. Univ. Tokyo, Sect. II, Vol. 1, Pt. 6*, p. 201, pl. 22, fig. 7; pl. 27, fig. 1a-c.

1926. *Yabeiceras orientale*, SHIMIZU, *Proc. Imp. Acad., Japan, Vol. 2, No. 10*, p. 547.

Type:—The holotype is the specimen described and figured by TOKUNAGA and SHIMIZU (1926, indicated above), which was almost certainly destroyed in 1944. A neotype has to be officially proposed and its validity should be acknowledged.

Material:—The two specimens to be described in this paper are GK. H5556, an internal mould of an adult shell (Coll. S. MAEDA and T. SATO), and GK. H5557, that of an immature shell (Coll. I. OBATA). They are preserved in the Type-Specimen Room, Departmet of Geology, Kyushu University, Fukuoka. The rock matrix is made up of calcareous sandstone. Therefore the fossils are secondarily little deformed. On some part an inner layer of the test is preserved. The innermost nuclear part and a half of the body-whorl of the first specimen are not preserved. The un-

illustrated side of the shell is dissolved and hardly separable from the rock matrix in which shells of *Apiotrigonia*, *Glycymeris* and other bivalves are accumulated.

Measurements (in millimeters):—

Specimen [Part]	Diameter	Umbilicus	Height	Breadth (Costal)	Breadth (Interc.)	B./H. (C.)	B./H. (I.)
GK. H5556	123.0(1)	59.4(0.48)	39.6	15.8×2		0.8	
,, [3/2 vol. early]	52.0(1)	23.0(0.44)	17.3(0.33)	27.5(0.53)	25.5(0.49)	1.58	1.47
,, [2 vol. ,,]	—	—	15.5	20.0	15.5	1.29	1.0
,, [3 vol. ,,]c.	40.0(1)	16.0(0.4)	12.5(0.31)	16.2(0.40)	13.2(0.33)	1.29	1.05
GK. H5557	29.6(1)	9.5(0.32)	12.0(0.40)	14.5(0.48)	12.3(0.41)	1.20	1.02
,, [¼ vol. ,,]	—	—	10.6	12.3	10.8	1.16	1.01
,, [½ vol. ,,]	20.4(1)	6.4(0.31)	8.8(0.43)	10.8(0.53)	9.4(0.46)	1.22	1.06
Holotype(T. & SH.)	62	26(0.41)	22(0.35)	26 (0.42)			1.18

Description:—The characters of the shell of this species change to a large extent with growth, as has been already mentioned by TOKUNAGA and SHIMIZU (1926) and SHIMIZU (1926). The change may be shown more clearly, at least in some respects, by the present two specimens than by the holotype. There may be also a certain extent of variation within a species. Even if the shells of the same diameter are brought into comparison, they may be somewhat dissimilar.

The smaller specimen, GK. H5557 (Pl. 48, Fig. 1a-c; Text.fig. 1a-d), probably represents a young shell. It is about 30 mm. in diameter and is wholly septate. It has an umbilicus of moderate size (about 31 percent of the diameter). It is moderately involute, about a half of the inner whorl being overlapped by the outer. The whorl of this stage is nearly as high as broad and subcircular in the intercostal section, but it is somewhat broader than high and rather polygonal in costal section. The ornament in this stage consists of fairly strong tubercles at about the middle of the flank (i. e. slightly below the mid-height), about eight in a half volution, simple, blunt ribs extending radially from the tubercle to near the umbilical margin without umbilical tubercles, secondary ribs bifurcating from the mediolateral tubercles with a moderate projection on the venter, and weak tubercles at the ventrolateral shoulder on the secondary ribs. A low siphonal keel is weakly undulated; each undulation corresponds in number and position with one of the secondary ribs which form obtuse chevrons on the venter. The lateral tubercles on the anterior part of the preserved last whorl of this specimen are rather mammillate and on the rest part they are bullate, although this is the character observed on the internal mould.

On the next inner whorl of the same specimen distant, weak radial ribs, which are broadened and elevated at the mediolateral tubercles are observable. The tubercles look subangular and in contact with the steep umbilical wall of the outer whorl. A siphonal keel, lateral tubercles and ribs seem to appear at about the shell diameter of 9 mm. The flanks are somewhat flattened and the venter is low, roof-shaped in this stage, although the details of the venter are not clearly seen. The characters of still

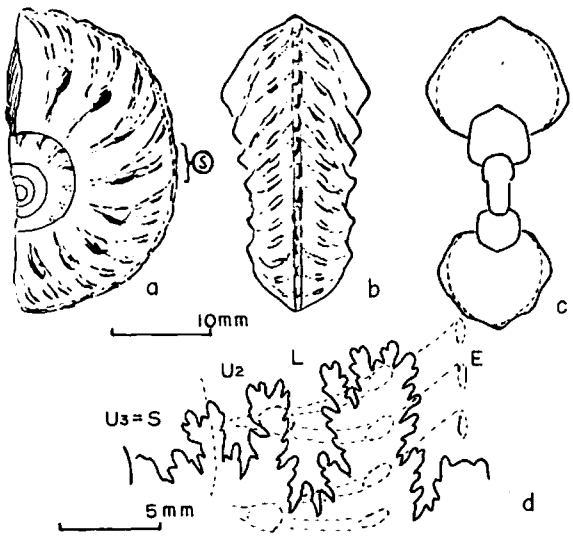

Fig. 1a-d. *Yabeiceras orientale* TOKUNAGA and SHIMIZU. A diagrammatic sketch (partly restored) of a young shell. GK. H5557. Lateral (a), ventral (b) and sectional (c) views; External suture (d) at the stage marked as s in Fig. 1a. *T. M. delin.*

inner whorl are not well shown.

The suture at whorl-height of 10 mm. on the outer whorl is illustrated (Text-fig. 1d). The heads of the saddles are arranged on a descending line. The saddle between E and L is high and asymmetrically divided; the outer larger branch is further subdivided. L is deep and has fairly deep and narrow, four, asymmetrically disposed branches. E is nearly as deep as or somewhat larger than L in this stage. Other auxiliary elements (U_2, adjacent saddles, subdivided U_3) are smaller. All the elements are moderately incised, inspite of the small, immature state of the shell.

The other, larger, specimen, GK. H5556 (Pl. 48 Fig. 2a-e; Text-figs. 2a-e, 3) shows slowly growing three outer whorls. Its inner nuclear part as large as the preceding specimen is not well preserved for some reason. The observable youngest whorl, with height of 12.5 mm. and intercostal breadth of 13.2 mm., approximately represents the stage which follows that of the smaller specimen described above. It has a similarly subcircular intercostal section and the same type of ornamentation as that of the smaller specimen. The lateral, rounded tubercles become increasingly stronger. There are fourteen tubercles in the whorl of about 40 mm. in diameter. Faint secondary ribs spring in pairs from the lateral tubercles and they are provided with faint outer ventrolateral or rather to say ventral tubercles on a line fairly close to the mid-venter. The siphonal keel is low and faintly undulated.

The succeeding whorl is unusually depressed and rather coronate in cross-section, with a much larger proportion of breadth to height (see *Measurements*). It has a steep umbilical wall and a

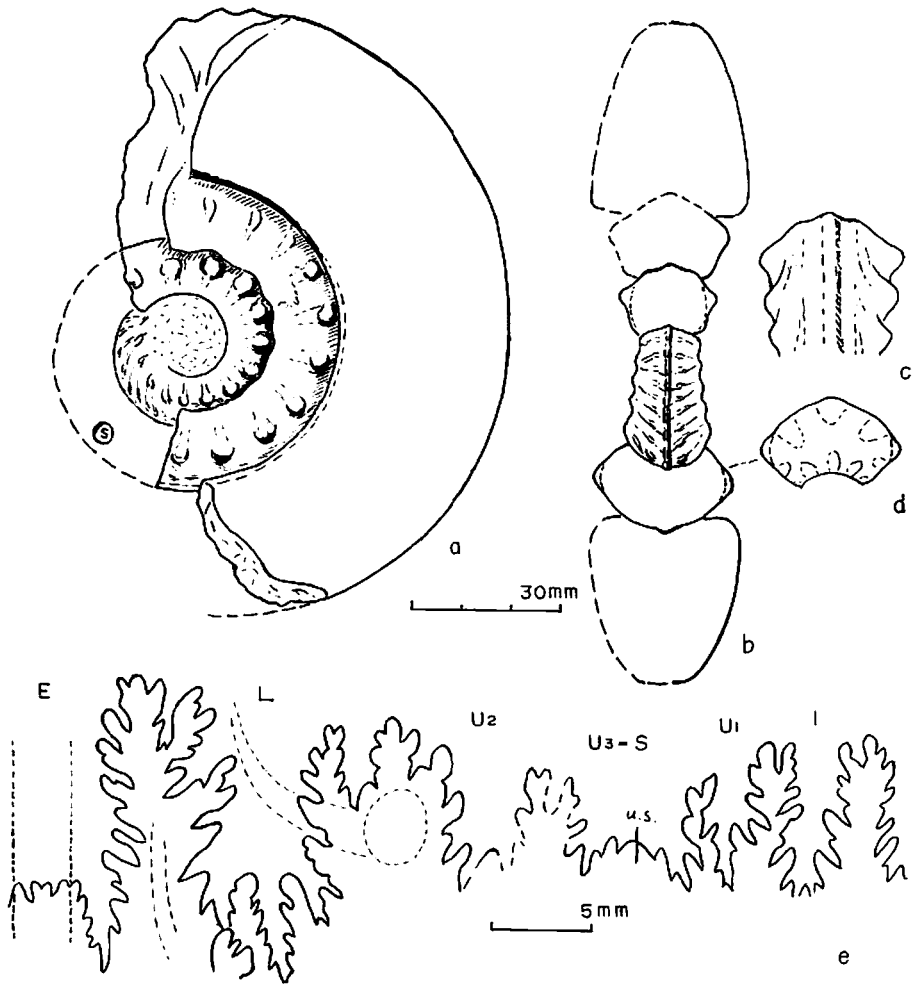

Fig. 2a-e. *Yabeiceras orientale* TOKUNAGA and SHIMIZU. A sketch of an adult shell, GK. H5556. Lateral (a) and sectional (b) views; a ventral view of the inner whorl is shown in Fig. 2b. Ventral view (partly restored) (c), cross-section (d) and suture (e) of a part of the last second whorl, which is removed and only indicated by broken lines in Fig. 2a. The illustrated suture is at the stage marked as s in fig. 2a. *T. M. delin.*

rounded umbilical shoulder. It embraces about one third of the inner whorl. The lateral tubercles are strong, rounded at the base and mammillate. The radial rib which extends from the lateral tubercle to the umbilical margin is blunt in this stage. The secondary, projected ribs which spring outward and forward from the lateral tubercles are also blunt, fading away on the venter, without showing clearly the paired state. There remain, however, scarcely perceptible elevations on the lines parallel to and not far from the siphonal keel. They

look as if they formed very faint side keels. The siphonal keel itself is also weakened and smoothed, although it is more distinct than the side keels.

The last suture is exposed on the late part of the tuberculate whorl, i.e. the last second whorl (see Pl. 48, Fig. 2a; Text-figs. 2a, 3). Beyond the last suture the flank of the whorl is less inflated and the lateral tubercles are rapidly weakened.

The suture in the stage of the strongly tuberculate, depressed whorl is illustrated in Text-fig. 2e. It consists of the elements of E, L, U_2, U_3 (=S), U_1, I. They are in general moderately deeply incised. E is broad and nearly as deep as L. L is longer than broad and has narrow and deep, apparently trifid branches, but its stem is not much narrowed. U_2 is moderately broad and its minor incisions are not very deep. The internal elements (I and U_1) are narrow. The summits of the saddles are arranged on a line descending to the umbilical seam. The saddle between E and L is considerably deeply incised and its stem is narrowed. Its head is asymmetrically bifid, with a narrower and somewhat oblique branch on the side of L. The saddle between L and U_2 is moderately broad, being situated on the row of lateral tubercles. It is as a rule divided but the outline in detail may be modified, probably due to the relation with the large tubercle. The saddle between U_2 and U_3 is rather unusually deeply divided.

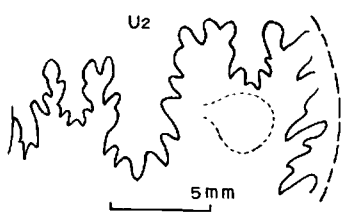

Fig. 3. *Yabeiceras orientale* TOKUNAGA and SHIMIZU. Exposed part of the last suture on the last second whorl of GK. H5556 (see a sketch in Fig. 2). Broken line indicates the umbilical margin of the outer whorl; the dotted line the mediolateral tubercle. *T. M. delin.*

The living chamber occupies more than a full volution in this specimen. A posterior half of the last whorl is unfortunately missing. Presumably it had been destroyed and gone before the deposition, as is suggested by the disposition of associated bivalved shells. As far as the observable part is concerned, the last whorl is quite dissimilar to the septate one. It grows slowly and overlaps about one third of the inner whorl. The umbilicus is wide, occupying well over 40 percent of the entire shell diameter. The umbilical wall is steep and somewhat excavated; the umbilical shoulder is subrounded to subangular.

The whorl is considerably higher than broad, with a proportion of 8:10 between breadth and height. It is broadest between the umbilical shoulders; the flanks are convergent and only gently convex; the venter is flat or slightly arched, with extremely obscured side keels at the ventrolateral shoulders and a faint remnant of the mid-ventral keel. The whorl-section is, thus, roughly trapezoid. The surface is smooth; tubercles and ribs, with which the inner whorls are characteristically ornamented, completely disappear from the last whorl.

The character of the whorl changes little within the last half volution. The diameter of the shell at the last end of the observable part is 123 mm. The apertural margin is not preserved in the present specimen.

Occurrence:—The two specimens were found in nodular calcareous sandstone embedded in the Lower Conglomerate

Member of the Futaba Formation, in the upper reaches of the Sakura-zawa, Oriki, Hirono-mura, Futaba-gun, Fukushima Prefecture. Many bivalves of shallow sea environments such as *Glycymeris*, *Apiotrigonia*, etc. are associated with the ammonites. *Inoceramus uwajimensis* YEHARA, an index of the Lower Urakawan (Coniacian), occurs abundantly in the same member.

Remarks

Comments are given here mainly on two points.—(1) Are the two described specimens from Futaba really of identical species with the holotype of *Yabeiceras orientale*? (2) What do the observed facts suggest about the affinities of *Yabeiceras*?

Although the holotype of *Y. orientale* is at present inaccessible to the writers, its characters are understandable to a considerable extent from the description and illustration of TOKUNAGA and SHIMIZU (1926, p. 201, pl. 22, fig. 7; pl. 27, fig. 1a-c). In the essential points the two specimens under consideration well agree with the holotype.

The smaller specimen, GK. H5557, is apparently more narrowly umbilicate than the larger one. This is probably ascribed, at least partly, to the difference between immature and grown whorls, because the width of umbilicus in proportion to the shell diameter gradually increases, as shown by the figures in the measurements. There can be also slight difference between individuals. The dimensions of the holotype, as measured by TOKUNAGA and SHIMIZU, indicate a somewhat smaller proportion of umbilicus to diameter than the present larger specimen, GK. H5556. The difference is, however, by no means great and can well be regarded as being within the extent of variation.

This species exhibits a peculiar type of change with growth in the shape of the whorl. In the relatively early growth-stage the whorl is nearly as high as broad; the flanks are rather flat when the shell is 5 to 15 mm. in diameter, and then become rounded (in costal section). In the middle growth-stage, with diameters over 30 mm. up to 60 mm. or so, the whorl is broader than high and the flanks are inflated. The most depressed whorl in the specimen GK. H5556, at a diameter of 52 mm., has the proportion of 1.47 between breadth (intercostal) and height. This seems to be somewhat larger as compared with 1.18 at a diameter of 62 mm. in the holotype. The exact comparison is, however, difficult, without seeing the actual specimen, since the change of dimensions with growth was not indicated by figures in the original description. The last whorl is higher than broad and has smooth, flattened flanks. In this point the writers' specimen agree with the holotype, although the ventral part of the last whorl of the latter is much damaged.

In the diagnostic change of ornamentation the two specimens described above essentially agree with the holotype. The ribs which extend from the lateral tubercles to the umbilical margin look more blunt in GK. H5556 than in the holotype. The lateral tubercles in the present two specimens seem to be situated on a line somewhat lower than that in the holotype. The differences are again rather slight and these characters change with growth even in one and the same individual. TOKUNAGA and SHIMIZU did not describe the faint elevations, i.e. the reduced outer ventrolateral tubercles, which should be discernible on the

secondary, ventral ribs on the inner whorls. This character is, however, shown on the photographs (TOKUNAGA and SHIMIZU, 1926, pl. 27, fig. 1 and also pl. 16, fig. 15 [*Y. kotoi*]).

The suture changes with growth and can be modified in correlation with the minor details of a whorl-shape and also strength and relative position of a tubercle. In the illustrated suture of the present larger specimen the saddle between L and U_2 is broader than that of the holotype. In the smaller specimen it is as narrow as the latter, but the saddle between E and L is comparatively broad. This and other minor differences in the suture between the present specimens and the holotype are not significant enough to separate them into different species. The general similarity is more remarkable than the minor differences.

To sum up the specific identity of the present two specimens with the holotype of *Yabeiceras orientale* is warrantable, granted that there is a certain entent of variation between individuals.

As regards the affinities of *Yabeiceras orientale*, Cenomanian *Schloenbachia* NEUMAYR, 1875, was at first considered by TOKUNAGA and SHIMIZU (1926, p. 201). SHIMIZU (1926, p. 548) on another occasion mentioned a similarity of *Yabeiceras* in shell-form and ornamentation to "the group of *Barroisiceras desmolinsi*." He (1934, p. 78) ascribed *Yabeiceras* to the family Priontropidae as understood at that date. For about two decades no comments had been given to the systematic position of the genus, until WRIGHT (1957, p. L 429) placed it in the subfamily Peroniceratinae of the family Collignoniceratidae. MATSUMOTO's opinion (personal communication in 1954) that *Yabeiceras* seemed to be somewhat similar to *Gauthiericeras* was taken into consideration by WRIGHT.

As has been described above, *Yabeiceras orientale* shows so particular type of changes with growth that it may be a puzzle to tell its true systematic position.

In the evolute, widely umbilicate, and tricarinate (although very indistinctly so) shell, *Yabeiceras* could be taxonomically included in the subfamily Perniceratinae. In fact the suture of *Yabeiceras* considerably resembles that of *Peroniceras* DE GROSSOUVRE, 1894. The carinate and arched venter of the septate whorls of *Yabeiceras* is similar to that of *Gauthiericeras* DE GROSSOUVRE, 1894, and *Ciryella* WIEDMANN, 1959. The mediolateral tubercles are developed in the middle growth-stage of *Gauthiericeras margae*, the type-species of *Gauthiericeras*, if not so strongly as in the adolescent stage of *Yabeiceras orientale*. But such an entirely smooth last whorl as that of *Y. orientale* is not seen in any well known examples of Peroniceratinae. Some species of *Peroniceras* attain a large size, as has been exemplified by those described by DESIO (1936) and VAN HOEPEN (1955). The last whorl in those species is distinctly costate and tricarinate.

In *Yabeiceras orientale* the mode of life must have been considerably different between the animal of the strongly ornate and inflated whorls of the middle ages and that of the smooth and compressed one of the adult to senile ages, although the writers have not got enough evidence in the mode of occurrence of the fossils.

In view of the moderate involution, polygonal costal section, and a particular type of ornamentation, the inner whorls of *Yabeiceras* resemble those of *Forresteria* REESIDE, 1931, of the subfamily Barroisiceratinae. In *Forresteria* not only the mediolateral but also the ventro-

lateral and ventral tubercles are strong, forming angular shoulders, while in *Yabeiceras* mediolateral tubercles are very strong but the ventrolateral and ventral tubercles are weak and finally lost as the shell grows and it has no angular ventrolateral shoulders. On the outer, adult whorl of *Forresteria* the mediolateral tubercles normally fuse with the exaggerated ventrolateral ones (in subgenus *Forresteria* s. s.), or to the umbilical ones (in subgenus *Reesideoceras*), or disappear (in subgenus *Harleites*). *Harleites* is however, much compressed and involute, and has angular ventrolateral shoulders on which fine clavae remain. Thus, *Yabeiceras* is related to but is distinguishable from any subgenera of *Forresteria*.

As far as the described species are concerned, *Yabeiceras* most closely resembles the subgroup of *Forresteria ampozaloakaense* BASSE (1947, p. 131, pl. 9, fig. 9), in which the ornaments gradually fade away on the outer whorl. BASSE's species is evidently more involute than *Y. orientale*. It probably needs a new subgeneric name.

The suture of the Barroisiceratinae is fairly variable, as has been demonstrated by BASSE (1947) and others. One of the illustrated sutures of *Forresteria forresteri* REESIDE (1931, p. 17, pl. 5, fig. 7) considerably resembles that of *Yabeiceras orientale* (Text-fig. 1d in this paper), although the former has broader saddles than the latter. In general the suture of *Yabeiceras* in the late growth-stage is more deeply and finely incised and has a narrower first lateral saddle than that of *Forresteria*.

It should be noted that *Eboroceras magnumbilicatum* BASSE (1946, p. 73, pl. 2, fig. 2a, b), from the Coniacian of Madagascar, closely resembles *Yabeiceras orientale*. The former has weak umbilical tubercles in addition to the strong mediolateral tubercles. This difference is specific, for *Yabeiceras kotoi* TOKUNAGA and SHIMIZU also has small umbilical tubercles on the inner whorl. *Eboroceras* BASSE, 1946, is certainly a synonym of *Yabeiceras* TOKUNAGA and SHIMIZU, 1926.

Further discussions and the final conclusion about the systematic position of *Yabeiceras* are to be reserved until more examples of *Yabeiceras* and related genera from Hokkaido are described by one of the writers (T. M.).

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Explanation of Plate 48

Figs. 1a-c, 2a-e. *Yabeiceras orientale* TOKUNAGA and SHIMIZU.

1. A young shell, GK. H5557, from the upper reaches of the Sakurazawa, Oriki, Hironomura, Futaba-gun, Fukushima Prefecture. Lower member of the Futaba Formation. Two lateral (a, b) and ventral (c) views, ×3/2.
2. An adult shell, GK. H5556, from the same locality and member. Lateral (a) and ventral (b) views of the main part. Natural cross-sections and ventral views of inner whorls (c). Lateral (d) and ventral (e) views of a part of the last second whorl, which is removed in Fig. 2a; a-e all in natural size.
(Photos by I. HAYAMI, without whitening)

1a

1c

1b

2b

2d

2c

2e

2a

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Locality Guide

Upper reaches of the Sakurazawa, Oriki, Hirono-mura, Futaba-gun, Fukushima Prefecture

(Approximately 140°57′45″ East Long., 37°12′10″ North Lat.)

福島県双葉郡広野村折木桜沢上流（国土地理院 5万分の 1 地形図幅「川前」の南東隅から北 4050 m 西 4250 m の地点）

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 56, pp. 332-344, pl. 49, Dec. 20, 1964

481. ON SOME LOWER AND MIDDLE TRIASSIC AMMONOIDS FROM JAPAN*

YUJI BANDO

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日本産，中・下部三畳紀アンモナイトについて：下部三畳紀アンモナイトとして愛媛県東宇和郡城川町魚成，田穂上組の田穂層産 *Hemiprionites* 属の一新種と *Paranannites* など二，三のアンモナイト，中部三畳紀アンモナイトとして南部北上山地，宮城県本吉郡歌津町伊里前の伊里前層，および仙台市北方の利府層から産出した数種のものと，四国の徳島県那賀郡上那賀町長安，五郎谷の蔵法院層からあらたに産出したアニシック型アンモナイト，*Ptychites* sp. および *Beyrichites* cf. *rotelliformis* (MEEK) の二種を記載報告し，且つ蔵法院層の時代についてアニシックにおよぶ可能性のあることを論じた。　　坂　東　祐　司

Abstract

The Lower Triassic *Anasibirites* fauna (*Hemiprionites shimizui* BANDO, n. sp., *Anasibirites* sp., *Hemiprionites* sp.) described in this paper from the Tao Formation at Tao (Taho) near Uonashi, Ehime Prefecture, Shikoku, including those previously mentioned (BANDO, 1961, 1964), belongs to the Upper Owenitan and is represented by the *Anasibirites multiformis* zone. Some Middle Triassic ammonites (*Balatonites* cf. *gottschei* (MOJSISOVICS), *Ptychites* sp., *Paracerati-tes* sp. and *Beyrichites* sp.) are also described in this paper. The Middle Triassic ammonites are from the Isatomae Formation (Anisian) in the Kitakami Massif and the Zohoin Formation (Ladinian) of eastern Shikoku. The ammonites from the Zohoin Formation at Gorodani, Nagayasu, Kaminaka-cho, Naka-gun, Tokushima Prefecture in eastern Shikoku, suggest that the age of the Zohoin formation may be Anisian to Ladinian.

* Received August 24, 1961; read Sept. 20, 1964, at Hiroshima.

Geological and chronological review of the fossil localities

The Triassic formations of the Kitakami Massif are included into two groups, i.e. the Inai and the Saragai. The Inai Group consists of four formations the Hiraiso, Osawa, Fukkoshi and the Isatomae in ascending order. The first two formations are regarded as of the Scythian stage and the later two as of the Anisian stage. On the other hand, the Saragai Group is Upper Triassic in age and belongs to the upper Carnian to Rhaetian?.

The Anisian ammonites from the Isatomae Formation have been known since many years ago and are characterized by and called the *Hollandites* fauna. In the southern part of the Kitakami Massif the Triassic beds show monoclinal structure along the Pacific coast whereas the general structure is of large synclinal form with NNE-SSW trend of axis which plunges SSW with low angle. The general order is normal, but the Scytho-Anisian beds and Aniso-Ladinian beds show different distribution, and forma-

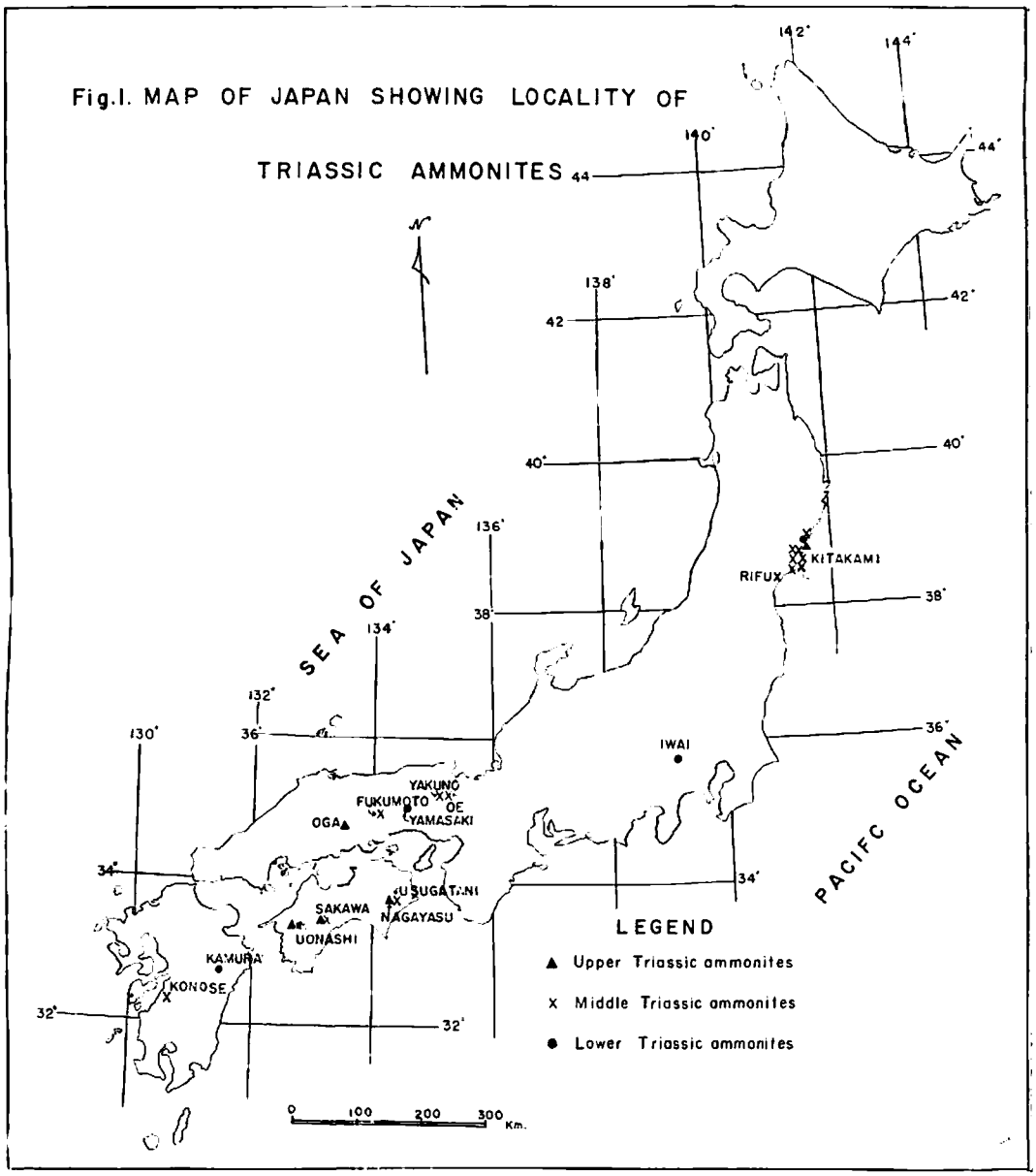


Fig. 1.

tions correlative with upper Ladinian to lower Carnian are missing in this district. On the synclinal axis, the Upper Triassic Saragai Group and the Lower Jurassic formations rest on the Middle Triassic Inai Group, but their distributions are restricted to the eastern wing of the syncline. No Lower Triassic ammonite

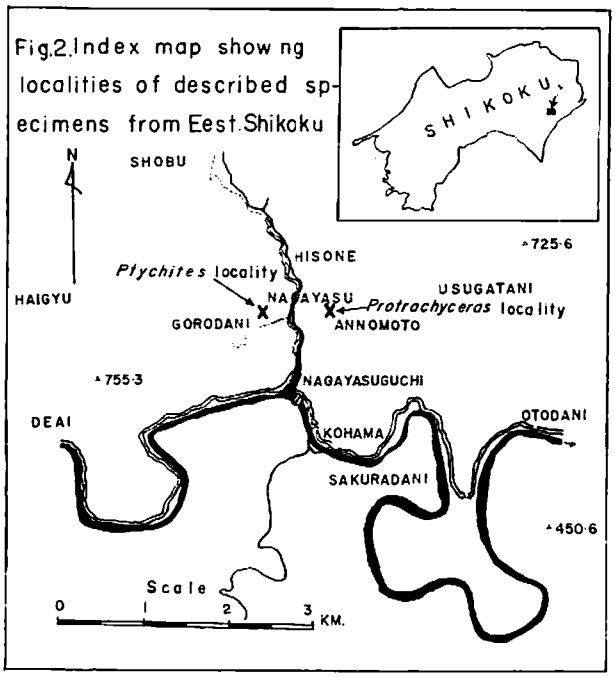


Fig. 2.

has been recorded from the Hiraiso Formation, but the Osawa Formation yielded a single characteristic ammonite, *Subcolumbites* cf. *perrini-smithi* ARTHABER (BANDO, 1964). The locality of *Paraceratites* sp. and *Baratonites* cf. *gottschei* (MOJSISOVICS), both described in this paper, is about 300 meters stratigraphically above the locality which yielded the Lower Triassic ammonite, and its geological horizon corresponds to the middle part of the Isatomae Formation.

The Triassic formations in the Nakagawa region, Tokushima Prefecture, eastern Shikoku are distributed in the so called Chichibu Terrane with a schuppe structure and with a general strike of ENE-WSW trend similar to the Paleozoic and Mesozoic strata. The formation of the locality of *Ptychites* sp. and *Beyrichites* sp. is the Zohoin Formation and the age of this formation is considered to be upper Ladinian. Recently NAKAZAWA (1964) described some Anisian ammonites i. e. *Ussurites yabei* DIENER, *Hollandites* sp. and *Balatonites* sp. from the Zohoin Formation(?) at Uonashi in western Shikoku. From the Zohoin Formation at Gorodani in eastern Shikoku, the occurrence of a *Ptychites* like ammonite was reported by KOBAYASHI and ICHIKAWA (1951, p. 93) and the material described in the present paper may probably be of the same species. However, the Zohoin Formation at Annomoto of Nagayasu yielded upper Ladinian ammonite, *Protrachyceras* cf. *pseudoarchelaus* (IAUBE), (BANDO, 1963, 1964). Accordingly the writer considers that the Zohoin Formation may range from the Anisian to upper Ladinian, although no lower Ladinian formations or beds

correlative with the Rifu Formation have been discovered in any known outcrops of the Zohoin Formation in Shikoku. However the material at hand is remarkable because the specimen of *Ptychites* sp. contains a single fragmental specimen of *Daonella* shell. Consequently, the paleontologic evidence shows that the geologic horizon of the formation which yielded *Ptychites* and *Beyrichites* may not be Anisian but should be taken as the lower Ladinian. Consequently, the formation which yielded those ammonites may be correlated with the Rifu Formation of the southern part of the Kitakami Massif in Northeast Japan.

Acknowledgements

The writer expresses his cordial thanks to Dr. Hisakatsu YABE, professor Emeritus of the Tohoku University, for his kind guidance and valuable suggestions and to Professor Kotora HATAI of the Institute of Geology and Paleontology of the Tohoku University for his continuous guidance. The writer also thanks Professor Yoshio ONUKI of the Department of Geology, Faculty of Education, Tohoku University, for his encouragements in many ways. Concerning the present work, acknowledgements are also due to Assistant Professor Kazumi SUYARI, Department of Geology of the Tokushima University, his valuable suggestions and Mr. Kagetoshi HASHIMOTO, the collector of the fossils.

Finally the writer his indebtedness to the Ministry of Education for a grant from the Science Expenditure Fund.

Description of Ammonoid fossils

Family Prionitidae HYATT, 1900

Genus *Hemiprionites* SPATH, 1929

Hemiprionites shimizui BANDO, n. sp.

Pl. 49, Figs. 1, 2

Description:—Shell involute, laterally compressed, discoidal, rather deeply embracing, umbilicus narrow. Side slightly convex from umbilical shoulder to ventral shoulder. Venter tabulated, neither keels nor furrows. Outer whorl indented at about one-fourth height by inner whorl. Height of whorl a little less than half of total diameter of shell, shell width about two-thirds of shell height. Umbilicus slightly opened, umbilical width a little narrower than one-fourth of total diameter of shell. Sides ornamented with radial folds, which are most elevated at half height of shell and diminish on umbilical margin, about 7-8 ribs in quarter part of outer whorl. Sides gently convex at a little below one-half height of whorl, where is maximum thickness. Venter tabulated and ventral edge slightly bicarinated, peripheral margin of side abruptly becoming flattened.

Septa caratitic, consists of rounded saddles and serrated lobes; peripheral lobe rather deep, divided by small angular saddles into four narrow entire lobes, medial lobe, shallower than peripheral one, divided into three lobes, wedge-shaped and terminates in two points. Umbilical lobe shallowest, separated into three to four lobes and three small rounded saddles. External saddle higher than first and second saddles, and roundly arched without serration, and second saddle lowest.

Remarks:—Two specimens were examined. This new species resembles *Hemiprionites tahoensis* (YEHARA) in the whorl shape, umbilicus and septal features, but can be distinguished from it by having distinct radial ribs on the

Measurements (in mm.):—

	D.	H.	H/D	W.	W/H	U.	U/D
IGPS *, coll. cat. no. 45158	27.5	13.0	0.47	8.0	0.62	6.5	0.24
GLKU**-C158	--	17.0	—	9.0	0.53	--	—

* IGPS-Abbreviation for the Institute of Geology and Paleontology, Tohoku University, Sendai, Japan. ** GLKU-Abbreviation for the Department of Geology, Kagawa University, Takamatsu, Japan.

surface, abruptly rounded umbilical shoulder, and higher external and first lateral saddles. The present species is similar to *H. morianus* (YEHARA) and the typical form of *H. shikokuensis* (SHIMIZU and JIMBO) from the same locality at Tao in the septal feature and umbilicus form, but differs in the shell ornamentation. The latter species has a smoother surface without radial ribs and a narrow umbilicus than that of the present species. On the other hand, the present new species is similar to *H. typus* (WAAGEN), which was described from the Upper Ceratite Limestone of Chideru, Salt Range, by WAAGEN (1895), in the septal feature and shell form, but differs in the shell sculpture.

Occurrence and geological horizon:— Argillaceous limestone of the Tao Formation at Tao near Uonashi, Shirokawa-cho, Higashiuwa-gun, Ehime Prefecture. Upper Scythian, *Anasibirites multiformis* Zone of the upper Owenitan ammonite stage.

Repository:—IGPS, coll. cat. no. 45158 and GLKU-C158 Coll. H. YABE, T. SUGIYAMA, S. SHIMIZU, N. JIMBO and Y. BANDO

Hemipronites sp.

Pl. 49, Fig. 4

Description:—Shell laterally compressed, involute, discoidal, with small umbilicus. Outer whorl indented at about one-third height by inner whorl. Venter narrowly tabulated with sharply angular ventral shoulder. Umbilicus very small, with abruptly rounded umbilical shoulder. General shape of umbilicus a funnel shape. Shell surface ornamented with faint falcoid ribs which diminish on peripheral and umbilical sides; most prominent on two-thirds height of outer whorl, and each ribs feeble on the umbilical side. Height of shell about three-fifths of total diameter of shell. Width of outer shell about three-sevenths of height. Width of umbilicus about 1/25 of total diameter of shell and almost closed.

Septa ceratitic, with rounded entire saddles and denticulated lobes. Siphonal lobe narrow, siphonal saddle narrowly arched; external lobe shallower than first lateral one, denticulated into three lobes by two narrow saddles; external saddle higher than other saddles; first lateral lobe deepest, widest, and corrugated by small saddles into three lobes; first lateral saddle roundly arched; second lateral lobe slightly corrugated into two points; auxiliary series consists of lower and wider saddle than any other saddles, umbilical lobe slightly serrated (See Fig. 3).

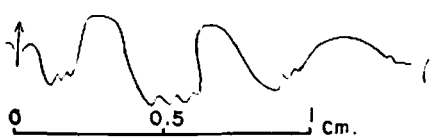


Fig. 3: Suture line of *Hemiprionites* sp. GLKU-C154, ×4

Measurements (in mm.):—

	D.	H.	H/D	W.	W/H	U.	U/D
GLKU-C154	25.0(?)	14.0	0.56(?)	6.0	0.43	1.0	0.04

Remarks:—A single specimen was examined. A part of the venter is broken off. The features of the septal element, umbilicus width, and whorl shape resemble with those of *Hemiprionites kuharanus iyonus* BANDO, but the material is distinguished therefrom by the features of the lateral lobes and the shell ornamentation. The general character of the septa is of the *Hemiprionites* type.

Occurrence and geological horizon:— Argillaceous limestone of the Tao Formation at Tao near Uonashi, Shirokawa-cho, Higashiuwa-gun, Ehime Prefecture. *Anasibirites multiformis* Zone (upper Owenitan), upper Scythian.

Repository:— GLKU-C154. Coll. Y. BANDO

Anasibirites sp.

Pl. 49, Figs. 3a-c

Description:—Shell laterally compressed, evolute, umbilicus slightly opened, surface smooth with fine radial striations. Umbilicus rather small and narrow, but slightly opened. Ventral part broken. Umbilical shoulder abruptly rounded and of rather funnel shape. Total diameter not measured because of broken ventral part. Septa well preserved, of ceratitic form, with rounded entire saddle and well serrated lobes. Ventral suture unknown, but auxiliary series well preserved. External saddle very high, rounded and broader than other saddles; first lateral saddle rounded and shorter than external one; second lateral saddle lowest and narrower than other lateral ones. External lobe well serrated by considerably deep narrow lobes into very high, narrow saddles, about 8 saddles; first lateral lobe well corrugated to near top of first lateral saddle by narrow lobes into 6 narrow saddles. Auxiliary lobes rather smooth with about 3 very small lobes. Second lateral saddle on umbilical shoulder and auxiliary series on umbilical wall.

Measurements (in mm.):—

	D.	H.	H/D	W.	W/H	U.	U/D
GLKU-C155	—	22.0(?)	—	12.0	0.55	7.0	—

Remarks:—A single specimen was examined. A part of the ventral portion and half of the outer volution of the specimen is broken, but the septal features are well preserved and differ from any known *Anasibirites* species. The shell ornamentation is similar to *Anasibirites onoi* (YEHARA) and *A. archiperipheras* BANDO, but is distinguished from them by the septal features. Judging from the character of the ventral form and shell ornamentation, the present specimen belongs to the genus *Anasibirites*. The general character of the

material is most allied to *A. archiperipheras*, but the present specimen shows deeper corrugation in lateral lobes than the above species. The feature of the septa is not identical with any known species of *Anasibirites* and it seems to be of a special type.

Occurrence and geological horizon:— Argillaceous limestone of the Tao Formation at Tao near Uonashi, Shirokawa-cho, Higashiuwa-gun, Ehime Prefecture, western Shikoku. *Anasibirites multiformis* Zone (upper Owenitan), upper Scythian.

Repository:— GLKU-C155. Coll. Y. BANDO

Family Paranannitidae SPATH, 1930

Subfamily Paranannitinae SPATH, 1930

Genus *Paranannites* HYATT and SMITH, 1905

Paranannites sp.

Pl. 49, Figs. 10, 11

Description:—Shell form involute, subglobose, slightly depressed, with broadly arched venter. Sides smooth, with a few radial irregular folds. Umbilicus very small, funnel shaped, nearly closed. Inner whorl of globose form. Venter broad and gently arched.

Suture lines ceratitic, with broadly serrated ventral lobes, and large external and internal saddles. Ventral lobe slightly corrugated, external lobe serrated into five points. Auxiliary series not observed because of poor preservation (See Fig. 4).

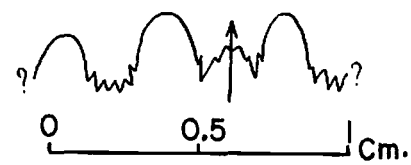


Fig. 4: Suture line of *Paranannites* sp., GLKU-C156, ×4

Measurements (in mm.):—

	D.	H.	H/D	W.	W/H	U.	U/D
GLKU-C156	10.0	6.0	0.6	8.0	1.3	1.5	0.15

Remarks:—Two specimens were examined. The materials were collected from a horizon slightly above the *Anasibirites-Hemiprionites* beds (about 5-7 m. above) of the Tao Formation at Tao. The present materials belong to the genus *Paranannites* and show the characteristic form of the whorl and septal features. Especially, the present form resembles *Paranannites gracilis* KIPARISOVA (KIPARISOVA, 1954, p. 21, fig. 1; 1961, p. 125, pl. 28, figs. 3-4), which was described from the Olenekian beds of Russky Island in Eastern Siberia, in the shell form and sutures. On the other hand, in the septal feature, the present form resembles *P. aspensis* HYATT and SMITH (1905, p. 81, pl. 78, figs. 1-3, figs. 4-30; pl. 8, figs. 1-15; SPATH, 1934, p. 190, pl. 14, figs. 6a-c, text-figs. 5a, h), from North America. But the specific identification with them cannot be done because of the poor preservation of the auxiliary series; the present materials are young forms.

Occurrence and geological horizon:— Argillaceous limestone of the Tao Formation at Tao near Uonashi, Shirokawa-cho, Higashiuwa-gun, Ehime Prefecture. *Anasibirites multiformis* Zone (upper

Owenitan), upper Scythian.

Repository: — GLKU-C156. Coll. Y. BANDO

Family Balatonitidae SPATH 1951

Genus *Balatonites* MOJSISOVICS, 1879

Balatonites cf. *gottschei* (MOJSISOVICS)

Pl. 49, Fig. 8

Cf. *Arpadites gottschei*, MOJSISOVICS, 1888, Ueber einige japanischen Trias-fossilien, *Beitr. z. Paläont. Oest.-Ung. u. d. Orients, Bd. 7, Heft 2*, p. 170 (10), pl. 2, figs. 2a-b.

Balatonites gottschei (MOJSISOVCS), SHIMIZU, 1930, On Some Anisic Ammonites from the *Hollandites* Beds of the Kitakami Mountainland, *Sci. Rep., Tohoku Imp. Univ., 2nd Ser. (Geol.), Vol. 14, no. 1*, p. 64.

Description:—Shell evolute, laterally compressed, with ornamented surface. Sides almost flattened, with numerous radial ribs. Umbilicus and venter indistinct. Shell ornamentation of numerous radial ribs composed of primaries and secondaries, latter start from ventral shoulders and die out on middle portion of flanks. Ventral end of each ribs elevated and with a node. Middle portion of flanks with small tubercles arranged in concentric line, about 9 nodes on one-third portion of outer whorl, and situated on primary rib. Radial ribs inserted in rather deep radial furrows. About three to four ribs to each furrow.

Remarks:—The present specimen resembles *Balatonites gottschei* (MOJSISOVICS) from the Isatomae Formation at Minato near Inai, Inai-mura, Ojika-gun, Miyagi Prefecture (MOJSISOVICS, 1888) in the shell ornamentation, but strict identification is impossible because the ventral part of the specimen is missing. The present form is also allied with *B. kitakamicus* (DIENER), but in the shell ornamentation it is more similar to *B. gottschei* than *B. kitakamicus*.

Occurrence and geological horizon:—*Paraceratites trinodosus* Zone? of the Isatomae Formation at Isatomae, Utazu-cho, Motoyoshi-gun, Miyagi Prefecture.

Repository: — GLKU-C152 Coll. T. KAMADA, 1962

Family Ptychitidae MOJSISOVICS, 1882

Genus *Ptychites* MOJSISOVICS, 1875

Ptychites sp.

Pl. 49, Fig. 7

Description:—Shell laterally compressed, discoidal, involute, with narrow funnel shaped umbilicus. Shell with almost smooth surface, without ribs or folds. Venter roundly arched in shape. Thickness of shell greatest at umbilical shoulder which is abruptly rounded; their wall of funnel shaped. Umbilicus considerably narrow and deep. Height of shell about two-fifths of total diameter of shell and width about one-third of height. Umbilicus about one-seventh of total diameter of shell. Septa unknown.

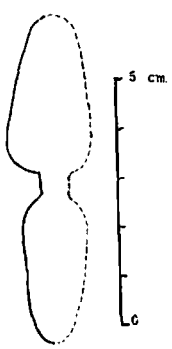


Fig. 5. *Ptychites* sp. Cross-section of the outer whorl. Specimen, GLKU-C150. $\times\frac{2}{3}$

Measurements (in mm.):—

	D.	H.	H/D	W.	W/H	U.	U/D
GLKU-C150	65.0	28.0	0.43	—	—	9.0	0.13

Remarks:—The present material shows a Ptychitid shell form in the general shell shape, whereas the ornamentation of the shell resembles the Arcestid or Joannitid type rather than the Ptychitid ammonite. Not with standing the missing of the septa and constrictions or striations, which are characteristic of the shell ornamentation of the genera *Arcestes* and *Joannites*, the umbilicus width and form of its shoulder most resemble those of the genus *Ptychites*. But specific identification is reserved due to the poor preservation of the material.

Occurrence and geological horizon:—Dark gray calcareous fine sandstone of the Zohoin Formation at Gorodani Nagayasu, Kaminaka-cho, Naka-gun, Tokushima Prefecture. Middle Triassic, upper Anisian?.

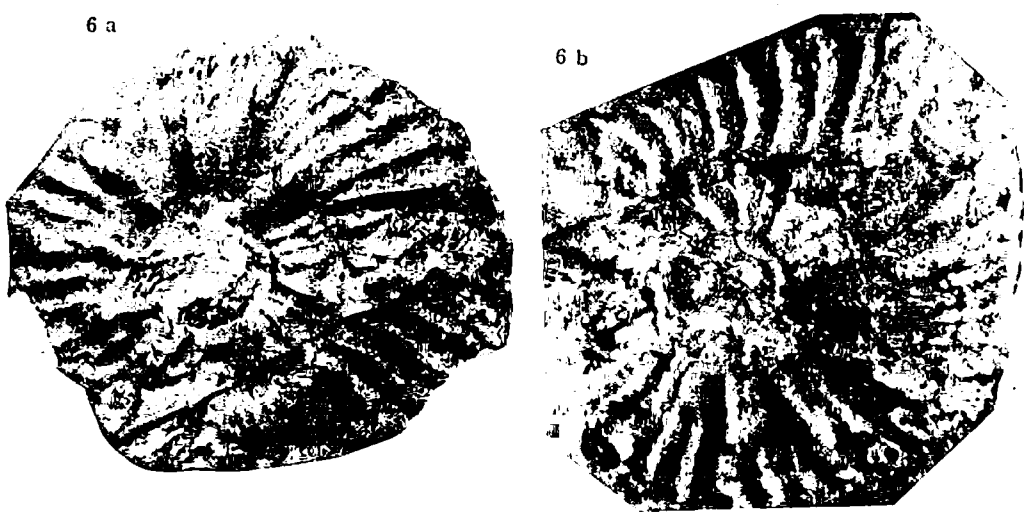
Repository: — GLKU-C150 Coll. K. HASHIMOTO

Family Ceratitidae MOJSISOVICS, 1879

Genus *Paraceratites* HYATT, 1900

Paraceratites sp.

Text-figs. 6a-b; Pl. 49, Fig. 6



Figs. 6a, b. *Paraceratites* sp.
6a. External mold and gumtype of fig. 6b, GLKU-C151, ×4/5.
6b. External mold, GLKU-C151, ×4/5.
Loc. Isatomae, Utazu-cho, Motoyoshi-gun, Miyagi Prefecture.
Isatomae formation of the Inai group, Anisian.

Description:— Laterally compressed, evolute, discoidal shell, with shallow umbilicus and well sculptured shell surface. Whorls high, rather deeply embracing and increasing rapidly in height. Height of whorl a little greater than half of total diameter of shell. Diameter of umbilicus about one-third of diameter of shell. Surface of shell ornamented with fine flexuous ribs and comparatively broad radial ribs, which start from umbilical shoulder and end at half of height with lateral tubercles. Tubercles consist of umbilical, lateral and marginal ones; first one weaker than other tubercles and lateral one most prominent. Lateral tubercles prominent at inner-half of outer volution, about 6 to 10 in outer volution, but diminished on body whorl. Marginal tubercles about 20 to a revolution and their position correspond to marginal end of ribs. Ventral part not preserved. Septa unknown.

Measurements (in mm.):—

	D.	H.	H/D	W.	W/H	U.	U/D
GLKU-C151	79.0(?)	30.0(?)	0.38(?)	—	—	29.0	0.36

Remarks:—The present material, unfortunately, lacks its ventral part and septa. In the shell sculpture and umbilicus, the material resembles *Paraceratites trinodosus* (MOJSISOVICS), but differs in the whorl indentation and umbilicus width. The same may be said between the material and *Paraceratites clarkei* (SMITH) and moreover, it is more laterally compressed than those two forms. *Paraceatites cricki* SMITH (1914, p. 87, pl. 47, figs. 19-24) is also similar to the present material in the shell sculpture, especially in the arrangement of the tubercles and ribs, but specific identification is reserved because of the poor preservation of the keel-like ridge, which characterizes *P. cricki*.

The three species of *Paraceratites* from Japan are from the Rifu Formation; they are *P.* aff. *trinodosus* (MOJSISOVICS), *P.* cf. *wardi* (SMITH) and *P. orientalis* (YABE and SHIMIZU), which were described by YABE and SAIMIZU (1927) and SHIMIZU (1930). On the other hand, recently, the present writer described three species of *Paraceratites*, i. e. *P.* cf. *clarkei* (SMITH), *P. orientalis* (YABE and SHIMIZU) and *P.* cf. *trinodosus* (MOJSISOVICS), from the Rifu Formation of the southern part of the Kitakami Massif (BANDO, 1964, Triassic stratigraphy and ammonite fauna of Japan). Recently NAKAZAWA (1963) reported on the occurrence of *Paraceratites* sp. with *Hollandites* sp. and *Ussurites yabei* from the Anisian calcareous sandstone at 500 m. west of Uonashi-bashi, Shirokawa-cho, Higashiuwa-gun, Ehime Prefecture, western Shikoku. The present material is the first occurrence from the type locality of the Isatomae Formation in the southern part of the Kitakami Massif.

Occurrence and geological horizon:— *Paraceratites trinodosus* Zone? of the Isatomae Formation at Isatomae, Utazu-cho, Motoyoshi-gun, Miyagi Prefecture.

Repository:—GLKU-C151 Coll. T. KAMAKURA, 1962

Family Beyrichitidae SPATH, 1934

Genus *Beyrichites* WAAGEN, 1895

Beyrichites cf. *rotelliformis* (MEEK)

Pl. 49, Fig. 5

Cf. *Gymnotoceras rotelliformis*, MEEK, 1877, *U.S. Geol. Expl. 40th Par., Vol. 4*, p. 111, pl. 10, figs. 9-9a.
Beyrichites rotelliformis (MEEK), SMITH, 1904, The comparative stratigraphy of the marine Trias of western America, *Proc. Calif. Acad. Sci., 3rd ser., Geol., vol. 1, no. 10*, p. 379, pl. 45, fig. 5; pl. 43, figs. 13-14; HYATT and SMITH, 1905, The Triassic cephalopod genera of America, *U.S.G.S. Prof. Paper 40*, p. 155, pl. 23, figs. 1-11; pl. 58, figs. 1-15; SMITH, 1914, The middle Triassic marine invertebrate faunas of North America, *U.S.G.S. Prof. Paper 83*, p. 118, pl. 4, figs. 1-7; pl. 8, figs. 1-15; pl. 4, fig. 9; pl. 31, figs. 1-6; pl. 91, figs. 1-10; DIENER, 1915, Fossilium Catalogus. 1. Pt. 8. Cephalopoda triadica, p. 70; SPATH, 1934, Catalogue of the Fossil Cephalopoda in the British Museum (Nat. Hist.). Pt. 4. The Ammonoidea of the Trias, p. 422.

Description:—Shell involute, discoidal, laterally compressed. Umbilicus very narrow and shallow. Venter slightly rounded. Sides almost flattened and smooth with falcoid radial folds. Height of whorl about half of outer revolution. Umbilicus width about one-fifth of total diameter of shell. Shell width about two-fifths of height.

Surface with numerous simple, fine, flexuous or falcoid ribs and radial striae of growth, with falcoid curve on flanks sharp bend foreward just below ventral shoulders. Each rib strongest on flanks and becomes weaker near umbilical and ventral shoulders. About 6 to 7 ribs in quarter part of outer whorl. Septa unknown.

Measurements (in mm.):—

	D.	H.	H/D	W.	W/H	U.	U/D
GLKU-C153	31.0	15.0	0.48	6.0(?)	0.4(?)	7.0	0.22

Remarks:—The present material, unfortunately, lacks a part of the outer whorl and the preserved volution is the body whorl. The present specimen is very similar to *Beyrichites rotelliformis* (MEEK), which was described from the "*Daonella dubia* zone" of North America by MEEK (1877), SMITH (1904), HYATT and SMITH (1905) and SMITH (1905) and SMITH (1914), in the shell sculpture and umbilicus form. From the American *B. rotelliformis* the present one may be distinguished by its more compressed whorl. The present material also resembles *B. falciformis* SMITH, which was first described by SMITH (1914) from the Middle Triassic "*Daonella dubia* zone" (*Paraceratites trinodosus* subzone) of Fossil Hill, West Humboldt Range, Nevada, but the present form differs from it in its more compressed whorl. The genus *Beyrichites* from the Zohoin Formation of the outer zone of southwest Japan is the first occurrence, and moreovere, this specimen suggests the occurrence of the Anisian beds in the Chichibu terrane of eastern Shikoku. In western Shikoku, NAKAZAWA (1963) discovered deposits of Anisian age and some characteristic ammonite fossils, *Ussurites*, *Paraceratites* and *Hollandites*, from the calcareous sandstone of the Zohoin Formation at Uonashi, Shirokawa-cho, Higashiuwa-gun, Ehime Prefecture.

Occurrence and geological horizon:—Anisian? beds at Gorodani, Nagayasu, Kaminaka-cho, Naka-gun, Tokushima Prefecture.

Repository: — GLKU-C153 Coll. K. HASHIMOTO

Beyrichites sp.

Pl. 49, Figs. 9a-b

Description:—Shell laterally compressed, involute, discoidal, with funnel shaped small umbilicus and narrowly rounded venter. Surface with flexuous falcoid ribs and striations. Height of last whorl about a half of total diameter of shell. Width of outer whorl about one-thirds of height. Width of umbilicus about one-sixth of total diameter of shell. Umbilicus wall of funnel shape, its shoulder abruptly rounded. Venter of narrowly arched shape, its shoulder rounded or slightly acuted. Width of shell largest at a little below middle height. Surface ornamented with flexuous, falcoid striations and foldings. Septa unkown.

Measurements (in mm.):—

	D.	H.	H/D	W.	W/H	U.	U/D
CLKU-C157	64.0	33.0	0.51	11.0	0.33	7.0	0.11

Remarks:—The present material unfortunately lacks a half of the outer volution, but the features of the umbilicus, shell sculpture, and venter are well preserved. Considering from the whorl shape and shell ornamentation the present material belongs to the genus *Beyrichites*, but specific identification is reserved because of their septal elements missing and due to the compressed deformation. The shell sculpture of the present specimen most resembles that of *Beyrichites falciformis* SMITH (1914, p. 116, pl. 91, figs. 11-13, type species), which was described from the Middle Triassic "*Daonella dubia* zone" of Fossil Hill, West Humboldt Range, Nevada, in North America, but the present specimen differs from the American species in the umbilicus width and the width of the shell.

Occurrence and geological horizon:—Dark gray calcareous sandstone of the Rifu Formation at Hamada, Shiogama City, Miyagi-gun, Miyagi Prefecture, Northeast Japan. Upper Anisian *Paraceratites trinodosus* Zone?

Repository:—GLKU-C157 Coll. Y. BANDO

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Explanation of Plate 49

Figs. 1, 2. *Hemiprionites shimizui* BANDO, n. sp.
1a, b. Holotype, IGPS, coll. cat. no. 45158, ×1.5.
2a, b. Crushed outer whorl, paratype, GLKU-C158, ×1.5.
Loc. Tao near Uonashi, Shirokawa-cho, Higashiuwa-gun, Ehime Prefecture. Tao formation, upper Scythian.

Figs. 3a-c. *Anasibirites* sp.
Specimen, GLKU-C155, Figs. 3a, b, ×1; Fig. 3c, ×1.3.
Loc. Same as figs. 1 and 2.

Fig. 4. *Hemiprionites* sp.
Specimen, GLKU-C154, ×1.8.
Loc. Same as figs. 1 and 2.

Fig. 5. *Beyrichites* cf. *rotelliformis* (MEEK)
External mold of outer whorl, GLKU-C153, ×2.
Loc. Gorodani, Nagayasu, Kaminaka-cho, Nakagun, Tokushima Prefecture. Zohoin formation, Aniso-Ladinian.

Fig. 6. *Paraceratites* sp.
External mold, GLKU-C151, ×3/5.
Loc. Isatomae, Utazu-cho, Motoyoshi-gun, Miyagi Prefecture. Isatomae formation, Anisian.

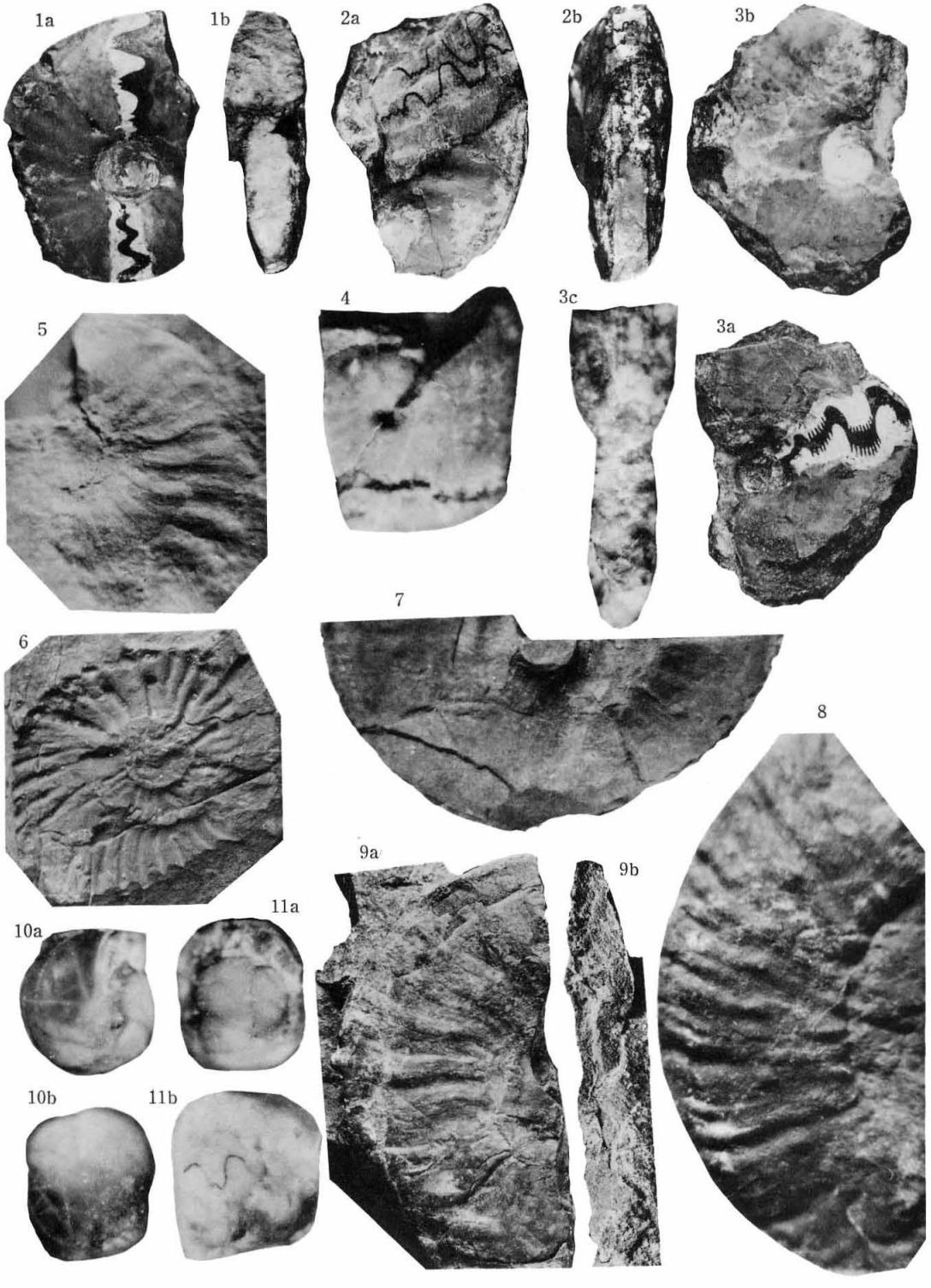
Fig. 7. *Ptychites* sp.
External mold, GLKU-C150, ×1.1.
Loc Same as fig. 5.

Fig. 8. *Balatonites* cf. *gottschei* (MOJSISOVICS)
External mold, GLKU-C152, ×3
Loc. Same as fig. 6.

Figs. 9a, b. *Beyrichites* sp.
Specimen, GLKU-C157, ×1.
Loc. Hamada along the Senseki Electric Car Line, Shiogama City, Miyagi Prefecture. Rifu formation, Aniso-Ladinian.

Figs. 10, 11. *Paranannites* sp.
10a, b. Complete specimen, GLKU-C156, ×2.1.
11a, b. Crushed specimen of outer whorl, GLKU-C159, ×2.
Loc. Same as figs. 1 and 2.

The illustrated specimen of fig. 1. is kept in the Institute of Geology and Paleontology, Tohoku University, Sendai, Japan. The other specimens are preserved in the Department of Geology, Kagawa University, Takamatsu, Japan.


1a
1b
2a
2b
3b
4
3c
5
3a
7
6
8
9a
9b
11a
10a
10b
11b

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Annomoto	庵ノ元	Motoyoshi-gun	本吉郡
Fukkoshi	風越	Nagayasu	長安
Gorodani	五郎谷	Naka-gun	那賀郡
Hamada	浜田	Ojika-gun	牡鹿郡
Higashiuwa-gun	東宇和郡	Rifu	利府
Hiraiso	平磯	Saragai	皿貝
Inai	稲井	Shirokawa-cho	城川町
Isatomae	伊里前	Tao (Taho)	田穂
Kaminaka-cho	上那賀町	Uonashi	魚成
Minato	港	Utazu-cho	歌津町
Miyagi-gun	宮城郡	Zohoin	蔵法院

PROCEEDINGS OF THE PALAEONTOLOGICAL SOCIETY OF JAPAN

日本古生物学会第88回例会および「ジュラ・白亜紀動物化石群の変遷」についてのシンポジウムは1964年9月20日(日)広島大学理学部において開催された。

個人講演

The Miocene Noroshi Flora of Noto, Japan..... Shirô ISHIDA

On the Shell Wall of *Triticites*..... Kimiyoshi SADA

Revision of the Takagami Conglomerate, Chôshi Peninsula, and Descriptions of the Permian Bryozoa from Its Limestone Pebbles ..... Sumio SAKAGAMI

Bryozoa of Akiyoshi. Part 1. Permian Bryozoa from the Shigeyasu Quarry..... Sumio SAKAGAMI

Ditto. Part 2. Lower Carboniferous Bryozoa from the Uzura Quarry..Sumio SAKAGAMI

Three Carboniferous Species of Bryozoa from Khao Noi, Central Thailand..... Sumio SAKAGAMI

On the Molluscan Fossils Collected from the Ryûkyû Limestone of Okinoerabu Island ..... Katsura OYAMA

Semifossils from the Silica Sand Deposits of Thui Tri, Vietnum .....Katsura OYAMA

Discovery of Marine Shells from the Kunohe Tarrace Deposits, Kuji City, Iwate Prefecture ..... Kotora HATAI and Rikizô IMAIZUMI

Monotis (*Entomonotis*) from Kyushu..... Minoru TAMURA

On the Corbiculidae from the Lower Neocomian Ryôseki Series, Japan ..... Yoshihisa OTA

Nautilus pompilius Drift on the West Coast of Thailand .....Ryuzo TORIYAMA, Tadashi SATO and Takashi HAMADA

Notes on the Drifted *Nautilus* in Thailand..... Takashi HAMADA

Yabeiceras (Cretaceous Ammonites) from Futaba, Northeast Japan ..... Tatsuro MATSUMOTO, Ikuwo OBATA, Shiro MAEDA and Teruo SATO

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動物における種の形成 .....川村智治郎

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ジュラ・白亜紀の海棲二枚貝の変遷 .....速水 格

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白亜紀頭足類フォーナについて .....松本達郎

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総合討論

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MISCELLANEA

INDEX OF FAMILIES, GENERA AND SPECIES

Notes: Words listed below are names of families, genera and species, which are either described or illustrated in the Transactions and Proceedings of the Palaeontological Society of Japan, New Series, Nos. 49-56; words in heavy type are names of new genera and species.

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日本古生物学會報告・紀事

Transactions and Proceedings of the Palaeontological Society of Japan

New Series

No. 49～No. 56

1963～1964

日本古生物学会

Palaeontological Society of Japan

The heading in Japanese commemorates the handwriting of Prof. M. YOKOYAMA, father of Japanese Palaeontology, who was Professor of Stratigraphy and Palaeontology at the Geological Institute, Imperial University of Tokyo.

The fossil on the front page is *Helicoprion bessonowi* KARPINSKY, 1899.

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例会・年会通知

	開催地	開催日	講演申込締切日
1965年総会・年会	国立科学博物館	1965年1月23, 24日	1964年12月20日

1965年々会（国立科学博物館）：脊椎動物に関する講演会　　（世話人 尾崎 博）

News

○ 第3回国際第四紀研究会議 (International Association for Quaternary Research VII International Congress) は1965年8月30日より9月5日にわたりアメリカ合衆国コロラド州のデンヴァーとボウルダーで開催される。この会議には総会・評議員会等の事務的会合の他8つ委員の会，3つの分科会，6つのシンポジウムが企画されており，又野外の研究会合も開かれる。これらの会合のうち古生物学に直接関係あるものには，第四紀の地域的な環境及び歴史に関する分科会で，古生態学と古生物地理学・脊椎動物及び無脊椎動物の古生物学と古動物地理学・花粉学とアイソトープによる時代決定などが取扱かわれることになっており，又後期新生代の歴史とベーリングの陸橋に関するシンポジウムも開かれる。くわしくは下記へ連絡するとよい。

Dr. Gerald M. RICHMOND, Secretary General VII INQUA Congress, Building 25, Denver Federal Center, Denver, Colorado, U. S. A.

購読御希望の方は本会宛御申込下さい

1964年12月15日　印刷
1964年12月20日　発行

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(Jan. 15, 1963)

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