

Fossil Algae from the Ishiyama Limestone, Gifu Prefecture

By

Manjiro NAKAMURA

Faculty of Science and Technology, Tokyo Science University, Noda 278

(Communicated by Kazuo ASAMA)

Introduction

The Ishiyama Limestone is distributed in the area centered on Ishiyama, a mountain 391.7 m in elevation, located on the boundary between Ono-machi and Tanigumi-mura of Ibi-gun, Gifu Prefecture. Along the east margin of the area the Neo River, a tributary of the Ibi River, flows southward. Ishiyama is at about 13.5 km northwest of Gifu Station of the Japanese National Railways (Fig. 1).

The limestone occurs as a lenticular body intercepted by faults (Fig. 2). The limestone has been quarried from old times, and the production continues to increase year after year, the latest annual yield amounting to nearly 1,800,000 tons.

The author visited this limestone area in 1968 and 1975. He obtained 42 thin

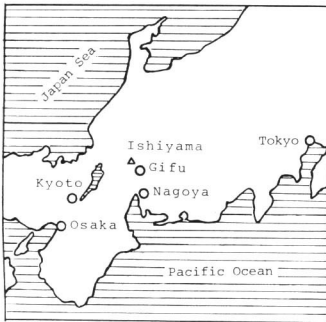


Fig. 1.

Fig. 1 (above). Map showing the situation of Ishiyama.

Fig. 2 (right). Map showing the distribution of the limestone around Ishiyama and sampling localities.

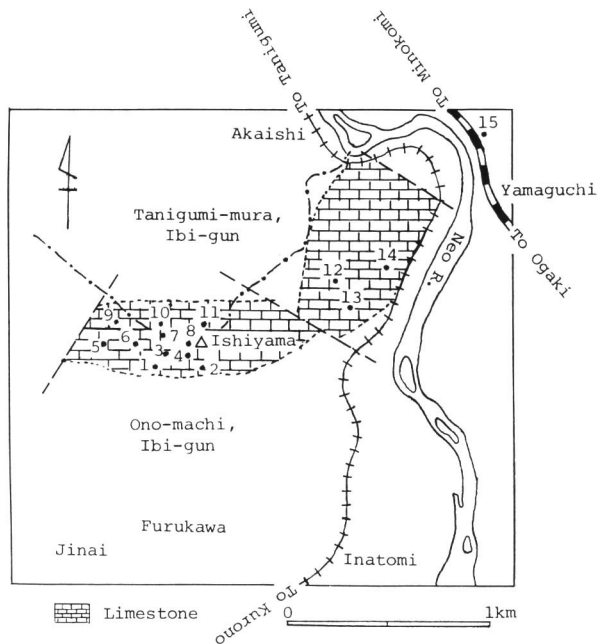


Fig. 2.

sections containing calcareous algae and fusulinids. Among these fossils, 7 genera and 7 species of fusulinids and 19 genera and 26 species of algae have been identified.

Acknowledgements

For the identification of fusuline fossils the author is greatly indebted to Prof. Takeshi CHISAKA, Professor Emeritus of Faculty of Education, Chiba University. The author's sincere thanks are extended to Prof. Mankichi HORIGUCHI of Faculty of Liberal Arts, Saitama University, for the preparation of thin sections, and to Dr. Hideyuki NAGASHIMA of Faculty of Science, Tokyo University of Science, for taking photographs of the specimens. In collecting samples, every facility was provided by the Gifu Quarry of the Sumitomo Cement Co., Ltd. and by the Kawai Industry Co., Ltd. for which the author is deeply grateful.

Stratigraphy

Research papers on the Ishiyama Limestone are meager.

Around the Ishiyama limestone, siliceous slate is predominant, and intercalation of chert, slate, shale and sandstone increases toward the outer margin. The limestone is grayish white to dark gray, usually gray but locally black.

ISOMI (1955) stated that the fusuline fossils in this limestone indicate the Middle Permian.

FUJIMOTO *et al.* (1962) reported that the limestone is divided into the upper, the middle and the lower members, which abound in *Yabeina*, *Neoschwagerina* and *Parafusulina* respectively, and that *Pseudofusulina* occurs abundantly in association with *Parafusulina*.

CHISAKA and others collected fusuline fossils from the northern part of the Ishiyama Limestone, as listed in Table 1, and reported that the limestone comprises the *Parafusulina* zone up to the *Yabeina* zone (CHISAKA and TAKAOKA, 1977).

Table 1. Fusulinids from the northern part of the Ishiyama Limestone (CHISAKA and TAKAOKA, 1977)

<i>Parafusulina splendens</i> DUNBER and SKINNER
<i>P. yabei</i> HANZAWA
<i>Pseudodoliolina ozawai</i> YABE and HANZAWA
<i>Colania douvillei</i> (OZAWA)
<i>Neoschwagerina nipponica</i> (OZAWA)
<i>N. akasakensis</i> MORIKAWA
<i>N. margaritae</i> DEPRAT
<i>Verbeekina verbeeki</i> (GEINITZ)
<i>Yabeina globosa</i> (YABE)
<i>Y. shiraiwensis</i> OZAWA

Table 2. Fusulinids from the Ishiyama Limestone.

<i>Eoschubertella</i> sp.
<i>Schubertella</i> sp.
<i>Pseudofusulina ishiyamensis</i> CHISAKA sp.
<i>Parafusulina</i> sp.
<i>Pseudodoliolina ozawai</i> YABE and HANZAWA
<i>Neoschwagerina sakaguchii</i> YAMAGIWA
<i>Yabeina globosa</i> (YABE)
<i>Y. katoi</i> (OZAWA)
<i>Y. multiseptata</i> DEPRAT
<i>Y. ozawai</i> HONJO

Paleontology

The fusuline fossils collected by the author are shown in Table 2. Judging from their distribution also, it is evident that the Ishiyama Limestone consists of three zones, namely, *Parafusulina*, *Neoschwagerina* and *Yabeina* zones and sampling localities (Fig. 2) 1–3 can be assigned to the *Parafusulina* zone, 4–8 to the *Neoschwagerina* zone, and 9–15 to the *Yabeina* zone.

Algal fossils are relatively abundant, and 19 genera have been defined as shown in Table 3. Among the fossils collected, the ones specifically determined attain to 27 species in 15 genera. Most of them were found in the *Neoschwagerina* and *Yebeina* zones, much less in the *Parafusulina* zone. New species found from 15 localities are 8 species in 6 genera.

The author has established two new genera, *Minoporella* and *Gifuporella*, which will be reported in detail later on. Other findings of interest were *Amicus* and *Eogoniolina*.

Amicus was discovered first from the Lower Devonian of the Kuznetsk basin, central Siberia. In 1961, a new species, *A. orientalis* ENDO, was described by Riuji ENDO from the Middle Permian system of the Ominagahama district of Shiga Prefecture. This was the first and the only record of *Amicus* in Japan up to date. The specimen was no more than one longitudinal section which is somewhat obscure, and the description by ENDO was not very explicit. The *Amicus* specimens found in the Ishiyama Limestone this time are numerous and in a good state of preservation, and 2 species were discovered among them as given in Table 3.

Genus *Eogoniolina* was established in 1953b by Riuji ENDO with *E. johnsoni* from the Akasaka limestone near the Ishiyama Limestone as the type species. Thereafter, ENDO reported this species successively from seven localities. Nevertheless, probably due to the lack of perfect specimens, ENDO came to have a doubt about this genus and in 1967 he announced that the genus requires further examination. Almost perfect specimens were collected from the Ishiyama Limestone, and the present author has come to consider that *Eogoniolina* is a valid genus.

Systematic description

The symbols used for the measurements in the following descriptions are listed below.

- D– Outer diameter of calcareous body.
- d– Inner diameter of calcareous body.
- s– Thickness of calcareous wall.
- p– Diameter of pore (primary branch).
- w– Number of verticillatae in a single member.
- h– Distance between centers of verticillatae.

Measurements are in micron.

Repository:— National Science Museum, Tokyo.

Registered numbers:— NSM-PP 6901 to 6942.

Table 3. Calcareous algae from the Ishiyama Limestone
and their distribution in the Fusulinacean zones.

Genus and species	Fusulinacean zone	Paf	Neos	Yab
Solenoporaceae				
<i>Solenopora texana</i> JOHNSON				×
<i>S. choshiensis</i> ISHIJIMA		×		
<i>S. ibiensis</i> sp. nov.				×
<i>Parachaetetes</i> sp.				×
Chaetangiaceae				
<i>Gymnocodium japonicum</i> KONISHI			×	×
Siphonoclaceae				
<i>Pycnoporidium lobatum</i> YABE et TOYAMA			×	×
<i>P. toyamai</i> ENDO			×	×
<i>P. furukawense</i> sp. nov.			×	×
<i>P.</i> sp.			×	
Dasycladaceae				
<i>Vermiporella</i> sp.		×		
<i>Amicus japonicus</i> sp. nov.		×		×
<i>A. konishii</i> sp. nov.		×		×
<i>Mizzia velebitana</i> SCHUBERT			×	×
<i>M. yabei</i> (KARPINSKY)			×	×
<i>Pseudogyroporella mizziaformis</i> ENDO		×	×	×
<i>P. ohnoensis</i> sp. nov.			×	×
<i>Eogoniolina johnsoni</i> ENDO			×	×
<i>Minoporella</i> sp.			×	×
<i>Pseudoepimastopora japonica</i> (ENDO)			×	
<i>Epimastopora</i> sp.			×	
<i>Macroporella alpina</i> PIA				×
<i>M. maxima</i> ENDO				×
<i>Gifuporella</i> sp.				×
<i>Gyroporella</i> cfr. <i>nipponica</i> ENDO		×		
<i>G. tenuimarginata</i> ENDO			×	×
<i>G. omensis</i> ENDO		×	×	
<i>G.</i> sp.				×
<i>Oligoporella</i> sp.			×	
<i>Poikiloporella japonica</i> ISHIJIMA et al.			×	×
Udoteaceae				
<i>Ortonella intermedia</i> ENDO			×	×
<i>O. taishakuensis</i> ENDO			×	
<i>Hikorocodium elegantae</i> ENDO			×	

Paf: *Parafusulina*, Neos: *Neoschwagerina*, Yab: *Yabeina*

Class Rhodophyceae
Family Solenoporaceae PIA, 1927
Genus *Solenopora* DYBOWSKY, 1878
Solenopora texana JOHNSON

Pl. 6, fig. 2

Solenopora texana JOHNSON, 1951, p. 23, pl. 6, figs. 4, 5.

Material:— One longitudinal section.

Remarks:— Probably subspherical thallus, 1.4 mm broad and 2.1 mm high, composed of closely packed slender tubes which are arranged radially from an area near the center of the basal portion. Tubes are very fine, $7\ \mu$ to $9\ \mu$ in diameter and almost uniform in thickness throughout the length. Cross partitions are well developed and irregularly spaced, $19\ \mu$ to $38\ \mu$ long. The present specimen may be identified with the type species of *Solenopora texana* JOHNSON from Apache Mountains, Texas, U. S. A., so far as the general appearance of the thallus and shape, size and arrangement of the tubes are concerned.

Occurrence:— Loc. 11.

Illustrated specimen:— NSM-PP 6935-1

Solenopora choshiensis ISHIJIMA

Pl. 1, fig. 5

Solenopora choshiensis ISHIJIMA, 1975, p. 121–122, pl. 1, figs. 1, 2.

Material:— One longitudinal section.

Remarks:— Thallus probably subspherical nodule in form, being about 0.9 mm broad and 1.5 mm high, composed of closely packed slender tubes which are arranged radially from an area near the center of the basal portion and do not branch. Tubes slightly increase diameter upward, $15\ \mu$ to $20\ \mu$ near the base and $20\ \mu$ to $25\ \mu$ near the distal end. Cross partitions are well developed and irregularly spaced, $20\ \mu$ to $35\ \mu$ long. As seen in the above description, the present specimen may be identified with the type species of *Solenopora choshiensis* ISHIJIMA from the Takagami Conglomerate, Choshi-shi, Chiba Prefecture.

Occurrence:— Loc. 1.

Illustrated specimen:— NSM-PP 6901-6

Solenopora ibiensis sp. nov.

Pl. 1, figs. 1–4

Material:— Two longitudinal sections.

Measurements:—

Specimens	Dimention of tube		Swallen end
	Width (in aver.)	Distance between cross partitions	
NSM-PP 6935-2	18	28-75	75 × 321
NSM-PP 6935-3	17	37-85	56 × 245

Description:— Thallus probably broad and flattened, being about 11 mm high and assumed to be 4 mm to 5 mm broad, composed of closely packed slender tubes which are commonly radially arranged from an area near the center of the basal portion and do not branch. The tubes are almost uniform in thickness throughout the length and swollen at the ends. The swollen part of the tubes are $240\ \mu$ to $325\ \mu$ long and $56\ \mu$ to $75\ \mu$ thick. The outlets of the tubes on the surface of the thallus are polygonal as if pressed one another. Cross partitions are well developed and irregularly spaced, $28\ \mu$ to $85\ \mu$ long. No definite remains of reproductive organs were observed.

Remarks:— Though the complete form of the thallus was not observed, general appearance and radiating structure in outward direction remind one of a unifoliated form. The most remarkable peculiarity of this species is in its sheet-like flattened thallus and slender tubes with swollen ends through which *S. ibiensis* is separable from most other species of this genus. This new species may be referable to *S. texana* JOHNSON which is approximate the former in size of the cell, but it is distinguished by the clearly better arranged vertical partitions and swollen ends. *S. choshiensis* ISHIJIMA resembles this new species in the arrangement of the tubes but differs in thickness and expanded ends.

Occurrence:— Loc. 11.

Illustrated specimens:— NSM-PP 6935-2, 3.

Genus *Parachaetetes* DENINGER, 1906

Parachaetetes sp.

Pl. 6, figs. 3, 4

Material:— One longitudinal section.

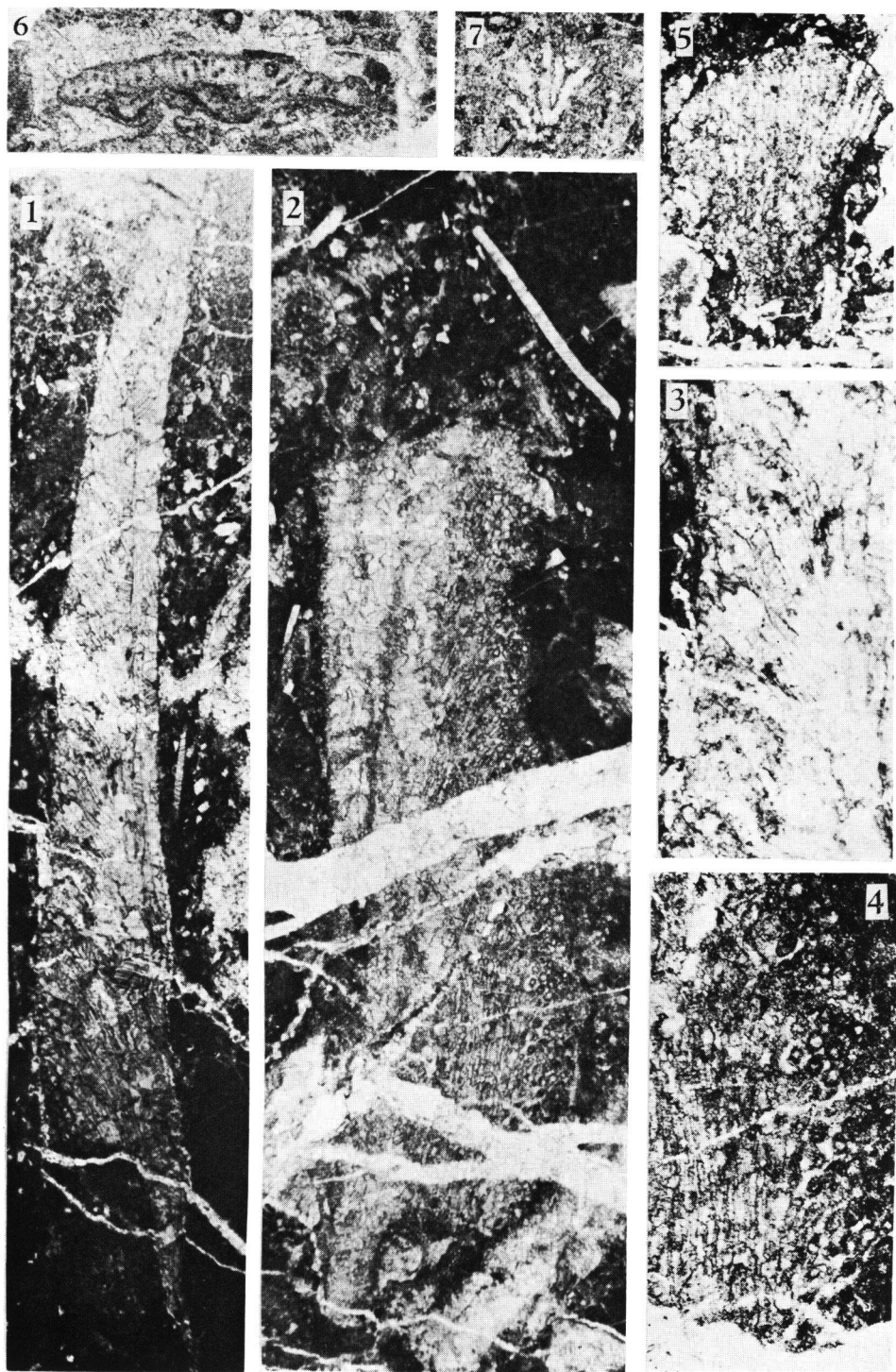
Description:— Thallus probably subspherical, being about 4.5 mm high and presumably 6 mm broad, composed of layers sinuously but concentrically arranged; each layer consists of cells with numerous partitions; vertical partition running con-

Plate 1. Figs. 1-4. *Solenopora ibiensis* sp. nov. 1. A longitudinal section of the syntype, showing half side of the thallus, $\times 15$ (S. No. NSM-PP 6935-2). 2. Another longitudinal section of the syntype, $\times 15$ (S. No. NSM-PP 6935-3). 3. Enlarged view of the middle part of the specimen in fig. 1, showing expanded ends of the tubes, $\times 30$. 4. Enlarged view of the lower part of the specimen in fig. 3, showing expanded ends of the tubes and polygonal outlets, $\times 30$.

Fig. 5. *Solenopora choshiensis* ISHIJIMA. A longitudinal section, $\times 30$ (S. No. NSM-PP 6901-6).

Fig. 6. *Pseudopimastopora nipponica* (ENDO). A longitudinal section, $\times 20$ (S. No. NSM-PP 6910-3).

Fig. 7. *Ortonella intermedia* ENDO. A longitudinal section, $\times 20$ (S. No. NSM-PP 6925-1).



tinuously throughout lamellose layers. Cells $60\ \mu$ to $70\ \mu$ long and $20\ \mu$ to $30\ \mu$ thick.

Remarks:— Though the present specimen is a fragmental one, it has the characteristic features suggestive of the genus *Parachaetetes*. It resembles *P. lamellatus* KONISHI from the Kuma Formation of Southern Kyushu, but differs in simple structure without overlapping subsequent layers. It may be referable to *P. asvapatti* RAMA RAO *et al.* but differs in shorter distance between cross partitions. At present, however, the data available to the writer are not sufficient as yet to give it an exact specific name.

Occurrence:— Loc. 9.

Illustrated specimen:— NSM-PP 6929-1.

Family Chaetangiaceae
Genus *Gymnocodium* PIA, 1920
Gymnocodium japonicum KONISHI

Pl. 2, figs. 1–4

Gymnocodium japonicum KONISHI, 1952, pp. 217–220, pl. 20, figs. 1–9.

Gymnocodium japonicum, ENDO, 1953 a, pp. 122–123, pl. 12, figs. 1–4.

Gymnocodium japonicum, ENDO, 1956, p. 239, pl. 8, fig. 5.

Gymnocodium japonicum, ENDO, 1957, pp. 293–294, pl. 44, figs. 4–7.

Gymnocodium japonicum, ENDO, 1959, p. 204, pl. 39, fig. 6.

Gymnocodium japonicum, ENDO, 1969, pp. 41–42, pl. 5, fig. 4.

Material:— From numerous specimens, three longitudinal and one oblique sections were selected for illustration.

Specimen	D	d	p
NSM-PP 6932-1	1495	515	48
NSM-PP 6932-2	1379	736	48
NSM-PP 6932-3	802		43
NSM-PP 6932-4	2432	1460	52

Description:— Thallus irregular in form, elongate to nodular, usually sub-cylindrical, sometimes constricted, provided with protuberances of various size, incrustated with lime around pith-like central stem. Pith relatively thick and irregular. Calcified crust variable in thickness, composed of closely packed filaments. Filaments inclined to the axial pith, branching and twisted, radiating from pith at small bases, widening gradually toward exterior, end with small expansion. Outlets on the surface of the thallus show honey-combed pattern.

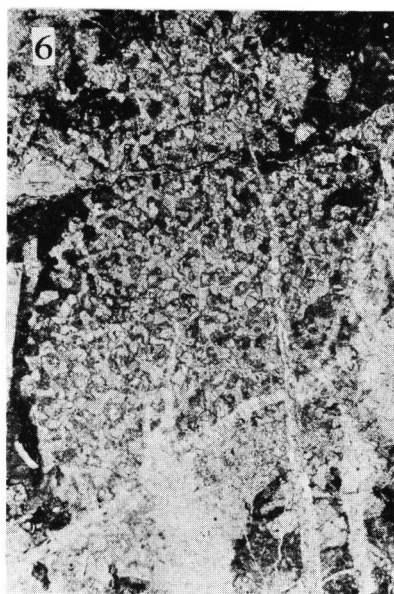
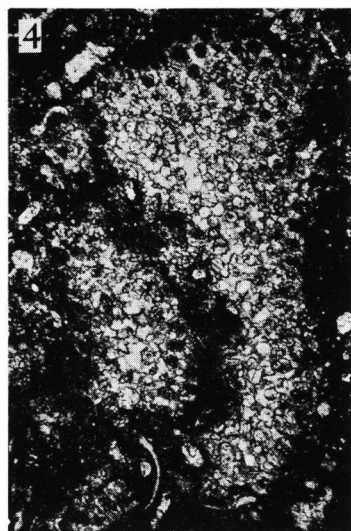
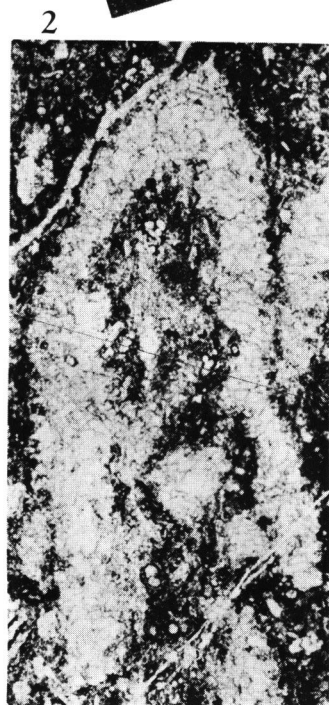
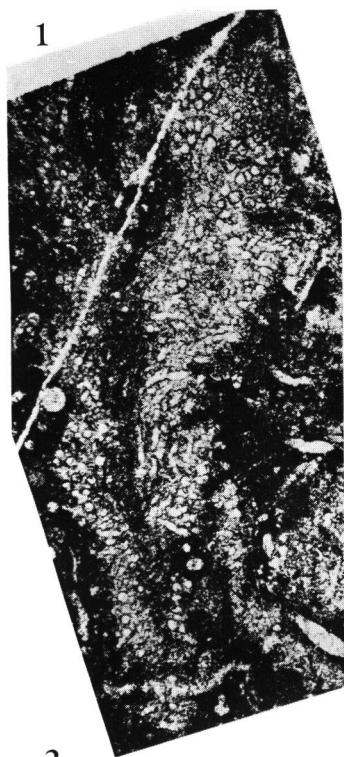
Remarks:— In appearance of the thallus and shape, size and branching form of filaments these specimens are identical with the type species of *Gymnocodium japo-*

Plate 2. Figs. 1–4. *Gymnocodium japonicum* KONISHI. $\times 25$. 1–3. Longitudinal sections (S. No. NSM-PP 6932-1, 2, 3). 4. An oblique section (S. No. NSM-PP 6932-4).

Fig. 5. *Pycnoporidium toyamai* ENDO. A longitudinal section, $\times 25$ (S. No. NSM-PP 6929-4).

Fig. 6. *Pycnoporidium* sp. A longitudinal section, $\times 10$ (S. No. NSM-PP 6908-1)

Fig. 7. *Epimastopora* sp. $\times 25$ (S. No. NSM-PP 6910-2).



nicum KONISHI from Imogadaira, Fukui Prefecture.

Occurrence:— Loc. 5, 9, 10.

Illustrated specimens:— NSM-PP 6932-1, 2, 3, 4.

Family Siphonoclaceae

Genus *Pycnoporidium* YABE and TOYAMA, 1928

Pycnoporidium lobatum YABE and TOYAMA

Pl. 6, fig. 1; Pl. 9, fig. 9

Pycnoporidium lobatum YABE and TOYAMA, 1928, pp. 146–147, pl. 20, fig. 3; pl. 21, figs. 1–5; pl. 22, fig. 1.

Pycnoporidium lobatum, ENDO, 1960, pp. 271–272, pl. 45, figs. 1, 2.

Pycnoporidium lobatum, ENDO, 1961a, pp. 58–59, pl. 1, figs. 1–3.

Pycnoporidium lobatum, ENDO, 1961c, pp. 121–123, pl. 7, fig. 6.

Material:— Two longitudinal sections.

Measurements:—

Specimen	Thallus (mm)	Diameter of tube (μ)
NSM-PP 6919-8	0.7×1.1	33–48
NSM-PP 6939-12	0.7×0.54	20–30

Description:— Thallus probably subspherical, composed of slender tubes which are intricately but arranged more or less radially from the basal portion. Tubes dichotomously branch and circular in transverse section, slightly flexuous and provided with cross partitions. A feeble trace of a curved structure in the rows of tubes is observed.

Remarks:— From the above description and measurements the present specimens may be identified with the type species of *Pycnoporidium lobatum* YABE and TOYAMA from the Soma district in the Abukuma Mountainland and Mitoda district in Shikoku.

Occurrence:— Loc. 7, 12.

Illustrated specimens:— NSM-PP 6919-8, 6938-12.

Pycnoporidium toyamai ENDO

Pl. 2, fig. 5; pl. 9, fig. 10; pl. 10, fig. 8

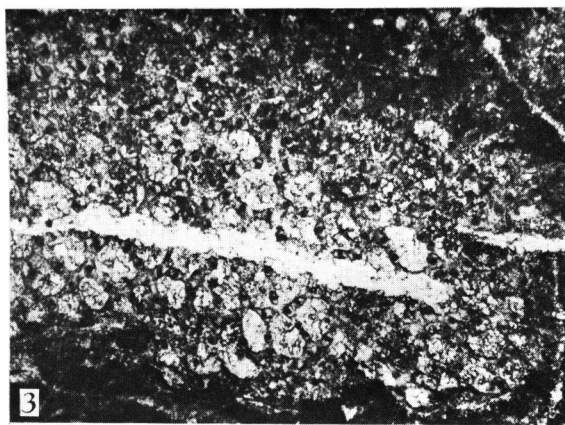
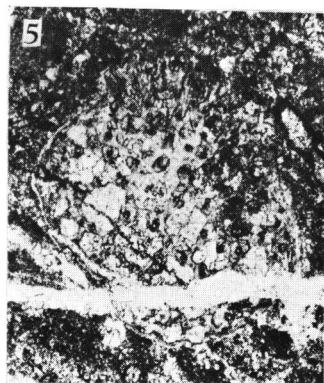
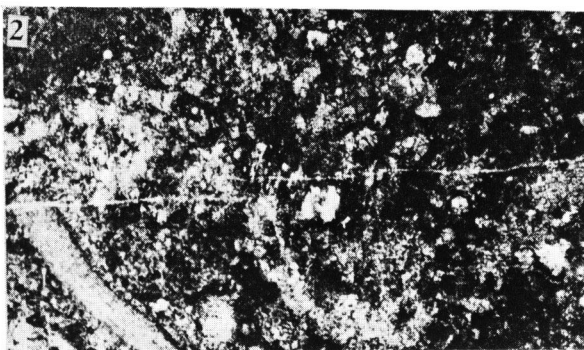
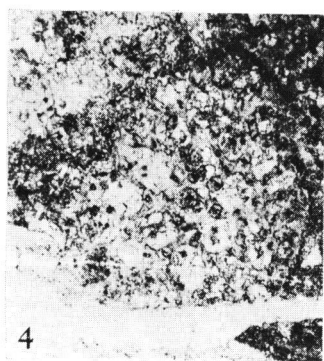
Pycnoporidium toyamai ENDO, 1956, p. 226, pl. 27, fig. 1; pl. 28, fig. 3.

Pycnoporidium toyamai, ENDO, 1961b, p. 82, pl. 1, fig. 1; pl. 3, fig. 3.

Pycnoporidium toyamai ISHIIJIMA *et al.*, 1971, pp. 103–104, pl. 2, figs. 2, 3.

Material:— Three longitudinal sections.

Plate 3. Fig. 1–5. *Pycnoporidium furukawense* sp. nov. 1. A longitudinal section of the holotype, associated with two transverse sections, $\times 15$ (S. No. NSM-PP 6933-1). 2. Enlarged view of the middle part of the specimen, showing dichotomously branching of the tube, $\times 30$. 3. Enlarged view of the right side of the same specimen showing thick primary tubes and slender branches, $\times 30$. 4, 5. Two associated transverse sections in the left side of the specimen in fig. 1, $\times 25$ (S. No. NSM-PP 6933-2, 3).



Measurements:—

Specimen	Thallus (mm)	Tube	
		Diameter of tube	Distance between cross partitions
NSM-PP 6904-1	1.3 × 1.8	18–24	31–47
NSM-PP 6929-4	1.1 × 3.1	24–37	37–57
NSM-PP 6938-10	1.0 × 1.1	14–26	28–37

Remarks:— Subspherical nodular thallus, ramifying tubes which radiate from the basal portion in outward direction, nearly uniform diameter and flexuous form, cross partitions, dichotomous branches, and feeble trace of concentric structure in the thallus and measurements indicate that the present specimens are identical with the type species of *Pycnoporidium toyamai* ENDO from Kagemori, Saitama Prefecture.

Occurrence:— Loc. 3, 9, 12.

Illustrated specimens:— NSM-PP 6904, 6929-4, 6938-10.

Pycnoporidium furukawense sp. nov.

Pl. 3, figs. 1–5; pl. 10, figs. 9, 10

Material:— Three longitudinal and two cross sections.

Measurements:—

Specimen	Thallus (mm)	Tube	
		Diameter of tube	Distance between cross partitions
NSM-PP 6933-1	8.2 × 5.7	90	340
NSM-PP 6933-2	1.2 × 1.5	90	
NSM-PP 6933-3	1.3 × 1.2	98	
NSM-PP 6924	1.3 × 1.9	84	263
NSM-PP 1914-10	1.0 × 2.4	82	238

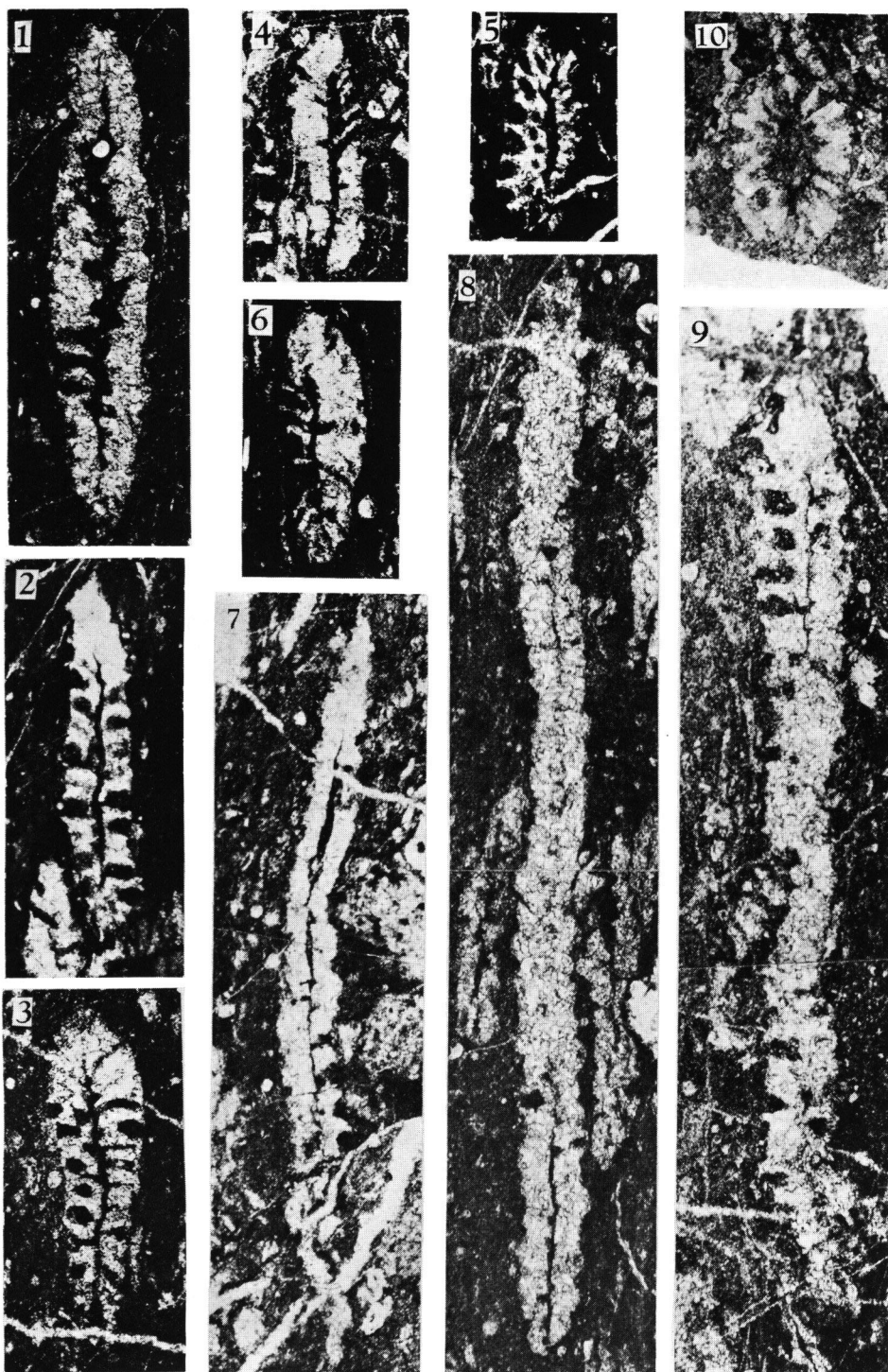
Description:— Thallus relatively large, lobed and segmented, composed of ramifying tubes which are commonly radially arranged from an area near the basal portion. Tubes are relatively thick circular in transverse section, dichotomously branch and gradually decrease in diameter toward the exterior, slightly flexuous, occasionally provided with cross partitions. A feeble trace of curved structure is observed in the rows of the tubes. No definite remains of reproductive organs were observed.

Remarks:— The most remarkable peculiarity of this species is in its thick tubes and their branching form through which *P. furukawense* is separable from other species of this genus. It may, however, be compared with the following species.

P. lobatum YABE and TOYAMA

P. toyamai ENDO

Plate 4. Figs. 1–10. *Amicus japonicus* sp. nov. 1, 2. Longitudinal sections of the syntype, cut slightly obliquely, ×25 (S. No. NSM-PP 6938-1, 2). 3, 4. Longitudinal sections cut slightly obliquely, ×25 (S. No. NSM-PP 6938-3, 4). 5, 6. Oblique longitudinal sections, ×25 (S. No. NSM-PP 6938-5, 6). 7–9. Longitudinal sections of the syntype, ×30 (S. No. NSM-PP 6938-7, 8, 9). 10. A cross section of the syntype, ×25 (S. No. NSM-PP 6901-5).



The general appearance of the thallus of this species may be referable to *P. lobatum* but distinguished by thick tubes, long distance between cross partitions and less flexuosity. The second ally is *P. toyamai*, but differs from it in size, shape and branching form of the tubes.

Occurrence:— Loc. 6, 9, 10.

Illustrated specimens:— NSM-PP 6914-10, 6924, 6944-1, 2, 3.

Pycnoporidium sp.

Pl. 2, fig. 6

Material:— One longitudinal section.

Description:— Thallus probably subspherical, being about 6 mm broad and 8 mm high, composed of ramifying tubes which are commonly arranged radially from the base. Tubes are thick and circular in transverse section, $108\ \mu$ to $168\ \mu$ in diameter, remarkably flexuous, dichotomously branching, provided with cross partitions and laterally connected at irregular intervals.

Remarks:— Although the specimen is only one, the generic features are clear as seen in the above description. The present specimen seems to represent a new species, but the data available to the writer are not sufficient as yet to give it an exact specific name.

Occurrence:— Loc. 3.

Illustrated specimen:— NSM-PP 6908-1

Family Dasycladaceae

Genus *Vermiporella* STOLLEY, 1893

Vermiporella sp.

Pl. 9, fig. 8

Material:— A number of specimens, not well preserved; from them one cross section was selected.

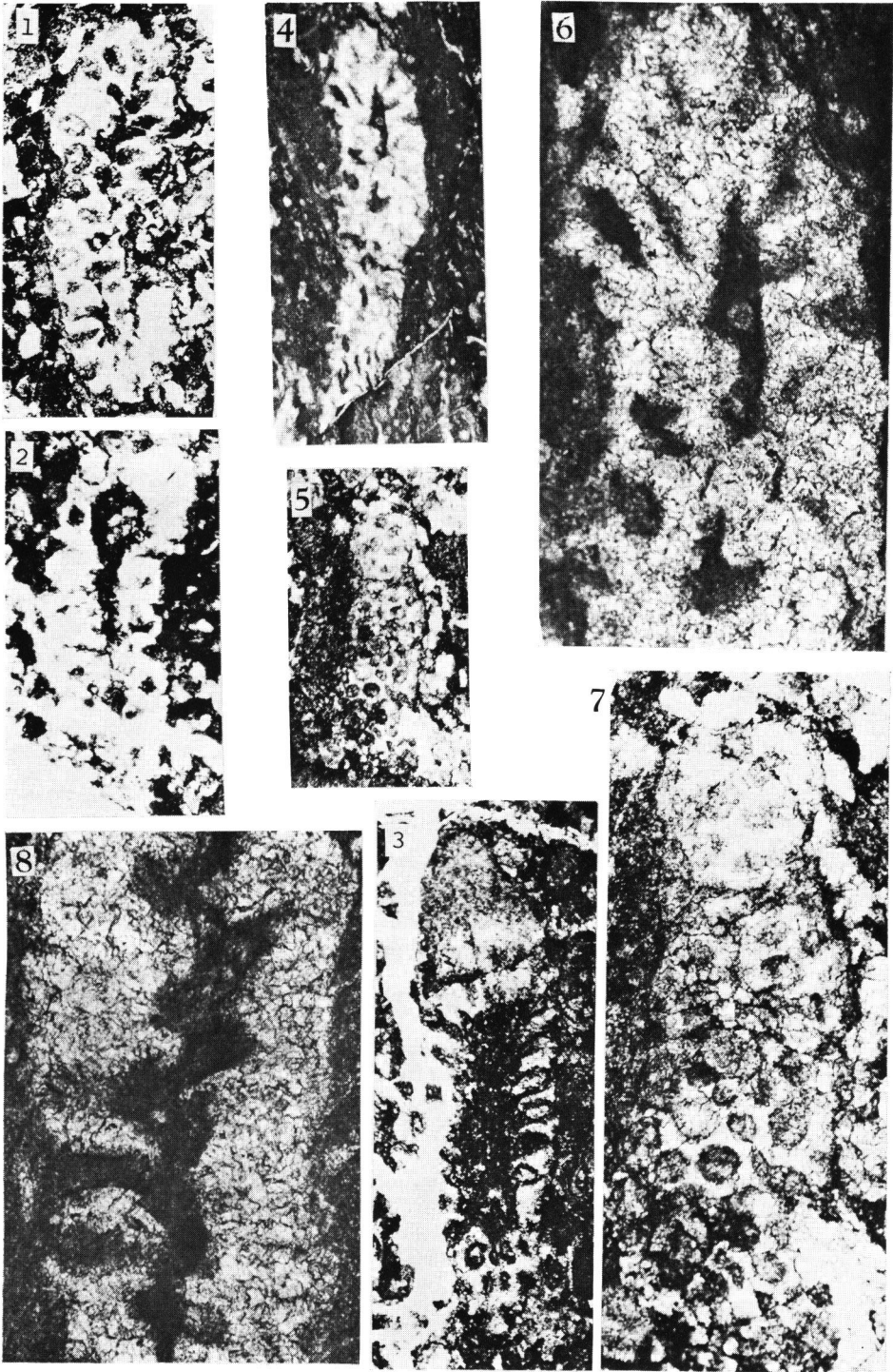
Measurements:—

Specimen	D	d	p
NSM-PP 6902-1	943	382	37

Remarks:— Thallus cylindrical, constricted, circular to subcircular in cross section; central stem rather thick; branches slender, gradually expanding toward the exterior and arranged nearly perpendicular to the central stem. The present specimen resembles the type species of *Vermiporella nipponica* ENDO from the Kuchibora For-

Plate 5. Figs. 1-7. *Amicus konishii* sp. nov. (syntype), $\times 25$. 1-3. longitudinal sections (S. No. NSM-PP 6901-1, 2, 3). 4. Another longitudinal section (S. No. NSM-PP 6901-4). 5. A longitudinal section, cut near the outer margin of the thallus (S. No. NSM-PP 69388-11). 6. Enlarged view of the upper part of the specimen in fig. 4, $\times 85$. 7. Enlarged view of the specimen in fig. 5, showing ring-shaped tufts of the secondary branches $\times 65$.

Fig. 8. Enlarged view of the lower part of the specimen in fig. 1 of plate 4, $\times 75$.



mation, Hachiman-machi, Gifu Prefecture, but the data available to the writer are insufficient as yet to give it an exact specific name.

Occurrence:— Loc. 2.

Illustrated specimen:— NSM-PP 6902-1.

Genus *Amicus* MASLOV, 1956

Amicus japonicus sp. nov.

Pl. 4, figs. 1–10; pl. 5, fig. 8

Material:— Three longitudinal, eight oblique longitudinal and one cross sections were selected from numerous specimens.

Measurements:—

	Hight	D	d	p	h	w
NSM-PP 6938-1		534	86	134	143	
NSM-PP 6938-2		401		114	143	
NSM-PP 6938-3		573		105	105	
NSM-PP 6938-4		419	95	86	115	
NSM-PP 6938-5		429	67	115	143	
NSM-PP 6938-6		458	76	114	124	
NSM-PP 6901-5		628	212	105		16±
NSM-PP 6938-7	3.6 mm	273		113	75	
NSM-PP 6938-8	5.2 mm	282		75	95	
		280	85	104	123	
		245		47	94	
NSM-PP 6938-9	4.4 mm	377	132	104	104	

Description:— Thallus elongate, cylindrical, with a slight undulation, probably 5 to 6 mm high, composed of an uncalcified central stem and a well calcified cortex which is penetrated by numerous branches. Central stem relatively thin, pinching and swelling slightly. Branches relatively short and thin, 48 μ long and 38 μ thick in average, arranged 15 to 20 per whorl, end in funnel-shaped tufts of secondary slender branches. No reproductive organs were observed.

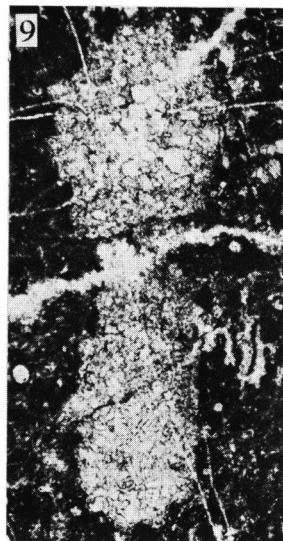
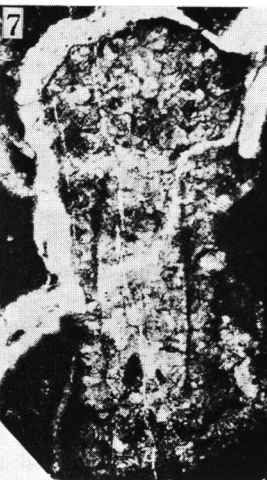
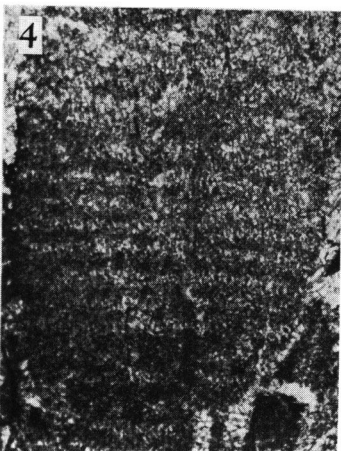
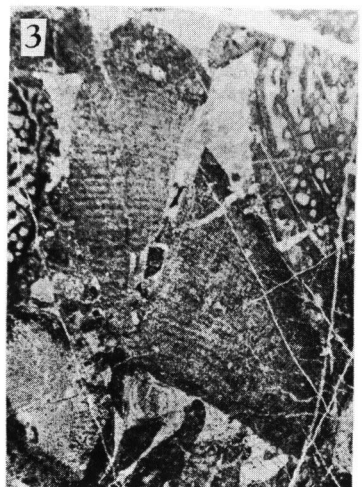
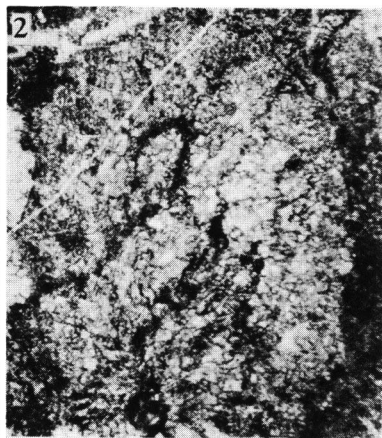
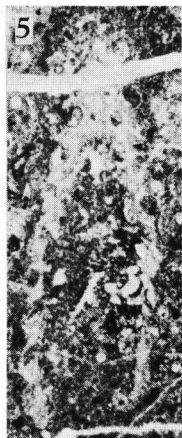
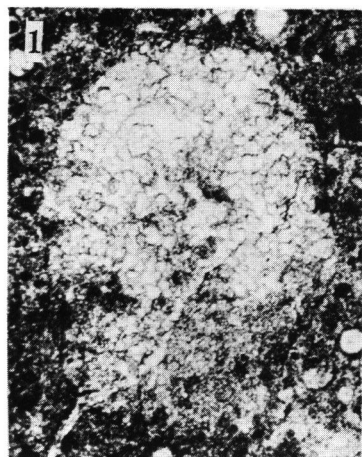
Plate 6. Fig. 1. *Pycnoporidium lobatum* YABE and TOYAMA. A longitudinal section, $\times 50$ (S. No. NSM-PP 6919-8).

Fig. 2. *Solenopora texana* JOHNSON. A longitudinal section, $\times 30$ (S. No. NSM-PP 6935-1).

Figs. 3–4. *Parachaetetes* sp. 3. A longitudinal section, $\times 10$ (S. No. NSM-PP 6929-1). 4. Enlarged view of the middle part of the specimen in the above fig. 3, $\times 30$.

Fig. 5. *Gyroporella tenuimarginata* ENDO. A longitudinal section $\times 32$ (S. No. NSM-PP 6919-7).

Figs. 6–9. *Eogoniolina johnsoni* ENDO. 6. A longitudinal section showing club-shaped central stem and longer branches from the upper part of the stem, $\times 25$ (S. No. NSM-PP 6935-4). 7. A longitudinal section cut slightly obliquely showing branches grown thick at the upper part of the thallus, $\times 25$ (S. No. NSM-PP 6935-5). 8. Another longitudinal section, slightly oblique, $\times 25$ (S. No. NSM-PP 6918-5). 9. A longitudinal section of the calcified specimen, $\times 20$ (S. No. NSM-PP 6919-6).



Remarks:— This new species may be compared with *Amicus fortunatus* MASLOV from the Devonian formation Kutznetzk, Siberia but it is distinguished by long thallus and narrow spaces between whorls of the branches. *A. orientalis* ENDO from the middle Permian in the Ominagahama district, Shiga Prefecture, Central Japan resembles the present new species but the latter differs from the former in long and thin thallus and narrow spaces between whorls of the branches.

Occurrence:— Loc. 1, 12.

Type species (Syntype):— NSM-PP 6901-1; 6938-1, 2, 7, 8, 9.

Amicus konishii sp. nov.

Pl. 5, figs. 1–7

Material:— Four longitudinal and one tangential sections were selected from a number of specimens.

Measurements:—

Specimen	D	d	p	h
NSM-PP 6901-1	668		67	152
NSM-PP 6901-2	716	286	47	143
NSM-PP 6901-3	715	334	67	191
NSM-PP 6938-11	525		37	124
NSM-PP 6901-4	434			

Description:— Thallus broadly cylindrical, undulating. Central stem relatively thin, pinching and swelling slightly. Primary branches relatively thick, arranged in somewhat closely spaced whorls, inclined slightly to the central stem and terminate in ring-shaped tufts of secondary slender branches. No reproductive organs were observed.

Remarks:— The most remarkable peculiarity of the present new species is in its branching form. The general appearance of this species may be referable to *Amicus fortunatus* and *A. orientalis*, but it is distinguished by narrow spaces between whorls of branches and tube-like tufts of secondary branches. *A. japonicus* having elongate thallus and funnel-shaped tufts of secondary branches is beyond of the comparison. The specific name was given in honor of Prof. Kenji KONISHI of Kanazawa University.

Plate 7. Figs. 1–2. *Mizzia yabei* (KARPINSKY). 1. A longitudinal section, $\times 25$ (S. No. NSM-PP 6926-1). 2. Another longitudinal section, $\times 15$ (S. No. NSM-PP 6942-1).

Fig. 3. *Pseudogyroporella mizziaformis* ENDO. A longitudinal section, $\times 20$ (S. No. NSM-PP 6901-7).

Fig. 4. *Gyroporella* cfr. *nipponica* ENDO and HASHIMOTO. A cross section, $\times 30$ (S. No. NSM-PP 6902-2).

Figs. 5–6. *Gyroporella omensis* ENDO. 5. A cross section, $\times 15$ (S. No. NSM-PP 6910-5).

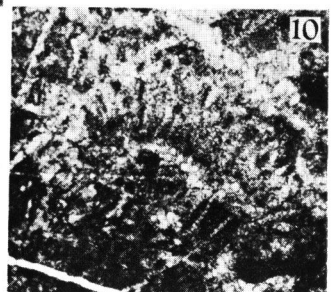
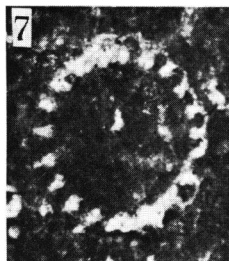
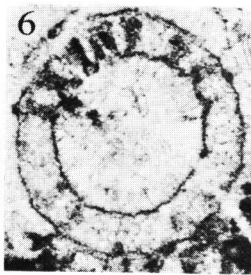
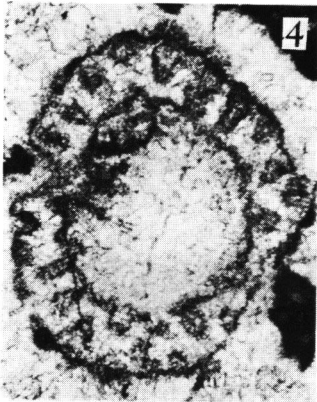
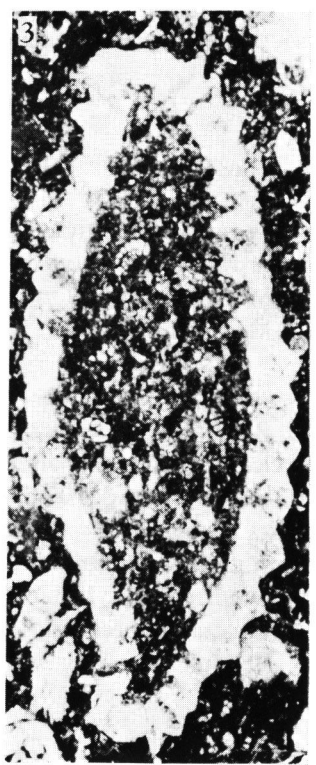
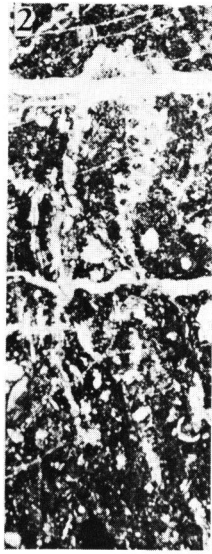
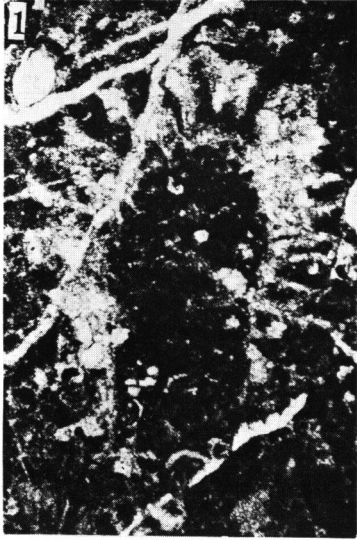
6. Another cross section, $\times 25$ (S. No. NSM-PP 6902-3).

Fig. 7. *Gyroporella tenuimarginata* ENDO. A cross section, $\times 30$ (S. No. NSM-PP 6934-2).

Fig. 8. *Poikiloporella japonica* ISHIJIMA *et al.* A cross section, $\times 25$ (S. No. NSM-PP 6929-3).

Fig. 9. *Gyroporella* sp. An oblique cross section, $\times 25$ (S. No. NSM-PP 6931-1).

Fig. 10. *Ortonella taishakuensis* ENDO. A longitudinal section, $\times 25$ (S. No. NSM-PP 6910-6).



Occurrence:— Loc. 1, 12.

Type species:— (Syntype):— NSM-PP 6901-1, 2, 3, 4; 6938-11.

Genus *Mizzia* SCHUBERT, 1907

Mizzia velebitana SCHUBERT

Pl. 10, fig. 4

Mizzia velebitana SCHUBERT 1908, p. 382, pl. 16, figs. 8–12.

Mizzia velebitana, ENDO, 1969, pp. 47–48, pl. 9, figs. 7–9; pl. 10, figs. 4, 5.

Material:— One longitudinal section was selected from a number of specimens.

Measurements:—

Specimen	D	d	p
NSM-PP 6910-1	1421	1076	124

Remarks:— Although the selected specimen is a fragment, the generic features are clear. It shows a ball-like shaped member with thick central stem, broad branches with bluntly rounded ends. The present specimen may be identical with the type species of *Mizzia velebitana* from Dalmatia and is referable to the specimens reported from the various localities in the world.

Occurrence:— Loc. 5, 8.

Illustrated specimen:— NSM-PP 6910-1

For full synonymy, see ENDO, 1952, p. 25.

Mizzia yabei (KARPINSKY)

Pl. 7, figs. 1, 2

Stolleyella yabei KARPINSKY 1908, pp. 268–269.

Mizzia yabei, ISHIJIMA *et al.*, 1971, p. 5, pl. 3, figs. 1–3.

Material:— Tow longitudinal sections were selected from a number of specimens.

Measurements:—

Specimen	D	d	p
NSM-PP 6926-1	1336	783	153
NSM-PP 6942-1	1813	678	124

Remarks:— Though the present specimens are fragmental, they show barrel-shape members of a chain-like thallus, broad central stem, thick calcified cortex; pores with bluntly rounded or funnel-shaped ends. As seen in the above description and measurements these specimens may be identical with the type species of *Mizzia yabei*.

Occurrence:— Loc. 6, 9, 15.

Illustrated specimens:— NSM-PP 6926-1, 6942-1.

For full synonymy, see ENDO, 1969, p. 48.

Genus *Pseudogyroporella* ENDO, 1959

Pseudogyroporella mizziaformis ENDO

Pl. 7, fig. 3; pl. 9, fig. 7

Pseudogyroporella mizziaformis ENDO, 1959, p. 184, pl. 30, figs. 3, 4.

Pseudogyroporella mizziaformis, ISHIJIMA *et al.*, 1971, p. 104, pl. 2, fig. 1.

Material:— Two longitudinal sections from a number of specimens.

Measurements:—

Specimen	D	d	p
NSM-PP 6901-7	1501	1034	205
NSM-PP 6923-1	566	302	113

Remarks:— Broadly cylindrical thallus with a slight undulation, broad central stem, thick calcareous wall; shape, size and arrangement of the branches indicate that the present specimens are identical with the type species of *Pseudogyroporella mizziaformis* ENDO from the Nyugawa Valley, Gifu Prefecture.

Occurrence:— Loc. 1, 9.

Illustrated specimens:— NSM-PP 6901-7, 6923-1

For full synonymy, see ENDO, 1969, p. 59.

Pseudogyroporella ohnoensis sp. nov.

Pl. 8, figs. 1–10

Material:— Seven longitudinal and four cross sections were selected from numerous specimens.

Measurements:—

Specimen	D	d	p	h	w
NSM-PP 6939-1	707	264	75	188	
NSM-PP 6939-2	518	151	66	141	
NSM-PP 6939-3	613	302	57	217	
NSM-PP 6939-4	745	217	75	198	
NSM-PP 6939-5	538	226	66	151	
NSM-PP 6909-1	1036	377	75	104	
NSM-PP 6939-6	736	302	73	132	
NSM-PP 6935-6	868	495	57		25±
NSM-PP 6935-7	848	453	58		24±
NSM-PP 6935-8	943	594	94		20±
NSM-PP 6935-9	924	462	85		22±

Description:— Thallus small and simple, broadly cylindrical, slightly undulating, probably less than a few millimeters high, circular to subcircular in cross section, about 0.8 mm thick in average; central stem simple, about 0.4 mm broad in average; lateral branches also simple, 55 μ to 95 μ thick and 160 μ to 245 μ long, nearly perpendicular or slightly inclined to the central stem. 20 to 25 branches per whorl. Whorls spaced regularly along the central stem at intervals of about 150 μ long in average. Branches terminated in bluntly rounded ends and are usually covered by thin calcareous deposit, 25 μ in average. No reproductive organs were observed.

Remarks:— In general appearance of the thallus this new species may be com-

pared with *Pseudogyroporella mizziaformis* ENDO and *P. longissima* NAKAMURA *et al.*, it differs, however, in having smaller thallus, thick branches in proportion to the central stem and thin calcareous deposit around both central stem and branches.

Occurrence:— Loc. 4, 9, 11, 13.

Type species (Syntype):— NSM-PP 6909-1, 6935-8, 6939-1, 2.

Genus *Eogoniolina* ENDO, 1953

Eogoniolina johnsoni ENDO

Pl. 6, figs. 6–9

Eogoniolina johnsoni ENDO, 1953 b, pp. 101–103, pl. 9, figs. 5–10.

Eogoniolina johnsoni, ENDO and KANUMA, 1954, p. 194, pl. 14, fig. 7; pl. 15, fig. 11.

Eogoniolina johnsoni, ENDO, 1956, p. 231, pl. 23, figs. 2–4.

Eogoniolina johnsoni, ENDO, 1957, p. 284, pl. 37, figs. 2, 3.

Eogoniolina johnsoni, ENDO, 1959, pp. 185–186, pl. 31, figs. 2–4; pl. 37, fig. 8.

Eogoniolina johnsoni, ENDO, 1961c, p. 126, pl. 5, figs. 1, 2.

Material:— Four longitudinal sections were selected from a number of specimens.

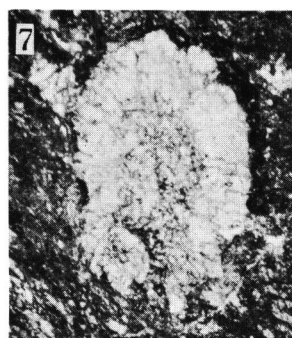
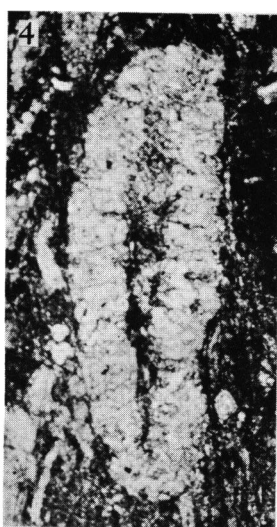
Measurements:—

Specimen	D		d		p	h
	upper	lower	upper	lower		
NSM-PP 6935-4	821	574	334	283	94	132
NSM-PP 6935-5	982	754		472	94	141
NSM-PP 6918-5	1241	981		632	113	188
NSM-PP 6919-6	1181	843			128	

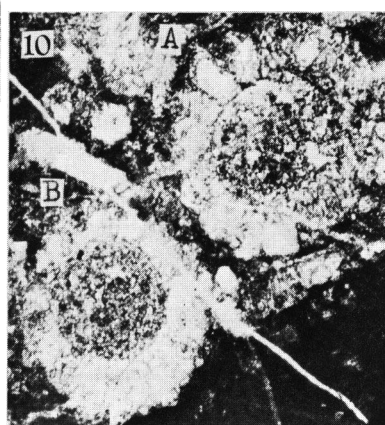
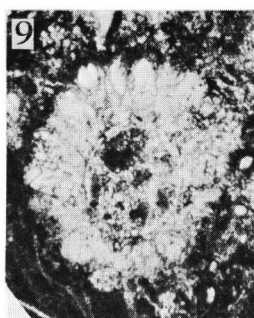
Description:— Thallus drumstick in shape, ball-shaped head and broadly cylindrical stalk; composed of an uncalcified central stem and a well calcified cortex which is penetrated by numerous primary branches. Central stem simple, club-shaped. Branches also simple with broad bases and nearly uniform diameter to bluntly rounded ends and do not branch. Primary branches are perpendicular or inclined slightly to the central stem, arranged irregularly, 15 to 25 per whorl. Branches were grown longer and closely on the upper part of the central stem, consequently thallus shows a spatulated form in longitudinal section. Outlets of the branches on the surface of the upper part are polygonal as if pressed one another.

Remarks:— Though in the present specimens globular expansions are not so much remarkable as in ENDO's description, they are identical with the type species of *Eogoniolina johnsoni* ENDO from Akasaka, Gifu Prefecture in general appearance of the thallus and shape, size and arrangement of the branches.

Plate 8. Figs. 1–10. *Pseudogyroporella ohnoensis* sp. nov., $\times 30$. 1, 2. Longitudinal sections of the syntype (S. No. NSM-PP 6939-1, 2). 3–5. Longitudinal sections (S. No. NSM-PP 6939-3, 4, 5). 6. An oblique longitudinal section of the syntype (S. No. NSM-PP 6901-1). 7. An oblique cross section (S. No. NSM-PP 6939-6). 8, 9. Cross sections (S. No. NSM-PP 6935-6, 7). 10. A cross section of the syntype (A) (S. No. NSM-PP 6935-8). Another cross section (B).



8



Occurrence:— Loc. 7, 10, 11.

Illustrated specimens:— NSM-PP 6918-5, 6919-6, 6935-4, 5.

Genus *Pseudoepimastopora* ENDO, 1960

Pseudoepimastopora japonica (ENDO)

Pl. 1, fig. 6

Epimastopora japonica ENDO, 1951, pp. 124–125, pl. 11, figs. 1, 2.

Epimastopora japonica, ENDO, 1953 b, pp. 99–100, pl. 9, figs. 1–4.

Epimastopora japonica, ENDO, 1959, p. 203, pl. 38, figs. 16–18.

Pseudoepimastopora japonica, ENDO, 1960, pp. 269–270, pl. 44, fig. 1.

Pseudoepimastopora japonica, JOHNSON, 1963, p. 182, pl. 69, fig. 1.

Pseudoepimastopora japonica, ENDO, 1969, p. 69, pl. 17, fig. 4.

Pseudoepimastopora japonica, ISHIJIMA *et al.*, 1971, pl. 15, fig. 4.

Material:— One section.

Measurements:—

Specimen	Thallus (mm)	p	Interspace between pores
NSM-PP 6910-3	0.2×2.1	37	62

Remarks:— Narrow, slightly undulating detached thallus, ball-shaped pores and their arrangement suggest that the present specimen may be identified with the type species of *Pseudoepimastopora japonica* (ENDO) from the Sakamotoazwa section in the Kitakami massif, Northeast Japan.

Occurrence:— Loc. 5.

Illustrated specimen:— NSM-PP 6910-3

Genus *Epimastopora* PIA, 1922

Epimastopora sp.

Pl. 2, fig. 7

Plate 9. Figs. 1, 2. *Macroporella alpina* PIA. 1. A longitudinal section, $\times 25$ (S. No. NSM-PP 6904-1). 2. Another longitudinal section, $\times 25$ (S. No. NSM-PP 6940-2).

Fig. 3. *Oligoporella* sp. A cross section, $\times 25$ (S. No. NSM-PP 6912-1).

Figs. 4–6. *Macroporella maxima* ENDO. 4. A longitudinal section, $\times 25$ (S. No. NSM-PP 6940-4). 5. An oblique cross section, $\times 25$ (S. No. NSM-PP 6940-5). 6. A cross section, $\times 25$ (S. No. NSM-PP 6904-6).

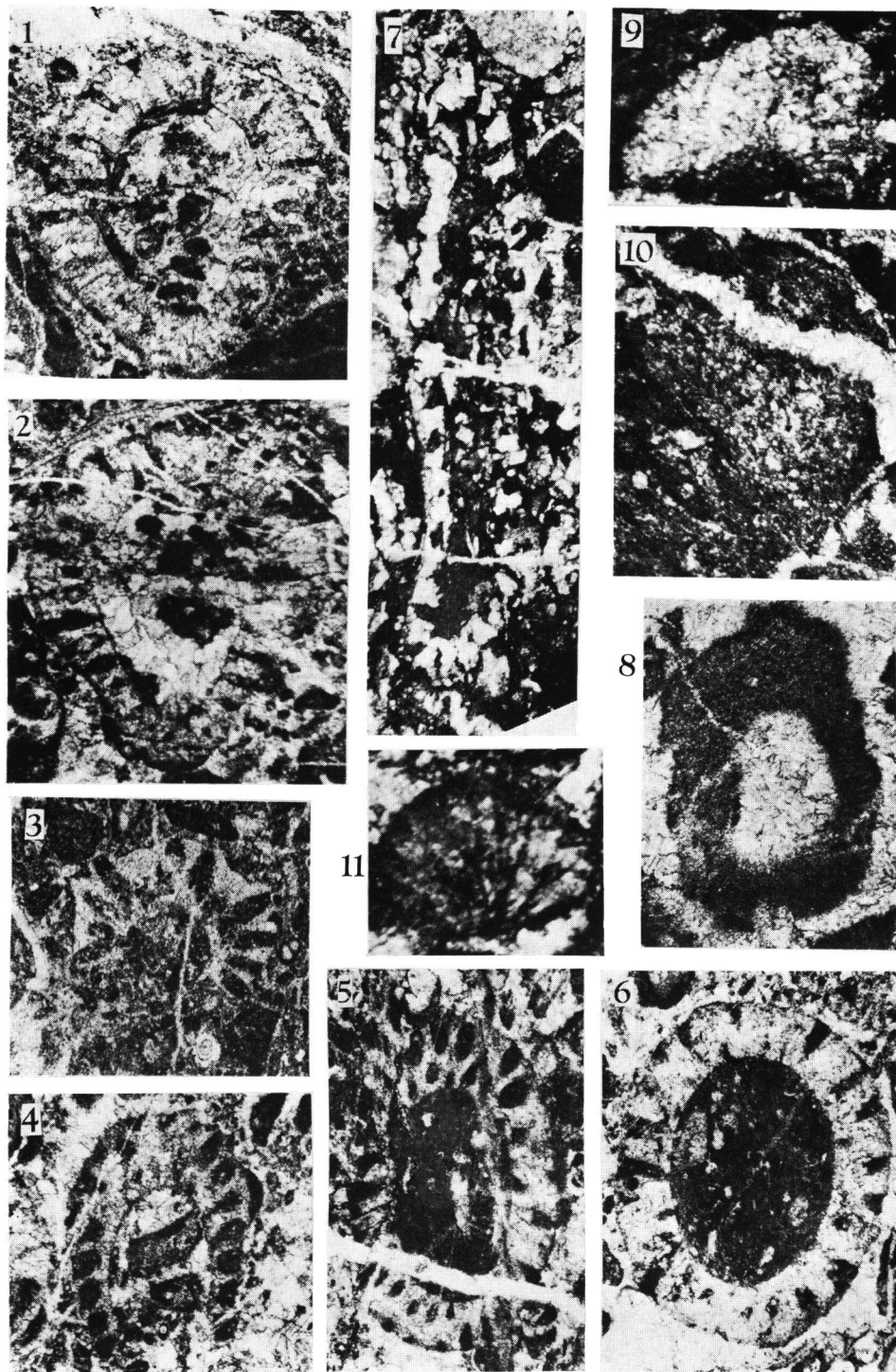
Fig. 7. *Pseudogyroporella mizziaformis* ENDO. A longitudinal section, $\times 30$ (S. No. NSM-PP 6923-1).

Fig. 8. *Vermiporella* sp. A cross section, $\times 30$ (S. No. NSM-PP 6902-1).

Fig. 9. *Pycnoporidium lobatum* YABE and TOYAMA. A longitudinal section, $\times 50$ (S. No. NSM-PP 6938-12).

Fig. 10. *Pycnoporidium toyamai* ENDO. A longitudinal section, $\times 50$ (S. No. NSM-PP 6938-10).

Fig. 11. *Ortonella intermedia* ENDO. A longitudinal section, $\times 80$ (S. No. NSM-PP 6914-12).



Material:— One section.

Description:— Stout calcareous tuft, fragmental, 3 mm long and 0.5 mm broad, bended, with slight undulation, perforated by numerous pores. Pores nearly uniform in breadth, $57\ \mu$ in average, nearly perpendicular to both inner and outer surfaces, arranged with relatively long intervals, $86\ \mu$ in average. Pores are given off from the inner surface at relatively broad bases and extend to the furrows of the outer surface, consequently swellings are observed between pores.

Remarks:— The specimen in exam. is characteristic enough and can be easily distinguished from other species described previously, for pinching and swelling of the surface and longer intervals between pores. It seems to represent a new species but the data are insufficient to give it an exact specific name.

Occurrence:— Loc. 5.

Illustrated specimen:— NSM-PP 6910-2

Genus *Macroporella* PIA, 1912

Macroporella alpina PIA

Pl. 9, figs. 1, 2; pl. 10, figs. 2, 3

Macroporella alpina PIA, 1912, p. 34, pl. 2, figs. 13–15.

Macroporella alpina, ENDO, 1969, pp. 50–51, pl. 6, figs. 3–7.

Macroporella sp. c, ISHIJIMA *et al.*, 1971, pp. 116–117, pl. 9, fig. 2.

Material:— Four longitudinal sections.

Measurements:—

Specimen	D	d	p	h
NSM-PP 6940-1	1613	811	114	188
NSM-PP 6940-2	1632	868	104	151
NSM-PP 6940-3	2055	1573	124	247
NSM-PP 6929-2	1282	668	115	148

Description:— Thallus short, stout, with irregular surface; central stem broad. Branches slightly inclined to the central stem and gently curved upward and widen progressively toward the distal surface.

Remarks:— As will be seen in the above description and the measurements the present specimen as well as the one reported previously by ISHIJIMA *et al.* (1971) as *M.* sp. c may be identified with the type species of *Macroporella alpina* PIA from the Triassic formation of Europe.

Occurrence:— Loc. 9, 14.

Illustrated specimens:— NSM-PP 6929-2, 6940-1, 2, 3.

For full synonymy, see ENDO, 1969, p. 50

Macroporella maxima ENDO

Pl. 9, figs. 4–6

Macroporella maxima ENDO, 1952, p. 26, pl. 1, figs. 3–8.

Macroporella maxima, ENDO and KANUMA, 1954, pp. 195–196, pl. 17, figs. 7, 8.

Macroporella maxima, ENDO, 1961b, p. 88, pl. 6, figs. 1, 2; pl. 16, fig. 6.

Macroporella maxima, ENDO, 1961c, p. 129, pl. 3, fig. 6.

Macroporella maxima, ISHIJIMA *et al.*, 1971, p. 114, pl. 8, figs. 1, 2.

Material:— Each one longitudinal, oblique and cross sections.

Measurements:—

Specimen	D	d	p	h	w
NSM-PP 6940-4	991	544	134	205	
NSM-PP 6940-5	1127	625	124	143	
NSM-PP 6940-6	1457	886	115		24±

Description:— Thallus broadly cylindrical, circular to subcircular in cross section, composed of an uncalcified central stem and a well calcified cortex which is penetrated by numerous phloiphor-typed branches. Branches are relatively thick and slightly inclined to the central stem and do not branch.

Remarks:— Although the present specimens are smaller as compared with the specimens reported up to date, they may be identified with type species of *Macroporella maxima* ENDO from the Maiya district, Miyagi Prefecture, so far as the general appearance of the thallus and shape and arrangement of the branches are concerned.

Occurrence:— Loc. 14, 15.

Illustrated specimens:— NSM-PP 6940-4, 5, 6.

Genus *Gyroporella* GÜMBEL, 1872 em. BENECKE, 1876

Gyroporella cfr. *nipponica* ENDO

Pl. 7, fig. 4

Gyroporella nipponica ENDO, 1969, pp. 55–56, pl. 15, fig. 6; pl. 16, figs. 5–7; pl. 17, figs. 1–7.

Gyroporella nipponica, ISHIJIMA *et al.*, 1971, pp. 117–118, pl. 10, figs. 1–3.

Material:— One cross section.

Measurements:—

Specimen	D	d	p	w
NSM-PP 6902-2	1178	785	123	22±

Remarks:— Circular thallus in cross section, relatively broad central stem, stout branches; shape, size and arrangement of the branches are referable to those of *Gyroporella nipponica* ENDO. The writer has, however, described the present specimen as an allied species due to insufficient data.

Occurrence:— Loc. 2.

Illustrated specimen:— NSM-PP 6902-2.

Gyroporella tenuimarginata ENDO

Pl. 6, fig. 5; pl. 7, fig. 7

Gyroporella tenuimarginata ENDO, 1956, pp. 232–233, pl. 23, fig. 12.

Gyroporella tenuimarginata, ENDO, 1957, p. 288, pl. 39, figs. 11, 12.

Gyroporella tenuimarginata, ENDO, 1959, pp. 188–189, pl. 32, figs. 1, 2.

Material:— Each one longitudinal and cross sections were selected from several specimens.

Measurements:—

Specimen	D	d	p	h	w
NSM-PP 6919-7	903	643	107	178	
NSM-PP 6934-2	736	556	85		22±

Description:— Thallus broadly cylindrical, circular in cross section, composed of broad central stem and thin calcified cortex which is penetrated by numerous lateral branches. About 22 branches are arranged per whorl. Branches consist of slender stalks and small ball-like rounded expansions.

Remarks:— As seen in the above description and the measurements the present specimens may be identified with the type species of *Gyroporella tenuimarginata* ENDO from Kagemori in Saitama Prefecture so far as the general appearance of the thallus and shape, size and arrangement of the branches are concerned.

Occurrence:— Loc. 6, 7.

Illustrated specimens— NSM-PP 6919-7, 6934-2.

Gyroporella omensis ENDO

Pl. 7, figs. 5, 6

Gyroporella omensis ENDO, 1961 b, pp. 93–94, pl. 10, fig. 1; pl. 12, figs. 1–4; pl. 19, figs. 1–3.

Gyroporella omensis, ENDO, 1969, pp. 56–57, pl. 15, fig. 7; pl. 18, figs. 2, 3, 7–9; pl. 19, figs. 1–3.

Gyroporella omensis, ISHIJIMA *et al.*, 1971, p. 119, pl. 10, figs. 1–4.

Material:— Two cross sections and several fragmental sections.

Measurements:—

Specimen	D	d	p	w
NSM-PP 6910-5	2049	1886	132	26±
NSM-PP 6902-3	962	582	113	22±

Description:— Thallus nearly circular in cross section, central stem relatively broad. Primary branches are composed of slender stalks and egg-shaped expansions and do not branch. About 24 branches are arranged per whorl.

Remarks:— The general appearance and size, shape and arrangement of branches indicate that the present specimens are identical with the type species of *Gyroporella omensis* ENDO from the Ominagahama district, Shiga Prefecture, Central Japan.

Occurrence:— Loc. 2, 5.

Illustrated specimens:— NSM-PP 6902-3, 6910-5.

Gyroporella sp.

Pl. 7, fig. 9

Material:— One oblique section.

Measurements:—

Specimen	D	d	p
NSM-PP 6931-1	1872	1143	76

Remarks:— Thallus probably broadly cylindrical and circular in cross section, composed of broad central stem and relatively thin calcareous wall. The lateral branches consists of relatively slender stalks, 100 μ long and 45 μ broad in average, and long oval expansions, 140 μ long and 75 μ thick in average. As seen in the above note the present specimen is presumed to belong to the genus *Gyroporella*. Moreover, it seems to represent a new species in having a peculiar form of branch, consisting of a long slender stalk and a long oval expansion, but the data available to the writer are not sufficient as yet to give it an exact specific name.

Occurrence:— Loc. 9.

Illustrated specimen:— NSM-PP 6931-1.

Genus *Oligoporella* PIA, 1912

Oligoporella sp.

Pl. 9, fig. 3

Material:— One cross section.

Measurements:—

Specimen	D	d	p	w
NSM-PP 6912	1224	534	134	18 $\pm$

Remarks:— Branches long, radiating from the central stem with small bases, expanding remarkably then decreasing in diameter gradually toward the exterior. The present specimen is presumed to belong to the genus *Oligoporella* so far as shape, size and arrangement of the branches are concerned. It resembles *O. elegans* ENDO from the Khao Rhlong Pharb district, Thailand, but the data available to the writer are insufficient as yet to give it an exact specific name.

Occurrence:— Loc. 6.

Illustrated specimen:— NSM-PP 6912.

Genus *Poikiloporella* PIA, 1943 em. OTT, 1963

Poikiloporella japonica ISHIJIMA *et al.*

Pl. 7, fig. 8; pl. 10, fig. 1

Poikiloporella japonica ISHIJIMA *et al.*, 1971, pp. 127–128, pl. 11, fig. 12; pl. 12, fig. 4.

Material:— Each one longitudinal and cross sections and some fragments.

Measurements:—

Specimen	D	d	p	h	w
NSM-PP 6929-3	1953	1107	115		24 $\pm$
NSM-PP 6910-4	1497	1138	186	354	

Remarks:— Thallus broadly cylindrical, with a slight undulation. Branches

composed of two swollen parts, showing gourd shape. Both inner and outer globes of branches are nearly same in size, furrow between globes relatively narrow and deep. The present specimens may be identified with the type species of *P. japonica* ISHIJIMA *et al.* from the Sakaishimachibun Limestone in Saitama Prefecture.

Occurrence:— Loc. 5, 9.

Illustrated specimens:— NSM-PP 6910-4, 6929-3.

Family Codiaceae

Genus *Ortonella* GARWOOD, 1914

Ortonella intermedia ENDO

Pl. 1, fig. 7; pl. 9, fig. 11

Ortonella intermedia ENDO, 1956, p. 241, pl. 27, fig. 3; pl. 29, fig. 4.

Ortonella intermedia, ENDO, 1961c, p. 136, pl. 6, fig. 3; pl. 7, fig. 2.

Ortonella intermedia, ISHIJIMA *et al.*, 1971, p. 130, pl. 16, fig. 4.

Material:— Two longitudinal sections and some fragments.

Measurements:—

Specimen	Thallus	Diameter of tube
NSM-PP 6925-1	742 × 804	62
NSM-PP 6914-12	40 × 38	18

Remarks:— Probably subspherical thalli, composed of ramified tubes radiating from the central portion of the basal part. Tubes gradually expand and slightly curved toward exterior, branch three or four times at an angle of 15° to 20°. The present specimens may be identified with the type species of *Ortonella intermedia* ENDO from Agano, Saitama Prefecture so far as the general appearance of the thallus and shape and arrangement of the tubes are concerned.

Occurrence:— Loc. 6, 9.

Illustrated specimens:— NSM-PP 6914-12, 6925-1.

Ortonella taishakuensis ENDO

Pl. 7, fig. 10

Plate 10. Fig. 1. *Poikiloporella japonica* ISHIJIMA *et al.* A longitudinal section, ×20 (S. No. NSM-PP 6910-4).

Figs. 2, 3. *Macroporella alpina* PIA. 2. A longitudinal section, ×20 (S. No. NSM-PP 6929-2).

3. Another longitudinal section, ×20 (S. No. NSM-PP 6940-3).

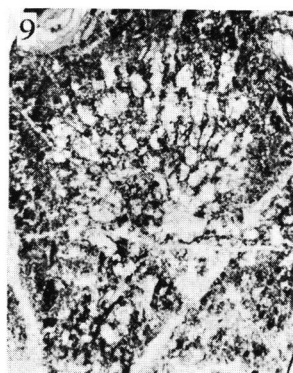
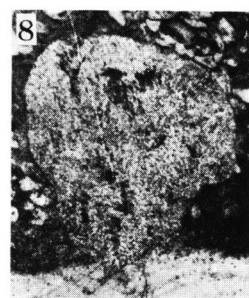
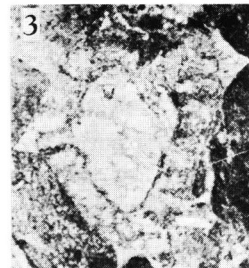
Fig. 4. *Mizzia velebitana* PIA. A longitudinal section, fragmental, ×20 (S. No. NSM-PP 6910-1).

Figs. 5–7. *Hikorocodium elegantae* ENDO. 5. A tangential section, ×20 (S. No. NSM-PP 6908-2).

6. Another tangential section, ×20 (S. No. NSM-PP 6902-4). 7. A cross section, ×20 (S. No. NSM-PP 6914-11).

Fig. 8. *Pycnoporidium toyamai* ENDO. A longitudinal section, ×20 (S. No. NSM-PP 6904).

Figs. 9, 10. *Pycnoporidium furukawense* sp. nov. 9. An oblique longitudinal section, ×20 (S. No. NSM-PP 6924). 10. A longitudinal section, ×20 (S. No. NSM-PP 6914-10).



Ortonella taishakuensis ENDO, 1957, p. 297, pl. 43, fig. 7.

Material:— One oblique longitudinal section was selected from several specimens.

Remarks:— Thallus probably foliaceous and subcircular in shape, about 1.5 mm broad and 1.1 mm high, composed of ramified tubes radiating from the central portion of the basal part. Tubes circular in cross section, $25\ \mu$ to $28\ \mu$ in diameter, slightly curved toward exterior and branch three or four times at an angle of 15° to 30° . Though this specimen shows a unifoliated subcircular in shape, it may be identified with the type species of *Ortonella taishakuensis* ENDO from the Taishaku district in Hiroshima Prefecture so far as shape, size and branching form of the tubes are concerned.

Occurrence:— Loc. 5.

Illustrated specimen:— NSM-PP 6910-6.

Genus *Hikorocodium* ENDO, 1951

Hikorocodium elegantae ENDO

Pl. 10, figs. 5–7

Hikorocodium elegantae ENDO, 1951, p. 127, pl. 10, figs. 1–3.

Hikorocodium elegantae, ENDO, 1953a, p. 124, pl. 12, fig. 8.

Hikorocodium elegantae, ENDO, 1954, pp. 218–219, pl. 19, figs. 1–3.

Hikorocodium elegantae, ENDO, 1957, pp. 297–298, pl. 42, figs. 5, 6.

Hikorocodium elegantae, ENDO and HORIGUCHI, 1957, p. 176, pl. 14, fig. 3.

Hikorocodium elegantae, ENDO, 1961c, p. 135, pl. 4, fig. 7.

Material:— Two longitudinal and one transverse sections were selected from a number of specimens.

Measurements:—

Specimen	Thallus (mm)	D	d	p
NSM-PP 6908-2	1.1×3.1			74–111
NSM-PP 6902-4	1.6×2.3			62–115
NSM-PP 6914-11		1674	618–866	87–124

Description:— Thallus probably broadly cylindrical or ellipsoidal, composed of pith-like central stem and calcified thick cortex which are penetrated by numerous anastomosing tubular pores. Pores twisted, undulating, dichotomously branching, arranging radially from the central stem and nearly perpendicular to the central stem.

Remarks:— The present specimens may be identified with the type species of *H. elegantae* ENDO from the Sakamotozawa section in Hikoroichi-mura, Kitakami Mountainous Land so far as the general appearance of the thallus and shape, size and arrangement of the pores.

Occurrence:— Loc. 2, 3, 6.

Illustrated specimens:— NSM-PP 6902-4, 6908-2, 6914-11.

References

- CHISAKA, T. and Y. TAKAOKA, 1977. Geology of the Hakusan Limestone, Ibi District, Gifu Prefecture. *Bull. Fac. Education, Chiba Univ.*, **26**: 19–27, text-figs. 1–4. (In Japanese).
- ENDO, R., 1951. Stratigraphical and Paleontological Studies of the Later Paleozoic Calcareous Algae in Japan, I — Several new Species from the Sakamotozawa section, Hikoroichi-mura, Kesen-gun, in the Kitakami Mountain Land. *Trans. Proc. Paleont. Soc. Japan, N. S.* (4): 121–129, pls. 10, 11.
- , 1952. *Ibid.*, III — A few species from the Maiya section, Maiya-machi, Tome-gun, Miyagi-ken —. *Sci. Rep. Saitama Univ.*, **1** (2): 23–28, pl. 1.
- , 1953a. *Ibid.*, V — Several species from the Iwaizaki limestone, Motoyoshi-gun, in the Kitakami Mountainland —. *Japanese Jour. Geol. Geogr.* **23**: 117–126, pls. 11, 12.
- , 1953b. *Ibid.*, VII — Several interesting species from the Kwanto Mountainous Land and a new genus from Kinshozan, Akasaka, Gifu-ken —. *Sci. Rep. Saitama Univ., Ser. B*, **1** (2): 97–104, pl. 9.
- , 1954. *Ibid.*, IX — Interesting species from the Yayamadake subgroup, Kyushu and new species from Sakamoto-mura, Taga-gun, Ibaraki-ken —. *Ibid., Ser. B*, **1** (3): 217–221, pl. 19.
- , 1956. *Ibid.*, X — Fossil algae from the Kwanto and Kitakami Mountains —. *Ibid., Ser. B*, **2** (2): 221–248, pls. 22–31.
- , 1957. *Ibid.*, XI — Fossil algae from the Taishaku district, Hiroshima-ken and Kitamino-kuni, Hokkaido —. *Ibid., Ser. B*, **2** (3): 279–305, pls. 37–44.
- , 1959. *Ibid.*, XIV — Fossil algae from the Nyugawa Valley in the Hida Massif —. *Ibid., Ser. B*, **3** (2): 177–207, pls. 30–42.
- , 1960. *Ibid.*, XV — A restudy of the Epimastopora —. *Ibid., Ser. B*, **3** (3): 267–270, pl. 44.
- , 1961 a. Calcareous Algae from the Jurassic Torinosu Limestone of Japan. *Ibid.*, Comm. Vol. Prof. R. ENDO: 53–75, pls. 1–17.
- , 1961 b. Stratigraphical and Paleontological Studies of the Later Paleozoic Calcareous Algae in Japan, XVI — Fossil Algae from the Ominagahama district —. *Ibid.*: 77–118, pls. 1–19.
- , 1961 c. *Ibid.*, XVII — Fossil Algae from the Akiyoshi Limestone Group —. *Ibid.*: 119–142, pls. 1–7.
- , 1969. Fossil Algae from the Khao Phrong Phrab District in Thailand. *Geol. Paleont. Southeast Asia* **7**: 33–85, pls. 5–42.
- , and M. HORIGUCHI, 1957. Stratigraphical and Paleontological Studies of the Later Paleozoic Calcareous Algae in Japan, XII — Fossil Algae from the Fukuji District in the Hida Massif —. *Japanese Jour. Geol. Geogr.*, **28** (4): 169–177, pls. 13–15.
- , and M. KANUMA, 1954. *Ibid.*, VII — Geology of the Mino Mountain Land and Southern Part of Hida Plateau, with descriptions of the algal remains found in those districts —. *Sci. Rep. Saitama Univ., Ser. B*, **1** (3): 177–208, pls. 13–17.
- FUJIMOTO, H., M. KANUMA, and H. IGO, 1962. On the Upper Paleozoic Group in the Hida Massif. *Geological Studies of the Hida Massif*: 44–70. (In Japanese).
- ISHIJIMA, W., 1975. On Some Permian Algae from the Takagami Conglomerate, Choshi, Chiba Prefecture. *St. Pauls Rev. Sci.*, **3** (4): 119–128, pls. 1–3.
- , H. OZAKI and M. NAKAMURA, 1971. Upper Paleozoic Algae from the Limestone at Sakaishimachibun, Saitama-ken. *Bull. Natn. Sci. Mus., Tokyo* **14** (1): 97–136, pls. 1–16.
- ISOMI, H., 1955. Explanatory Text of the Geological Map of Japan - Ogaki -. 1–24 pp. Kawasaki, Geol. Sur. Japan. (In Japanese).
- JOHNSON, J. H., 1951. Permian Calcareous Algae from the Apache Mountains, Texas. *Jour. Paleont.*, **25** (1): 21–30, pls. 6–10.
- , 1963. Pennsylvanian and Permian algae. *Ibid.*, **58** (3): 1–211, pls. 1–81.
- KARPINSKY, A., 1908. Einige problematisch Fossilien aus Japan. *Russ. K. Min. Gesell. verh.*, Ser. 2, **46**: 257–272, pls. 1–3.

- KONISHI, K., 1952. Occurrence of *Gymnocodium*, a Permian Alga, in Japan. *Trans. Paleont. Soc. Japan N. S.*, (7): 215–221, pl. 20.
- PIA, J. V., 1912. Neue Studien über triadischen Siphonaeae Verticillatae. *Beiter. Paleont. Osterr. Ungarn. u. des Orients*, **25**: 25–81, pls. 1–8.
- SCHUBERT, R., 1908. Zur Geologie des österreichischen Velebit. *K. k. Geol. Reichsanstalt, Wien, Jahrb.*, **58** (2): 345–386, pl. 16, figs. 1–5.
- YABE, H., and S. TOYAMA, 1928. On some rock-forming Algae from the Younger Mesozoic of Japan. *Sci. Rep. Tohoku Imp. Univ.*, 2nd Ser. **12** (2): 141–152, pls. 18–23.