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JAPANESE PERMIAN BRYOZOA

By

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Japanese Permian Bryozoa

By

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CONTENTS

Abstract

The writer describes and illustrates 77 species of bryozoa, 45 new and 23 indeterminable. The faunal assemblage resembles that of the Permian of Timor, Australia and Vancouver Island. Identical with the Japanese species are: three from Timor (one of Cyclostomata, one of Trepostomata and one of Cryptostomata); three from Australia (all of Trepostomata); five from Russia (one of Trepostomata; and four of Cryptostomata); and one from India (of Cryptostomata).

INTRODUCTION

The present comprehensive study of the Japanese Paleozoic Bryozoa has been delayed because of the difficulties encountered in working with poorly preserved specimens abundant in many localities. Fortunately, better preserved and more suitable material was eventually obtained from some of them. Geological ages of the rocks in these localities are well established by the well known and described fusulinids, corals and brachiopods. Stratigraphical sequences of these rocks, which range from the lower to the upper Permian, are also well known from the geological literatures and the writer's observations.

In some areas of Japan, especially Hokkaidô, there are some bryozoan-bearing rocks that contain no index fossils. It is hoped that progress in systematic studies in Japanese Paleozoic Bryozoa will help to clarify the geologic age of these groups.

All specimens described in this paper are preserved in the collection of the Hakodate Branch, Hokkaidô Gakugei University.

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Particular thanks are due to the Ministry of Education for grant in aid which has rendered possible the publication of this paper. Part of the expenses in connection with the present study was defrayed by the Scientific Research Fund of the Ministry of Education of the Japanese Government.

HISTORICAL REVIEW OF PALEOZOIC BRYOZOA OF JAPAN

Only about twenty species of the upper Paleozoic Bryozoa were hitherto known in Japan. The following forms from the Omi limestone, Niigata Prefecture were described and illustrated by I. HAYASAKA in 1924:

Fistulipora minima HAYASAKA .....L. Carb.
Fenestella spp. (more than two species).....?
Polypora sp.....L. Carb.
Phyllopora sp. .....Unknown age
Batostomella sp.[1] .....L. Carb.

In the next year (1925), Y. OZAWA described and illustrated the following species from the Akiyoshi limestone, Yamaguchi Prefecture:

Fistulipora kotoi OZAWA .....L. Perm.
Fistulipora nagatoensis OZAWA[2] .....L. Carb.
Geinitzella cf. *columnaris* SCHLOTHEIM.....L. Perm.
Fenestella perelegans MEEK .....L. Perm.
Polypora sp. .....L. Perm.

However, in these comprehensive paleontological studies, the bryozoans are treated as comparatively unimportant fossils.

T. SUGIYAMA (1941) reported three forms of *Batostomella* from some localities of the Hidaka group in Hidaka and Ishikari Provinces in Hokkaidô. SUGIYAMA considered that these forms indicate Permian age, but on the evidence of the brachiopods from one of the SUGIYAMA's bryozoan localities[3], A. FUKADA subsequently concluded that the Hidaka group belongs to Triassic rather than Permian age.

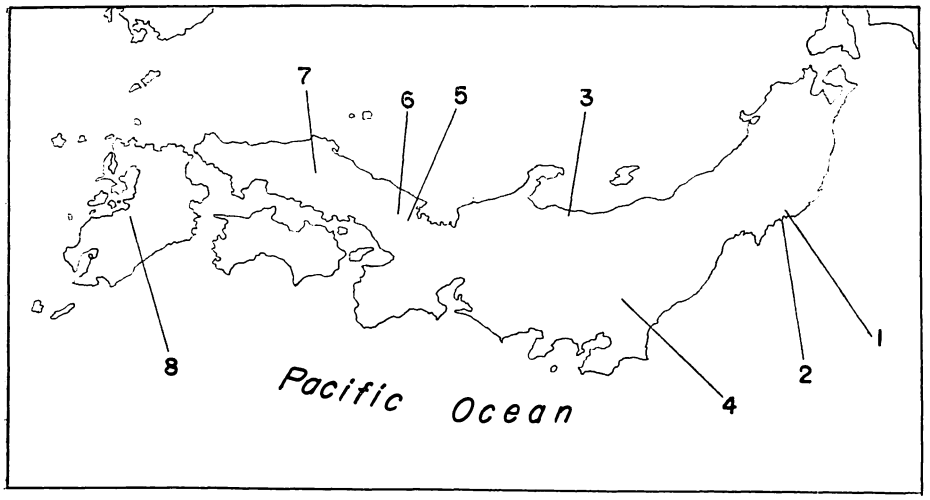
Recently, S. SAKAGAMI (1960a, 1960b) established two new genera, *Hayasakapora* from the upper Permian of the Iwaizaki limestone, Miyagi Prefecture and *Nipponostenopora* from the lower Carboniferous of Fukuji, Gifu Prefecture. Subsequently, S. SAKAGAMI and S. AKAGI (1961) described and illustrated the following species from the lower Permian of Miharano, Taishaku limestone plateau, Hiroshima Prefecture:

Fistulipora miharanoensis SAKAGAMI and AKAGI
Batostomella sp. indet.
Fenestella (*Minilya*) *taishakuensis* SAKAGAMI and AKAGI
Polypora eliasi SAKAGAMI and AKAGI
Anastomopora orientalis SAKAGAMI and AKAGI
Streblascopora lineata SAKAGAMI and AKAGI

FOSSIL LOCALITIES AND THEIR HORIZONS

The described Bryozoa were collected from eight localities whose age has been already determined on the evidence of fusulinids, corals, brachiopods, and other fossils. The stratigraphic sequences and fossiliferous horizons in these localities are as follows:

1) This form may belong to the genus *Hayasakapora* as mentioned by the writer (1960).
2) This form may be questionably referred to *Prismopora*.
3) The writer intends to reexamine these bryozoa in the near future.



Text figure 1. Map showing the localities of Permian Bryozoa.
1, Kamiyatsuse, 2, Iwaizaki limestone, 3, Omi limestone, 4, Kuzuu limestone, 5, Kawahigashi, 6, Takauchi limestone, 7, Morono (Taishaku limestone), 8, Kasamatsu.

1. Kamiyatsuse

The Shigeji-zawa Valley of Kamiyatsuse, northern part of Kesen-numa City, Miyagi Prefecture, is a well known fossil locality of the Kanokura Series.

This series overlies the Sakamotozawa Series with a slight unconformity. The Kanokura series may be divided on lithologic evidence into two groups. The lower group begins with a basal conglomerate and consists mostly of variegated sandstones and slates, occasionally very fossiliferous. The upper group consists of limestone and black slate.

The following fossils were reported from the lower group by M. MINATO (1954, 1959) and other geologists:

Parafusulina matsubaishi FUJIMOTO, *Camarophoria humbletonensis* HOWSE, *Cancrinella villiersi kozlowskiana* (FREDERICKS), *Chonetes deplanata* (WAAGEN), *Chonetes blanfordi* var. *lata* HAYASAKA, *Chonetes sinuosa* SCHELLWIEN, *Derbyia hemisphaerica* WAAGEN, *Derbyia magnifica* LIKHAREW, *Dielasma* cf. *biplex* WAAGEN, *Leptodus richthofeni* (KEYSER), *Marginifera? gratiosa* WAAGEN, *Martinia semiplana* WAAGEN, *Phricodothyris multipustulosa* HAYASAKA et MINATO, *Rhynchonella* (*Uncinulus*) *jabiensis* WAAGEN, *Spiriferella saranae* var. *lita* FREDERICKS, *Spiriferina cristata* SCHELLWIEN, *Stacheoceras iwaizakiensis* MABUCHI.

Abundant and well preserved bryozoans are associated with these fossils in Shigeji-zawa Valley of Kamiyatsuse. They were collected by the writer and identified as follows:

Fistulipora kesenumensis SAKAGAMI, n. sp.
Fistulipora megastoma SAKAGAMI, n. sp.
Meekopora delicata SAKAGAMI, n. sp.

Batostomella sp. indet.
Leioclema globosa CROCKFORD
Fenestella cf. *retiformis* (SCHLOTHEIM)
Polypora fujimotoi SAKAGAMI, n. sp.
Polypora hataii SAKAGAMI, n. sp.
Polypora endoi SAKAGAMI, n. sp.
Polypora sugiyamae SAKAGAMI, n. sp.
Polypora toyokoae SAKAGAMI, n. sp.
Tabulipora? sp. indet.
Septopora kawamatae SAKAGAMI, n. sp.
Thamniscus cf. *dubius* (SCHLOTHEIM)
Penniretepora kamiyatsusensis SAKAGAMI, n. sp.
Hayasakapora? sp. indet.
Sulcoretepora nipponica SAKAGAMI, n. sp.

2. Iwaizaki limestone

The Iwaizaki limestone of Hashigami-mura, Motoyoshi-gun, Miyagi Prefecture was studied by many stratigraphers and paleontologists, namely, S. MABUCHI (1935), Y. INAI (1939), T. SHIIDA (1940), M. MINATO (1944), R. MORIKAWA *et al.* (1958) and others.

According to the recent investigation of MORIKAWA *et al.*, the stratigraphical sequence of the Iwaizaki limestone is as follows (in descending order).

i: black fissile slate (100 m+)
h: black slate and limestone alternating (35 m)
g: black limestone (8 m)
f: grey limestone (38 m)
e: black limestone (7 m)
d: white limestone (65 m)
c: sandstone, slate and black limestone, alternating (34 m)
b: grey limestone with pebbles of conglomerate of the Usuginu type (7 m)
a: sandy slate (5 m)

The bryozoans were collected from the horizon h and the lower part of d.

The g member has yielded *Codonofusiella* sp., *Verbeekina* sp., *Yabeina shiraiwensis*, and *Iranophyllum* cf. *splendens;* and the overlying h member is known to contain the following fossils (the list compiled by S. HANZAWA, 1954, and the writer):

Scachinella cf. *gigantea* SCHELLWIEN, *Richthofenia* spp., *Leptodus richthofeni* (KEYSER), *Productus* spp., *Shanshiella*? *altispiralis* var., *Spirifer* cf. *saranae* var. *lita* FREDERICKS, *Zigopleura* sp., *Pleuronectites* cf. *interlineatus* MEEK and WORTHEN, *Spiriferina eristata* SCHELLWIEN, *Porcellia* sp., *Phymatifer* sp., *Dentalium* (*Phaglypta*) *herculeum* De KONINCK, *Aviculopecten* sp., *Syringopora* sp., *Pleurotomaria* sp., *Camarophoria humbletonensis* HOWSE, *Soleniscus*? sp., *Wentzellela persica* var. *minor* (MS., MORIKAWA *et al.*), *Waagenophyllum* cf. *indicum*

(WAAGEN)?, *Pseudophillipsia* sp., *Anisopyge* sp., *Codonofusiella* sp..

According to the listed fossils h member may be correlated with the uppermost part of the Kanokura series.

The following bryozoans from h member are described in this paper:

Fistulipora iwaizakiensis SAKAGAMI, n. sp.
Fistulipora cf. *timorensis* BASSLER
Fistulipora sp. indet. A
Meekopora densa SAKAGAMI, n. sp.
Ramipora ambigua SAKAGAMI, n. sp.
Goniocladia intricata SAKAGAMI, n. sp.
Coscinotrypa? sp. indet.
Batostomella yamazakii SAKAGAMI, n. sp.
Batostomella igoi SAKAGAMI, n. sp.
Batostomella microstoma SAKAGAMI, n. sp.
Dyscritella iwaizakiensis SAKAGAMI, n. sp.
Dyscritella cylindrica (CROCKFORD)?
Coeloclemis minima SAKAGAMI, n. sp.
Fenestella spp.
Polypora spp.
Penniretepora iwaizakiensis SAKAGAMI, n. sp.
Penniretepora tenuis SAKAGAMI, n. sp.
Penniretepora akiyamae SAKAGAMI, n. sp.
Penniretepora rectodichotoma SAKAGAMI, n. sp.
Hayasakapora erectoradiata SAKAGAMI
Streblascopora delicatula SAKAGAMI, n. sp.
Clausotrypa exillis SAKAGAMI, n. sp.

The lower part of d member consists of grey, slaty limestone containing many bryozoans, crinoid stems and fusulinids*. This limestone may correspond to that of the upper of the *Parafusulina* zone.

The following bryozoans from the lower part of d member are here described:

Fistulipora cf. *timorensis* BASSLER
Fistulipora sp. indet. C
Meekopora delicata SAKAGAMI, n. sp.
Batostomella spinigera BASSLER
Fenestella rhomboidea NIKIFOROVA
Hayasakapora matsudae SAKAGAMI, n. sp.
Saffordotaxis morikawae SAKAGAMI, n. sp.
Streblascopora delicatula SAKAGAMI, n. sp.
Sulcoretepora nipponica SAKAGAMI, n. sp.

* No fusulinids have been found in the lower part of d member by MORIKAWA *et al*; but the writer detected many *Schwagerina* spp. in association with bryozoans in thin sections of a limestone in this member.

3. Omi limestone

An impure tuffaceous limestone exposed at the sea shore near the entrance of Koshirazu tunnel of Hokuriku railroad has yielded brachiopods, crinoidal columnals, and bryozoans. The greater part of the limestone may be correlated with the lower part of the *Pseudoschwagerina-Pseudofusulina* zone (P_1), as indicated in the columnar section by S. KAWADA (1954).

The following bryozoans are here differentiated:

Fistulipora sp. indet. E
Coscinotrypa minor SAKAGAMI, n. sp.
Thamniscus? *problematicus* SAKAGAMI, n. sp.
Tabulipora cf. *maculosa* NIKIFOROVA
Sulcoretepora sp. indet.

4. Kuzuu limestone

The Kuzuu limestone, called the Nabeyama formation, is divided into three limestone members by S. YOSHIDA (1950, in H. FUJIMOTO, 1951). H. IGO has collected bryozoans from the lower limestone member (Yamasuge limestone member of H. IGO) at Izuru, Terao-mura, Shimotsuga-gun, Tochigi Prefecture. This member belongs to the lower part of the *Parafusulina* zone. Bryozoans are as follows:

Fistulipora regularis SAKAGAMI, n. sp.
Fistulipora sp. indet. D
Prismopora kuzuensis SAKAGAMI, n. sp.
Stenopora sp. indet. A
Stenopora sp. indet. B
Rhombopora? sp. indet.

5. Kawahigashi

The Kawahigashi bryozoans have been found in a limestone slab collected by K. NAKAZAWA (his Loc. KP-16, 1958) at Ayabe City (formerly called Toyosato-mura). According to K. NAKAZAWA and T. SIKI (1958) the limestone contains many bryozoans, calcareous algae, *Reichelina matsushitai* NOGAMI (MS) and *Schubertella*? sp. (probably new genus); the latter two fossils were differentiated by NOGAMI. NAKAZAWA and SIKI referred the limestone to the *Lepidolina-Yabeina* zone.

Bryozoans are as follows:

Dyscritella takauchiensis SAKAGAMI, n. sp.
Dyscritella sp. indet.
Fenestella sp. indet. A
Fenestella sp. indet. B
Polypora sp. indet. A
Polypora sp. indet. B
Septopora sp. indet.

Penniretepora zigzag SAKAGAMI, n. sp.
Hayasakapora? sp. indet.
Streblascopora delicatula SAKAGAMI, n. sp.

6. Takauchi limestone

The Takauchi limestone outcrops at about 4.5 km west of Shimoyakuno Station of San-in RR line. It belongs in the Nukada formation, so named by S. OISHI (1933), and redefined by K. NAKAZAWA (1951). This limestone has yielded abundant brachiopods and bryozoans:
Leptodus nobilis WAAGEN, *Cancrinella* sp., *Martinia* sp., *Productus* sp., *Reticularia*? sp., *Squamularia, Schizophoria, Camarophoria, Stenopora, Fistulipora, Polypora* (K. NAKAZAWA, T. SIKI, and D. SHIMIZU (1957)).

K. NAKAZAWA *et al* (1957) placed this limestone in the *Lepidolina-Yabeina* zone, the rocks of which are known in the area.

Bryozoans are as follows:
Fistulipora takauchiensis SAKAGAMI, n. sp.
Fistulipora sp. indet. A
Fistulipora cf. *timorensis* BASSLER
Dyscritella takauchiensis SAKAGAMI, n. sp.
Prismopora deformis SAKAGAMI, n. sp.
Fenestella nomatae SAKAGAMI, n. sp.
Fenestella sp. indet. C.
Polypora cf. *kutorgae* STUCKENBERG
Polypora longifenestrula SAKAGAMI, n. sp.
Polypora elongata SAKAGAMI, n. sp.
Septopora kamakurae SAKAGAMI, n. sp.
Synocladia sp. indet.
Penniretepora sikii SAKAGAMI, n. sp.
Penniretepora sp. indet.
Rhabdomeson nakazawae SAKAGAMI, n. sp.
Hayasakapora? sp. indet.
Streblascopora delicatula SAKAGAMI, n. sp.

7. Morono, Taishaku limestone plateau

The following bryozoan have been collected from the north-western part of Morono Pass, Misakagô, Tôjô-machi, Hiba-gun, Hiroshima Prefecture.
Hayasakapora taishakuensis SAKAGAMI, n. sp.
Penniretepora akagii SAKAGAMI, n. sp.
Polypora sp.

The white limestone containing these bryozoans is intercalated between two fusulinid bearing limestones. According to S. AKAGI (personal communication) the lower limestone contains *Triticites* cf. *nishikawai* AKAGI (MS), *Pseudoschwagerina miharanoensis* AKAGI, *Pseudoschwagerina* sp., *Pseudofusulina*

fusiformis, and *Pseudofusulina kraffti*; and the upper contains *Triticites nishikawai* (MS), *Pseudoschwagerina* sp., and *Schwagerina* sp.. AKAGI places these limestones in the Morono formation belonging in the upper part of the *Pseudoschwagerina* zone.

8. Kasamatsu, Kyushu

A bryozoan-bearing limestone occurs in the Kuma formation of T. MATSUMOTO and K. KANMERA (1949), and was described in detail by K. KANMERA (1953). It outcrops in the eastern part of Kasamatsu, Kawamata-mura, Yatsushiro-gun, Kumamoto Prefecture.

According to KANMERA the Kuma formation consists mainly of sandstone, shale, and conglomerate. In the area near Kawamata there are limestones which occur at three horizons. The lower and the middle limestones are about 10-20 m, and about 240 m, respectively, above the formation base. The following fossils have been differentiated in them:

Yabeina yasubaensis TORIYAMA, *Yabeina columbiana* (DAWSON), *Yabeina gubleri* KANMERA, *Lepidolina kumaensis* KANMERA, *Lepidolina toriyamai* KANMERA, *Pseudodoliolina pseudolepida gravitesta* KANMERA, *Pseudodoliolina* sp. A, *Pseudodoliolina* sp. B, *Verbeekina* sp., *Schwagerina* aff. *acris* THOMPSON and WHEELER, *Schwagerina pseudocrassa* KANMERA, *Parafusulina*? sp., *Codonofusiella cuniculata* KANMERA, *Rauserella* sp., *Dunbarula*? sp.

The upper limestone is about 550 m above the base of the formation and has yielded corals, bryozoans, crinoidal columnals, sponges, and calcareous algae. KANMERA reported from it *Waagenophyllum indicum* (WAAGEN), and *Wentzellela* sp.. The following bryozoans are here described (KANMERA's Loc. Ku-459):

Fistulipora kumaensis SAKAGAMI, n. sp.
Fistulipora sp. indet. B
Prismopora deformis SAKAGAMI, n. sp.
Streblascopora delicatula SAKAGAMI, n. sp.
Acanthocladia sp. indet.

AFFINITIES AND CORRELATIONS OF JAPANESE PERMIAN BRYOZOAN FAUNA AND THE FOREIGN FAUNAS

All in all 26 genera and 77 species are here differentiated from eight Japanese localities. The Japanese generic assemblages resemble closely those of the Permian of Timor, Australia and Vancouver Island; and some genera resemble those of India, China, and the U.S.S.R.

BASSLER described and illustrated from the Permian of Timor 23 genera and 76 bryozoan species. Three of the genera, *Ulrichotrypa*, *Phyllopora*, and *Pinnatopora* are now referred to *Stenopora*, *Protoretepora*, and *Penniretepora*, respectively; and *Rhombopora* has been divided by BASSLER into *Rhombopora* and *Saffordotaxis*. Sixteen Timor genera are found also in Japan. *Fistulotrypa*

and *Fistulocladia* of Timor have not been found in any other Permian rocks of the world. *Batostomella spinigera* BASSLER from the Basleo beds of Timor occurs also in the *Parafusulina* zone of Japan; and *Fistulipora* cf. *timorensis* BASSLER from the Japanese *Parafusulina* and *Lepidolina-Yabeina* zones resembles closely BASSLER's species from the Basleo beds. *Thamniscus* cf. *dubius* (SCHLOTHEIM) also resembles closely the Timor species.

The following Japanese species are broadly related to the Timor species.
Fistulipora takauchiensis SAKAGAMI, n. sp. .....*Fistulipora lunatifera* BASSLER
Batostomella igoi SAKAGAMI, n. sp. .....*Batostomella spinigera* BASSLER
Fenestella nomatae SAKAGAMI, n. sp. .....*Fenestella parviuscula* BASSLER
Penniretepora iwaizakiensis SAKAGAMI, n. sp.....
..... *Penniretepora crassicaulis* (BASSLER)
Saffordotaxis morikawae SAKAGAMI, n. sp. ....*Saffordotaxis wanneri* (BASSLER)
Clausotrypa exillis SAKAGAMI, n. sp.....*Clausotrypa minor* BASSLER
Streblascopora delicatula SAKAGAMI, n. sp.....*Streblascopora germana* (BASSLER)

CROCKFORD described from the Australian Permian 38 genera and 150 species of bryozoans. Nineteen of the genera occur also in Japan. *Batostomella spinigera* BASSLER and *Leioclema globosa* CROCKFORD from the Nura Nura member of the Poole Sandstone, Fitzroy Basin, Western Australia, occur also in the *Parafusulina* zone of Japan. *Dyscritella cylindrica* (CROCKFORD) from the h member of Iwaizaki limestone (*Lepidolina-Yabeina* zone) may be identical with the Australian form from the Ulladulla mudstone of the Upper Marine Series. The following Japanese bryozoans are broadly related to the Australian forms:
Ramipora ambigua SAKAGAMI, n. sp. .....*Ramipora ambrosoides* (BRETNALL)
Dyscritella iwaizakiensis SAKAGAMI, n. sp. ....*Dyscritella tenuirama* CROCKFORD
Fenestella rhomboidea NIKIFOROVA ....*Fenestella* (*Minilya*) *duplaris* CROCKFORD
Fenestella nomatae SAKAGAMI, n. sp.....*Fenestella horologia* BRETNALL
Polypora fujimotoi SAKAGAMI, n. sp. .....*Polypora fobea* CROCKFORD
Polypora elongata SAKAGAMI, n. sp. .....*Polypora magnafenestrata* CROCKFORD
Rhabdomeson nakazawae SAKAGAMI, n. sp...*Rhabdomeson bispinosa* CROCKFORD

FRITZ described from the Permian of Vancouver Island 11 genera and 17 species of bryozoans. Ten of the genera occur also in Japan. Two Japanese species, *Polypora sugiyamae* SAKAGAMI, n. sp., (*Parafusulina* zone) and *Streblascopora delicatula* SAKAGAMI, n. sp., (*Parafusulina* and *Lepidolina-Ybeina* zones) are comparable with *Polypora megastoma* KONINCK and *Streblascopora pulchra* (FRITZ) from the lower Permian of Vancouver Island. Although the Japanese and the Vancouver bryozoans are generically intimately related, there are no common species among them.

WAAGEN and PICHL (1885) and WAAGEN and WENTZEL (1886-7) described from the *Productus* limestones 15 genera and 33 species of bryozoans. Japanese *Thamniscus* cf. *dubius* (SCHLOTHEIM) resembles closely the form from the Middle *Productus* limestone, and the following Japanese species are closely related to the Indian forms:

Fistulipora takauchiensis SAKAGAMI, n. sp. .....
.....*Fistulipora grandis* (WAAGEN and PICHL)
Polypora sugiyamae SAKAGAMI, n. sp. .....*Polypora megastoma* KONINCK
Polypora longifenestrula SAKAGAMI, n. sp. .....
..... *Polypora gigantea* WAAGEN and PICHL

Some Permian bryozoans were recently described from China by K. C. YANG (1956, 1958) and L. H. LOO (1958). Although none of these species could be recognized among the Japanese forms, two of them are related to the following species:

Fistulipora takauchiensis SAKAGAMI, n. sp. .....*Fistulipora maanensis* YANG
Stenopora sp. indet. A .....*Stenopora* sp. (YANG, 1958, Chinghsichung ls.)

Many Permian bryozoans have been described from Russia. *Fenestella rhomboidea* NIKIFOROVA from the *Schwagerina anderssoni* zone at Kazarmennyi Kamen, U. S. S. R., occurs in the d member of Iwaizaki limestone (*Parafusulina* zone). Japanese *Tabulipora* cf. *maculosa* NIKIFOROVA, *Fenestella* cf. *retiformis* (SCHLOTHEIM) and *Polypora* cf. *kutorgae* NIKIFOROVA are close to the comparable Russian species. *Pennirelepora akagii* SAKAGAMI, n. sp. from the Morono (upper part of the *Pseudoschwagerina* zone) is close to *P. invisa* (TRIZNA) from the *Schwagerina anderssoni* zone of Bashkirian Ural. Japanese and Russian Cryptostomata are closer to each other than the Permian bryozoans of the other orders from these two countries.

GLOSSARY OF MORPHOLOGICAL TERMS

The following morphological terms are used in the present paper and the definitions have been selected from those of "Glossary of Morphological Terms" by BASSLER (1953) and CROCKFORD (1957). The terms with an asterisk are illustrated in the text figures.

*acanthopore.** Cylindrical tube adjoining zooecial walls and parallel to them in growth, formed of cone-in-cone layers with narrow central tubule which may be crossed by minute diaphragms; position commonly marked surficially by projecting spines, mostly at angles between zooecial in Paleozoic species (syn., spiniform tubule) (see *megacanthopore*, *micracanthopore*).

*anastomosing.** Uniting irregularly to form a network; applied to branches that diverge and rejoin.

*aperture.** Outermost opening of zooecium; in cryptostomes, mouth of the vestibule, and in cheilostomes, the opening occupied by an uncalcified frontal membrane.

bifoliate. Consisting of two layers of zooecia growing back to back with a double-walled median lamina (mesotheca) between them.

*diaphragm.** Transverse calcareous platform extending across zooecial tube or mesopore; common in most trepostomes, many cyclostomes, and some cryptostomes.

*dichotomous.** Dividing in two branches.

dissepiment. Generally noncelluliferous crossbar connecting branches of fenestrate zoaria.

distal. Direction of growth away from the ancestrula. (see *proximal*).

epitheca. Basal lamina of zoarium from which zooecia arise (syn., *coenelasma, epizoarium*).

*fenestrule.** Open space in reticulate zoarium enclosed by branches and connecting crossbar or by anastomosing branches; characteristic of some cryptostomes (Fenestellidae) and trepostomes (Phylloporinidae).

*hemiseptum.** (pl. *hemisepta*). A plate, extending partially a cross the zooecial tube in some cryptostomes; either one or two hemisepta may occur in an individual tube, being placed near the orifice at the base of the vestibule; they are designated as superior hemiseptum (on proximal wall of tube) and inferior hemiseptum (on distal wall).

*immature region.** Basal or internal part of zoarium characterized by thin-walled zooecial tubes, and by the usual absence of structures which are developed in the mature region, such as acanthopores and mesopores; and usually differentiated from the mature region also by less numerous diaphragms, or by lesser development of moniliform walls; or in some cyclostomes by some difference in the development of lunaria, or in the nature of the tissue infilling the interspaces between the zooecial tubes.

incrusting. Attached along one side to a foreign body.

*inferior hemiseptum.** Shelf projecting part way into zooecial tube from distal side not far from aperture; typical of some cryptostomes.

interspace. Part of zoarium between adjacent zooecia or their apertures.

*longitudinal.** Parallel to zooecial tube, as longitudinal thin section (syn., *vertical*).

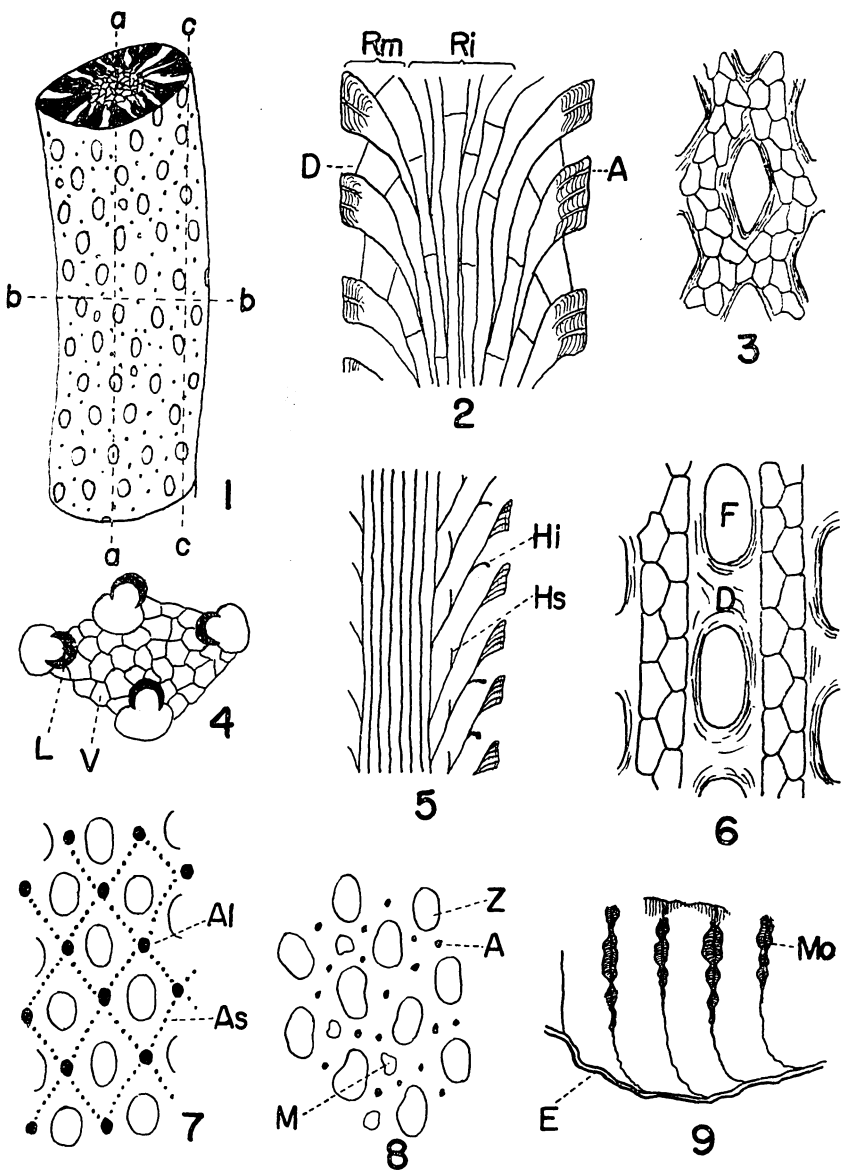
*lunarium.** (pl., *lunaria*). Hoodlike overarching projection of peristome on proximal side of zooecial tube, somewhat thickened and more strongly curved than other parts of tube, and in some perforated by 1 to 6 minute longitudinal tubules with diaphragms; common in cyclostomes and some cryptostomes.

*mature region.** The outer part of the zoarium, within which the zooecial walls may be thickened, either evenly or unevenly; and in which vesicular tissue or dense stereom, or acanthopores and mesopores, commonly occur between the zooecial tubes; and in which diaphragms become relatively more abundant with the zooecial tubes.

*megacanthopore.** Conspicuously large acanthopore, commonly located at distal border of zooecium in some cryptostomes.

*mesopore.** Small tubes occuring between the zooecial tubes in the mature region, and typically developed in the trepostomes.

mesotheca. Double lamiae of bifoliate zoarium produced by back-to back growth of two unilamellar series of zooecia.



Text figure 2. Morphological features of Paleozoic Bryozoa.
1, a-a: longitudinal section, b-b: transverse section, c-c: tangential section, 2, Rm: mature region, Ri: immature region, D: diaphragm, A: acanthopore, 3, anastomosing, 4, L: lunarium, V: vesicular tissue, 5, Hi: inferior hemiseptum, Hs: superior hemiseptum, 6, D: dissepiment, F: fenestrule, 7, Al: megacanthopore, Am: micracanthopore, 8, Z: zooecium, M: mesopore, A: acanthopore, 9, E: epitheca, Mo: monila.

*micracanthopore.** Small (normal) acanthopore associated with much enlarged ones (megacanthopores); common in cryptostomes and some trepostomes.

monila. Beadlike expansion in wall of some trepostomes (Stenoporidae).

node. Place of articulation in jointed zoarium, as in some cryptostomes, cyclostomes, and cheilostomes; or junction of stolons in ctenostomes.

obverse side. Side of unilamellar or reticulate zoarium bearing zooecial apertures (syn., *front, celluliferous*).

orifice. The primary opening of the zooecium for extrusion of the polypide.

peristome. Rim surrounding orifice in cheilostomes, many cyclostomes, and some trepostomes, or surrounding aperture in many cryptostomes.

pinnate. Feather-like, with lateral (generally oblique) branches on each side of a midrib.

polypide. The soft part of the zooid.

proximal. Direction toward origin of growth (syn., *posterior*) (see *distal*).

reverse side. Back of unilamellar or reticulate zoarium, lacking zooecial apertures (syn., *back, dorsal, noncelluliferous, nonporiferous*).

*superior hemiseptum.** Shelf projecting part way into zooecial tube from proximal side.

stereom. Dense calcareous tissue.

*tangential.** Referring to sections cut parallel to surface of zoarium.

*vesicular tissue.** Superposed irregular arched small lamellae forming cystose fillling of interzooecial spaces, commonly filled partly of entirely near zoarial surface by stereom; characterizes many cryptostomes and some cyclostomes.

vestibule. A circular or oval shaft extending inwards from the zooecial apertures to the orifice in cryptostomes; commonly replaced partly or entirely by stereom near the surface.

zoarium. (pl., *zoaria*). Assemblage of many zooids comprising an entire bryozoan colony, formed by repeated gemmation from a single initial zooid; form generally fairly constant for each species.

zooecium. (pl., *zooecia*). The tube which contained the soft part of zooid.

zooid. Single bryozoan animal, consisting of soft parts (*polypide*) and skeleton (*zooecium*).

Systematic Descriptions

Phylum BRYOZOA EHRENBERG, 1831

Order CYCLOSTOMATA BUSK, 1852

Family FISTULIPORIDAE ULRICH, 1882

Genus *Fistulipora* M'COY, 1850

Type species:—Fistulipora minor M'COY, 1850.

Diagnosis:—Zoaria lamellate, free or incrusting; ramose, or massive; com-

monly with regular maculae or monticules. Zooecia cylindrical, with straight diaphragms; apertures rounded, with lunaria moderately developed, not projecting into the tubes. (BASSLER, 1953, p. G83)

Range:—Silurian to Permian.

Fistulipora cf. *timorensis* BASSLER

Pl. 1, Figs. 1-8

1929. *Fistulipora timorensis* BASSLER, Paläont. Timor, xiv Leif., xxviii, p. 44, pl. CCXXVII (3), figs. 4-9.

Zoarium incrusting and attaching to foreign substances such as pebbles, corals or other bryozoans. Zooecium spherical in tangential section, with well developed lunarium occupying about one half of zooecial circumference. Diameter of zooecium increasing from immature to mature regions from 0.19-0.27 mm to 0.30-0.37 mm. There are 4 to 4.5 zooecia per 2 mm in tangential section near surface. Interspaces between zooecial tubes 0.19 mm to 0.32 mm, filled by vesicular tissue which is subquadrate in longitudinal section and irregular pentagonal or hexagonal in tangential section. One to three rows of vesicles occur in interspaces between zooecial tubes. Diaphragms not observed.

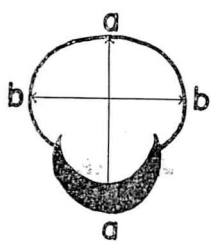
Remarks:—The species agree well with *Fistulipora timorensis* BASSLER, from Timor except it has fewer rows of vesicles.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. nos. 5076-A, 5083-A, 5093-A, 5093-B), d member of the Iwaizaki limestone (Reg. nos. 5205-A, 5207-A, 5214-A) and the Takauchi limestone (Reg. nos. 8113-A, 8113-B), which belong to the *Parafusulina* to *Lepidolina-Yabeina* zones.

Fistulipora iwaizakiensis SAKAGAMI, n. sp.

Pl. 2, Figs. 1-3

Zoarium could have been attached to foreign substance, such as seaweed. Zooecium with very weak lurarium in tangential section, oval, with average longer diameter (a-a′) 0.24 mm and shorter (b-b′) 0.19 mm. There are 4 zooecia per 2 mm. Diaphragms spaced at intervals of two to three times of zooecial diameter. Vesicular tissue subquadrate in longitudinal section, irregularly hexagonal in tangential section. One to four rows of vesicles in interspaces between zooecial tubes.



Text figure 3. Showing the method of measurement used for species in which the zooecial tubes are surrounded by distinct lunaria.

Remarks:—Easily distinguished from the other species of the genus.

Occurrence and horizon:—The h member of

Table 1. Determination of the Genus *Fistulipora*.

Species	Localities	Diameter of zooecium (in mm)		Thickness of lunarium (in mm)	No. of apertures in 2 mm in tangential section	Interspace between zooecial tubes (in mm)	No. of diaphragms in 2 mm
		a-a′	b-b′				
F. cf. *timorensis* BASSLER	Iwaizaki (d, h) Takauchi	?	0. 30-0. 37	0. 06-0. 13	4-4. 5	0. 19-0. 32	no
F. iwaizakiensis SAKAGAMI, n. sp.	Iwaizaki (h)	0. 24	0. 19	very weak	4	0. 14-0. 24	3-4
F. kesenumensis SAKAGAMI, n. sp.	Kamiyatsuse	?	0. 26-0. 33	very weak	4. 5-5	0. 19-0. 22	no
F. takauchiensis SAKAGAMI, n. sp.	Takauchi	0. 27-0. 40	0. 24-0. 34	0. 05-0. 10	5	0. 10-0. 30	4-5
F. megastoma SAKAGAMI, n. sp.	Kamiyatsuse	?	0. 33-0. 44	very weak	3-4	0. 11-0. 26	seldom occur
F. regularis SAKAGAMI, n. sp.	Kuzuu	0. 26-0. 32	0. 22-0. 32	0. 05	4	0. 16-0. 32	no
F. kumaensis SAKAGAMI, n. sp.	Kasamatsu	0. 27-0. 32	0. 19-0. 26	0. 06-0. 07	5	0. 13-0. 29	seldom occur
F. sp. indet. A	Iwaizaki (h) Takauchi	?	0. 18-0. 21	0. 08-0. 11	6	0. 19-0. 30	no
F. sp. indet. B	Kasamatsu	0. 26-0. 32	0. 24-0. 29	0. 03	5. 5-6	0. 08-0. 11	6-7
F. sp. indet. C	Iwaizaki (d)	?	0. 23-0. 32	very weak	3-3. 5	0. 16-0. 32	2
F. sp. indet. D	Kuzuu	0. 35-0. 40	0. 24-0. 32	0. 05	4	0. 19-0. 40	no
F. sp. indet. E	Omi	?	0. 33-0. 41	?	?	?	no

the Iwaizaki limestone (Reg. nos. 5068-A (holotype), 5066-A, 5074-A), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Fistulipora kesenumensis SAKAGAMI, n. sp.

Pl. 2, Figs. 4, 5

Zoarium incrusting and irregularly branched, with maximum thickness about 1.9 mm. Zooecium subspherical in tangential section, with weakly developed lunarium occupying about one third of zooecial circumference. Diameter of zooecium 0.26 mm to 0.33 mm. There are 4.5 to 5 zooecia per 2 mm near surface. Interspaces between zooecial tubes 0.19-0.22 mm, filled by regularly distributed vesicular tissue: subquadrate with rounded corners in longitudinal section, irregularly pentagonal or hexagonal in tangential section. Surface generally covered by dense tissue. Diaphragm unobservable.

Remarks:—The species resembles *Fistulipora iwaizakiensis* SAKAGAMI, n. sp. in general appearance, but can be distinguished by the absence of diaphragms.

Occurrence and horizon:—Kamiyatsuse (Reg. nos. 5531-A (holotype), 5509-A), which belongs to the *Parafusulina* zone.

Fistulipora takauchiensis SAKAGAMI, n. sp.

Pl. 3, Figs. 1, 2; Pl. 4, Figs. 1-5

Zoarium solid, ramose, attached to foreign substance, such as crinoid stems or pebbles. Zoarial diameter usually 7 mm to 8 mm, but the thin sectioned largest specimen is about 20 mm or more across. Zooecium oval, with longer diameter (a-a′) 0.27-0.40 mm and shorter diameter (b-b′) 0.24-0.34 mm. There are usually 5 zooecia per 2 mm. Interspaces between zooecial tubes 0.10-0.30 mm; tubes occasionally interconnected near zoarial surface. Vesicular tissue subquadrate, irregularly pentagonal, or hexagonal in longitudinal section; more or less irregularly arranged and elongated in immature region, becoming more regular and depressed in mature region. Vesicular tissues irregularly pentagonal or hexagonal in tangential section. One to three rows of vesicles in interspaces between zooecial tubes. Lunarium well developed, 0.05-0.10 mm thick occupying about one half of zooecial circumference. Diaphragms spaced at intervals of one to two times of zooecial diameter, 4 to 5 per 2 mm of zooecial tube.

Remarks:—This is the most common species of *Fistulipora* in the Takauchi limestone. The species resembles *Fistulipora lunatifera* BASSLER from the Koeka (Amarassi) in Timor but differs in that its lunarium occupies about one half of the zooecial circumference instead of one fourth, and its zooecium is thicker than that of the Timor form. It can be distinguished from *Fistulipora grandis* (WAAGEN and WENTZEL) from the Middle *Productus* limestone of the Salt Range, India, by the character of vesicular tissue in longitudinal section, the diameter of zooecium, and the number of zooecia per 2 mm. It

also resembles *Fistulipora kotoi* OZAWA from the lower Permian of the Akiyoshi limestone, but differs in the spacing of diaphragms and the shape of lunarium.

It is closely related to *Fistulipora maanensis* YANG (1956) from the lower part of the Changhsing Formation, Hapeh Province, China, but differs in the size of lunarium, which occupies one half of the zooecial circumference instead of one third in the Chinese species.

Occurrence and horizon:—The Takauchi limestone (Reg. nos. 8120 (holotype), 8106-A, 8108-A, 8110-A, 8115-A, 8118-A, 8119-A, 8119-B, 8130-A, 8137-A), which belongs to the *Lepidolina-Yabeina* zone.

Fistulipora megastoma SAKAGAMI, n. sp.

Pl. 5, Figs. 1, 2

Zoarium incrusting, could have been attached to foreign substance. Zooecium oval, with diameter 0.33-0.44 mm. There are 3 to 4 zooecia per 2 mm. Interspaces between zooecial tubes 0.11-0.26 mm. Vesicular tissue subquadrate in longitudinal section, irregularly hexagonal in tangential section. One to three rows of vesicles occur in interspaces between zooecial tubes. Lunarium very weak or nearly obsolete. Diaphragm rare.

Remarks:—The species can be distinguished from *Fistulipora kesenumensis* SAKAGAMI, n. sp. from the same locality, by the larger diameter of zooecial tube and sparse diaphragms.

Occurrence and horizon:—Kamiyatsuse (Reg. nos. 5532-B (holotype), 5520-A), which belongs to the *Parafusulina* zone.

Fistulipora regularis SAKAGAMI, n. sp.

Pl. 7, Figs. 1-3

Zoarium relatively thinly lamellate, about 1.5 mm thick. Zooecium oval in tangential section, with longer diameter (a-a′) 0.26-0.32 mm, shorter (b-b′) 0.22-0.32 mm. There are 4 zooecia per 2 mm. Interspaces between zooecial tubes 0.16 mm to 0.32 mm. Vesicular tissue very fine, regularly distributed, subquadrate in longitudinal section, pentagonal or hexagonal in tangential section. Two to three rows of vesicles occur in interspaces between zooecial tubes. Lunarium well developed, occupying about one half of zooecial circumference. Thickness of lunarium about 0.05 mm. Diaphragms not observed.

Remarks:—Very fine, regularly arranged vesicular tissue and relatively small zooecial diameter are characteristic of this new species. It somewhat resembles *Fistulipora* cf. *timorensis* BASSLER (which is described in this paper) but differs by the smaller diameter of zooecium.

Occurrence and horizon:—The Kuzuu limestone (Reg. nos. 6209-A (holotype), 6203-A, 6206-A), which belongs to the lower part of the *Parafusulina* zone.

Fistulipora kumaensis SAKAGAMI, n. sp.

Pl. 6, Figs. 5, 6

Form of zoarium indistinct. Zooecium oval, with longer diameter (a-a′) 0.27-0.32 mm, shorter diameter 0.19-0.26 mm. There are usually 5 zooecia per 2 mm. Interspaces between zooecial tubes 0.13-0.29 mm, filled by poorly developed vesicular tissue in inner regions, but greater part of them covered by dense tissue. Lunarium very large. Occupying about two thirds or more of zooecial circumference. Thickness of lunarium 0.056-0.072 mm. Relatively thick diaphragms sparse.

Remarks:—The species is quite unlike any others of the genus. The well developed dense tissue and poor vesicular tissue are characteristic of new species.

Occurrence and horizon:—Kasamatsu (Reg. nos. 9027-A (holotype), 9028-A), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Fistulipora sp. indet. A

Pl. 6, Figs. 1-4

Only two tangential sections, but the material can be separated distinctly from the other described species of the genus in Japan. Form of zoarium unknown. Zooecium oval, its diameter (b-b′) 0.18-0.21 mm. There are 6 zooecia per 2 mm. Interspaces between zooecial tubes 0.19 mm to 0.30 mm. Vesicular tissue irregularly pentagonal. One to three rows of vesicles occur in interspaces between zooecial tubes. Lunarium very thick, 0.08 mm to 0.11 mm and occupying about one half to two thirds of zooecial circumference. Diaphragm not observed.

Remarks:—The smaller size of zooecial diameter, and very strong and thick lunaria are characteristic of this form, but only two tangential sections are at hand and insufficient for specific discrimination. The two specimens which occurred from the h member of the Iwaizaki limestone and Takauchi limestone may belong to the same species even though slight differences are recognized.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. no. 5076-A) and Takauchi limestone (Reg. no. 8103-A), which belongs to the *Lepidolina-Yabeina* zone.

Fistulipora sp. indet. B

Pl. 5, Fig. 3

A single oblique section. Form of zoarium unknown. Zooecium oval in tangential section, its longer diameter (a-a′) 0.26 mm to 0.32 mm, shorter diameter (b-b′) 0.24 mm to 0.29 mm. There are 5.5 to 6 zooecia per 2 mm. Interspaces between zooecial tubes measure 0.08 mm to 0.11 mm. Vesicular tissue

regularly arranged, quadrilateral in longitudinal section and irregularly polygonal in tangential section. One or two rows of vesicles occur in interspaces between zooecial tubes. Lunarium moderately developed and occupying about one half of zooecial circumference. Thickness of lunarium about 0.03 mm. Diaphragms developed at intervals of one to two times of zooecial diameter.

Remarks:—The present form differs from the previously described species but specific discrimination must be reserved until a larger number of specimens accumulate.

Occurrence and horizon:—Kasamatsu (Reg. no. 9029-A), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Fistulipora sp. indet. C

Pl. 5, Figs. 4-6

Zoarium thin lamellate, its thickness about 2 mm or 3 mm. Zooecium oval in tangential section, its diameter (b-b′) 0.23 mm to 0.32 mm. There are 3 to 3.5 zooecia per 2 mm. Interspaces between zooecial tubes measure 0.16 mm to 0 32 mm. Vesicular tissue regularly arranged, quadrilateral in longitudinal section and irregularly pentagonal in tangential section. One to three rows of vesicles occur in interspaces between zooecial tubes. Lunarium very weak. Diaphragm at intervals of two to four times of zooecial diameter, usually 2 diaphragms in 2 mm of zooecial tube.

Remarks:—The present form differs from *Fistulipora iwaizakiensis* SAKAGAMI, n. sp. which occcurred from the h member of the Iwaizaki limestone by the larger diameter of zooecium and longer interval between diaphragms.

Occurrence and horizon:—The d member of the Iwaizaki limestone (Reg. nos. 5203-A, 5212-A, 5218-A), which belongs to the upper part of the *Parafusulina* zone.

Fistulipora sp. indet. D

Pl. 7, Figs. 4, 5

Form of zoarium unknown. Zooecium oval in tangential section, its longer diameter (a-a′) 0.35 mm to 0.40 mm, shorter diameter (b-b′) 0.24 mm to 0.32 mm and usually 4 zooecia per 2 mm. Interspaces between the zooecial tubes measure 0.19 mm to 0.40 mm, and filled by dense tissue instead of vesicular tissue which poorly developed. Lunarium occupying about one third of zooecial circumference. Thickness of lunarium about 0.05 mm. Diaphragms not observed.

Remarks:—This ill-preserved specimen is insufficient for species determination.

Occurrence and horizon:—The Kuzuu limestone (Reg. nos. 6203-B, 6207-A), which belongs to the lower part of the *Parafusulina* zone.

Fistulipora sp. indet. E

Pl. 6, Fig. 7

A single longitudinal section. Zooecicm lamellate and 3 mm to 3.5 mm thick. Diameter of zooecial tube 0.33 mm to 0.41 mm. Vesicular tissue irregularly arranged and fish-scale like in longitudinal section. Lunarium well developed and diaphragm lacking.

Remarks:—Irregularly arranged vesicular tissue, relatively larger zooecial diameter and absence of diaphragm are characters of this form, but the only one longitudinal section is insufficient for decision of species.

Occurrence and horizon:—The Omi limestone (Reg. no. 6515-A), which belongs to the lower part of the *Pseudoschwagerina* zone.

Family HEXAGONELLIDAE CROCKFORD, 1947

Genus *Meekopora* ULRICH, 1890

Type species:—*Meekopora eximia* ULRICH, 1890.

Diagnosis:—Flat narrow bifurcating to broad bifoliate fronds. Apertures circular to oblique, lunarium present but not indenting the cavity. Maculae prominent; interzooecial vesicular structure well developed. (BASSLER, 1953, p. G88).

Range:—Silurian to Permian.

Meekopora densa SAKAGAMI, n. sp.

Pl. 7, Figs. 6, 7

Zoarium bifoliate and laterally extended in sheet-like form, its thickness about 1.1 mm. Mesotheca apparently a closely jointed double layer. Zooecium tubular, proximally parallel to mesotheca, making large angle in mature region. Diameter of zooecial tube about 0.16 mm. Interspaces between zooecial tubes filled by vesicular tissue, which is roundly quadrilateral in longitudinal section, however, parts of near surface covered by dense tissue. Diaphragm generally lacking but one is seldom present in a zooecial tube.

Remarks:—The present form resembles *Meekopora prosseri* ULRICH which was reported from the upper Pennsylvanian to lower Permian of the United States of America in the general appearance. However, the present form differs distinctly from the American species by the thicker and dense tissue and in the generally thinner zoarium.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. nos. 5043-A (holotype), 5041-B), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Meekopora delicata SAKAGAMI, n. sp.

Pl. 8, Figs. 1, 2

Zoarium bifoliate and laterally extended in ribbon-like form, its thickness about 1.6 mm. Mesotheca apparently a closely joined double layer. Zooecial tube rather short, proximally parallel to mesotheca, making large angles in mature region and usually 4 per 2 mm. Length and diameter of tube 0.70 mm to 0.85 mm and 0.19 mm to 0.24 mm, respectively. Interspaces between zooecial tubes filled by vesicular tissue which is quadrilateral in longitudinal section from mesotheca to surface and 0.22 mm in average. Surface not covered by dense tissue. Diaphragms unobservable. Lunarium weakly developed or nearly absent.

Remarks:—The present form differs from *Meekopara densa* SAKAGAMI, n. sp. which occurred from the h member of the Iwaizaki limestone by the larger diameter of zooecial tube, mode of vesicular tissue and lack of dense tissue covering near the surface. The Iwaizaki specimen have larger diameter of zooecium than the Kamiyatsuse specimen. However, they are quite identical in the essential characters.

Occurrence and horizon:—The d member of the Iwaizaki limestone (Reg. no. 5223-A (holotype)), and Kamiyatsuse (Reg. no. 5540-A), which belong to the *Parafusulina* zone.

Genus *Prismopora* HALL, 1883

Type species:—*Prismopora triquetra* HALL, 1883.

Diagnosis:—Triangular bifurcating or trifurcating branches with zooecia arising from mesothecae, radiating from the center to the margins. (BASSLER, 1953, p. G88)

Range:—Devonian to Permian.

Prismopora deformis SAKAGAMI, n. sp.

Pl. 8, Figs. 3-6

Zoarium trifoliate, sharply triangular in transverse section. Three rays of mesotheca straight or somewhat curved, radially developed from center to edges. Two rays of them long and developed at about 130 to 140 degrees, and third ray is short and making about 60 to 80 degrees to one of longer rays. Zooecial tube short, proximally parallel to mesotheca, making rapidly large angle in mature region. Diameter of zooecium 0.14 mm to 0.16 mm. Vesicular tissue poorly developed in immature region. Interspaces between zooecial tube in mature region filled by dense fibrous tissue. Lunarium apparently developed, indistinct. Diaphragm lacking.

Remarks:—The present from can be distinguished from any described species in the genus. Recently, J. CROCKFORD (1957) described and illustrated

three species of *Prismopora* but two of them questionably belong to the genus from the Noonkanbah formation of the Fitzroy Basin, West Australia. They differ distinctly from the present form by the larger size of zoarium, and more delicate and complicate the inner structures.

Occurrence and horizon:—The Takauchi limestone of Kyoto (Reg. nos. 8101-D (holotype), 8135-C) and Kasamatsu of Kyushu (Reg. no. 9024-A), which belong to the *Lepidolina-Yabeina* zone.

Prismopora kuzuensis SAKAGAMI, n. sp.

Pl. 8, Figs. 7-9

Zoarium triradiate, sharply triangular with side slightly concave in transverse section. Three rays of mesotheca radially developed from center to edges, measuring 2.7 mm to 3.0 mm, 2.7 mm to 3.0 mm and 1.7 mm to 2.0 mm, respectively. Thickness from center to most concaved points 1.0 mm to 1.3 mm. Zooecium circular, its diameter 0.16 mm to 0.18 mm. Vesicular tissue irregular in its arrangement and form. Covered by thick, dense, fibrous tissue which is about 0.6 mm to 0.8 mm in thickness. Lunarium and diaphragm not observed.

Remarks:—The thick dense tissue and small zooecia are the important characters of this species.

Occurrence and horizon:—The Kuzuu limestone of Tochigi Prefecture (Reg. nos. 6210-A (holotype), 6202-A, 6202-B), which belongs to the *Parafusulina* zone.

Genus *Coscinotrypa* HALL and SIMPSON, 1887

Type species:—*Coscinium cribriforme* PROUT, 1859.

Diagnosis:—Flattened bifoliate branches, inosculating at short distances forming a broad frond with circular to elliptical fenestrules. (BASSLER, 1953, p. G87)

Range:—Ordovician to Permian.

Coscinotrypa minor SAKAGAMI, n. sp.

Pl. 8, Figs. 10-12; Pl. 9, Figs. 3-4

Surface represented by a fragment of a bifoliate leaf-like zoarium. Zoarium perforated at regular rows intersecting in diagonal direction. Three fenestrules in 10 mm of diagonal direction. Fenestrules circular or ellipsoidal in outline, about 1.0 mm wide and 1.8 mm long. Width of branch 1.2 mm to 1.3 mm. Branches occupied by zooecial tubes which are disposed usually at 7 rows.

In the section, zooecial tube proximally parallel to mesotheca, making large angles in mature region, and its diameter about 0.16 mm. Interspaces between zooecial tubes measure 0.4 mm to 0.6 mm and 8 apertures in 10 mm of one row. Vesicular tissue poorly developed in immature region, but covered

by dense layer in mature region. Lunarium very weak or not developed.

Remarks:—The skeleton of the described form is completely replaced by secondary mineralization. Therefore, the structure of the immature region can not be observed in detail. However, the present form can be easily distinguished from any previously described species by the smaller mesh work and smaller diameter of zooecial tube.

Occurrence and horizon:—The Omi limestone of Niigata Prefecture (Reg. nos. 6500-A (holotype), surface), 6508-A, 6509-A, 6509-B), which belongs to the lower part of the *Pseudoschwagerina* zone.

Coscinotrypa? sp. indet.

Pl. 9, Figs. 5, 6

A few oblique sections of fragments. Zoarium bifoliate a portion of both sides of zoarium seems to show margin of fenestrule. Near surface of zoarium covered by dense tissue. Vesicular tissue present, one or two rows of vecicles occur in interspaces between zooecial tubes. Diameter of zooecium about 0.16 mm to 0.18 mm. Lunarium poorly developed occupying about one third of zooecial circumference. Diaphragm lacking.

Remarks:—The present form may belong to the genus *Coscinotrypa*. The present form resembles *Coscinotrypa cyclops* (KEYSERLING) in the general characters, but differs in the diameter of zooecial tube. The present form differs from *Coscinotrypa minor* SAKAGAMI, n. sp. in the inner structures.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. nos. 5014-A, 5015-A, 5052-A), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Family GONIOCLADIIDAE NIKIFOROVA, 1938

Genus *Ramipora* TOULA, 1875

Type species:—*Ramipora hochstetteri* TOULA, 1875.

Diagnosis:—Like *Goniocladia* but zoarium dendroid, branches extended or short, ending bluntly. (BASSLER, 1953, p. G90)

Range:—Carboniferous to Permian.

Ramipora ambigua SAKAGAMI, n. sp.

Pl. 9, Figs. 1, 2

A single tangential section. Zoarium bifoliate, ramose and consists of a branch of the first order from which diverge alternate branches of second order. Width of branch of first order and second order 1.85 mm and 1.00 mm, respectively. Branch of second order very short, observed only as an evelation. Distance between branches of second order from center to center 3 mm to 3.5 mm. Zooecium tubular, spherical, forming acute angle in immature region,

making large angle in mature region. Length and diameter of zooecium about 1.04 mm and 0.18 mm, respectively. Thickness of zooecial wall about 0.01 mm. Diaphragm nearly absent but very rarely developed near proximal ends of zooecia. Lunarium not observed. Mesotheca apparently a closely jointed double layer, its thickness 0.046 mm to 0.063 mm. Vesicular tissue well developed from immature to mature regions.

Remarks:—The present form can be distinguished from *Ramiporella asimmetrica* which SHULGA-NESTERENKO reported from the Carboniferous (C_3) of Pechora Land by the more complicated form. The present form closely resembles *Ramipora ambrosoides* (BRETNALL) which CROCKFORD (1944) described and illustrated from Western Australia in the general appearance, but differs by the broader main branch.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. no. 5004-A (holotype)), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Genus *Goniocladia* ETHERIDGE, 1876

Type species:—*Carinella cellulifera* ETHERIDGE, 1873.

Diagnosis:—Zoarium reticulate, composed of angular bifoliate branches with zooecia opening on both sides of the median lamina which bisects the branch and projects as a keel on the front and a flat area on the back; fenestrules polygonal. (BASSLER, 1953, p. G89)

Range:—Mississippian to Permian.

Goniocladia intricata SAKAGAMI, n. sp.

Pl. 14, Fig. 3

Zoarium bifoliate, anastomosing. Fenestrules variable in size and form. Length and width 1.9 mm to 4.0 mm and 1.7 mm to 2.5 mm, respectively. Width of branch about 1.8 mm, Mesotheca consists of double layer. Length of zooecial tube about 0.9 mm and spherical or oval in tangential section, its diameter 0.18 mm to 0.22 mm. Lunarium poorly developed. Interspaces between zooecial tube filled by vesicular tissue which is quadrilateral in longitudinal section and pentagonal or hexagonal in tangential section.

Remarks:—The present form somewhat resembles *Goniocladia miloradovitschi* which SHULGA-NESTERENKO reported from the Permian (P_1) of Pechora Land. However, the present form can be distinguished from *G. miloradovitschi* by the larger diameter of zooecium, and more intricate vesicular tissue.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. no. 5033-A (holotype)), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Order TREPOSTOMATA ULRICH, 1882

Family BATOSTOMELLIDAE MILLER, 1889

Genus *Batostomella* ULRICH, 1882

Type species:—*Chaetetes gracilis* NICHOLSON, 1874.

Diagnosis:—Slender to thick smooth branches. Zooecia with thick walls more or less fused in mature region; diaphragms straight. Mesopores and acanthopores present.

Range:—Ordovician to Permian.

Batostomella yamazakii SAKAGAMI, n. sp.

Pl. 9, Figs. 7, 8; Pl. 10, Figs. 1-3

Zoarium slender branch-like, its diameter 2 mm to 2.8 mm. Zooecial tube oval in tangential section, its larger diameter 0.18 mm to 0.21 mm and shorter diameter 0.11 mm to 0.18 mm. There are 7 to 8 per 2 mm measuring longitudinally. Interspaces between zooecial tube near surface about 0.16 mm longitudinally. Mesopore rarely present, its diameter about 0.08 mm. Each point of intersection of zooecial wall with one acanthopore usually present. Diaphragms 3 to 5 in one zooecial tube.

Remarks:—The present form is similar to *Dyscritella cylindrica* (CROCKFORD) which was reported from the Ulladulla Mudstone of New South Wales, Australia under the generic name of *Batostomella* in its shorter mature zone of zooecia and the angle at which the zooecia bend to the mature zone. However, the present form is distinguished from the Australian species by the larger number of diaphragms. The present species is named after Mr. Hiroshi YAMAZAKI who was a student in our Department for his kind assistance in collecting and preparating the bryozoan specimens.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. nos. 5006-A (holotype), 5006-B, 5009-A, 5022-A and 5062-A), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Batostomella igoi SAKAGAMI, n. sp.

Pl. 10, Figs. 5-9; Pl. 11, Figs. 5, 6

Zoarium ramose, its diameter 2.4 mm to 4 mm. Zooecial tube in tangential section oval, its larger diameter 0.19 mm to 0.22 mm and smaller diameter 0.13 mm to 0.18 mm. There are 7 to 8 per 2 mm measuring longitudinally. Interspaces between zooecial tube near surface 0.14 mm to 0.22 mm longitudinally. Mesopore present, its maximum diameter 0.10 mm. Acanthopore numerous. Diaphragms 3 to 5 in a zooecial tube.

Remarks:—The present form resembles *Batostomella spinigera* which BASSLER reported from Timor in the diameter of zoarium and number of acantho-

Table 2. Determination of the Genera *Batostomella* and *Dyscritella*.

Species	Localities	Diameter of zoarium (in mm)	Diameter of zooecium (in mm)		No. of zooecia in 2 mm longitudinally	Interspace between zooecial tubes (in mm)	Diameter of mesopore (in mm)	No. of diaphragms in a zooecial tube
			longer	shorter				
B. yamazakii SAKAGAMI, n. sp.	Iwaizaki (h)	2. 0-2. 8	0. 18-0. 21	0. 11-0. 18	7-8	0. 16	0. 08	3. 5
B. igoi SAKAGAMI, n. sp.	Iwaizaki (h)	2. 4-4. 0	0. 21	0. 13-0. 18	7-8	0. 14-0. 22	0. 10	3. 5
B. microstoma SAKAGAMI, n. sp.	Iwaizaki (h)	1. 9	0. 14-0. 16	0. 14-0. 16	7	0. 08-0. 12	0. 10	very rare
B. spinigera BASSLER	Iwaizaki (d)	2. 8-3. 0	0. 33-0. 41	0. 17-0. 22	4-6	0. 11-0. 15	0. 80-0. 11	1-2
B. sp. indet.	Kamiyatsuse	1. 6-1. 7	?	0. 16-0. 19	4. 5	0. 08-0. 13	0. 03-0. 06	very rare
D. iwaizakiensis SAKAGAMI, n. sp.	Iwaizaki (h)	2. 4-2. 8	0. 21-0. 24	0. 14-0. 19	7-8	0. 08-0. 20	0. 10	no
D. cylindrica CROCKFORD ?	Iwaizaki (h)	2. 2	0. 21	?	6	?	0. 03-0. 10	no
D. takauchiensis SAKAGAMI, n. sp.	Takauchi	1. 3-1. 7	0. 21-0. 29	0. 16-0. 21	4	0. 05-0. 10	0. 04-0. 08	no
D. sp. indet.	Kawahigashi	1. 0	0. 10	?	?	?	?	no

pore. The diaphragms of the present form develop only in the immature region of the zooecial tube, but those of BASSLER's species develop in the mature and immature regions. The present form can be distinguished from *Batostomella yamazakii* SAKAGAMI, n. sp. by the larger diameter of zoarium and larger number of mesopores and acanthopores.

The specific name is dedicated to Dr. Hisayoshi IGO of the Tokyo University of Education, who helped me in many ways.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. nos. 5093-C (holotype), 5008-A, 5058-B, 5060-A, 5075-B, 5092-A), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Batostomella microstoma SAKAGAMI, n. sp.

Pl. 10, Fig. 4

A single longitudinal section. Zoarium ramose, its maximum diameter about 1.9 mm. Zooecial tube in tangential section about 0.21 mm. There are 7 per 2 mm measured longitudinally. Interspaces between zooecial tube near surface 0.075 mm to 0.12 mm longitudinally. Mesopore can seldom be observed, its maximum diameter about 0.10 mm. Acanthopore numerous. Diaphragm very rare.

Remarks:—The present form resembles *Batostomella spinigera* BASSLER, but differs by the smaller diameter of zooecial tube.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. no. 5071-A (holotype)), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Batostomella spinigera BASSLER

Pl. 12, Figs. 3-6

1929. *Batosotmella spinigera* BASSLER, Paläont. Timor, xvi Leif., xxviii, pp. 61, 62, pl. CCXXXVI (12), figs. 6-11.

?1957. *Dyscritella spinigera* CROCKFORD, Commonwealth of Aust. Dept. Nat. Dev., Bull. 34, p. 51.

Zoarium attached to foreign substance such as pebble, lamellate in form, making slender cylindrical stem. Zoarial diameter 2.8 mm to 3.0 mm. Zooecial tube ellipsoidal in tangential section, becoming more elongate near surface. Larger diameter of zooecium 0.26 mm to 0.29 mm, but 0.33 mm to 0.41 mm at near surface, and shorter diameter 0.17 mm to 0.22 mm. Four to six zooecia disposed in 2 mm measuring longitudinally. Interspaces between zooecial tubes near surface 0.11 mm to 0.15 mm longitudinally. Mesopores commonly occur, its diameter about 0.08 mm to 0.11 mm. In each point of intersection of zooecial wall one acanthopore usually present. One or two diaphragms seldom occur in one tube.

Remarks:—The present form agrees with BASSLER's original specimens

which occurred from the Island of Rotti in its essential characters. CROCKFORD (1957) described without illustration this species under the genus name of *Dyscritella*. However, this species belongs to the genus *Batostomella* by the apparent existence of diaphragms in the original specimen. CROCKFORD (1957, p. 86) also stated that *Orbipora ambiensis* WAAGEN and WENTZEL which was reported from the Lower *Productus* limestone may be identical with *Dyscritella spinigera* BASSLER. However, the writer's opinion is that *Orbipora ambiensis* belongs to the genus *Dyscritella* and is not identical with *Batostomella spinigera*.

Occurrence and horizon:—The d member of the Iwaizaki limestone (Reg. nos. 5203-B, 5204-A, 5206-A), which belongs to the *Parafusulina* zone.

Batostomella sp. indet.

Pl. 12, Figs. 7, 8

Only two sections, tangential and transverse. Zoarium ramose, its diameter 1.6 mm to 1.7 mm. Zooecial tube oval, its diameter 0.16 mm to 0.19 mm near surface and 0.11 mm to 0.14 mm at immature region, and 4.5 in 2 mm measuring longitudinally. Interspaces between zooecial tube near surface 0.08 mm to 0.13 mm longitudinally. Mature region characterized by thickened wall seems to occupy greater part of zooecial length. Mesopore and acanthopore irregularly present. Diaphragm seldom occurs.

Remarks:—The present species characterized by the thickened wall can be distinguished from the previously described species by the above stated features.

Occurrence and horizon:—Kamiyatsuse, Miyagi Prefecture (Reg. nos. 5524-A, 5528-A), which belongs to the *Parafusulina* zone.

Family STENOPORIDAE WAAGEN and WENTZEL, 1886

Genus *Dyscritella* GIRTY, 1911

Type species:—*Dyscritella robusta* GIRTY, 1911.

Diagnosis:—Like ramose *Leiolema* but zooecia thick-walled, lacking diaphragms. (BASSLER, 1953, p. G102)

Range:—Mississippian to Permian.

Dyscritella iwaizakiensis SAKAGAMI, n. sp.

Pl. 11, Figs. 1-4; Pl. 12, Figs. 1, 2; Pl. 13, Figs. 1, 2

Zoarium slender and ramose, its diameter 2.4 mm to 2.8 mm. Zooecial aperture oval and its longer diameter 0.21 mm to 0.24 mm and shorter diameter 0.14 mm to 0.19 mm. There are 7 to 8 per 2 mm measuring longitudinally. Interspaces between zooecial tubes near surface 0.08 mm to 0.20 mm longitudinally. Mesopore relatively numerous and its maximum diameter about 0.10

mm. In each point of intersection of zooecial wall one acanthopore is usually present. Diaphragm lacking.

Remarks:—The present form is not unlike *Dyscritella tenuirama* CROCKFORD in the general features, but differs in the size of zoarium and number of mesopores. Zoarial diameter of the present form is 2.4 mm to 2.8 mm instead of 1.5 mm to 1.8 mm (occasionally to 2.4 mm) as in *Dyscritella tenuirama* and the number of mesopores are more numerous than in *D. tenuirama*.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. nos. 5057-A (holotppe), 5056-A, 5057-B, 5057-C), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Dyscritella cylindrica (CROCKFORD)?

Pl. 13, Fig. 3

1941. *Batostomella cylindrica* CROCKFORD, Jour. Proc. Royal Soc. New South Wales, Vol. LXXIV, pp. 504, 505, pl. 20, fig. 1, text-fig. 1.

A single longitudinal section. Zoarium ramose, its diameter 2.2 mm. Zooecial tube spherical or oval in tangential section, its diameter about 0.21 mm. There are 6 per 2 mm measured longitudinally. Zooecial tubes bend rather sharply from immature to mature region. Mesopore rather few in number. In each point of intersection of zooecial wall one acanthopore is usually present. Zooecial wall in immature region is very thin. Diaphragm lacking.

Remarks:—The present form seems to be quite identical with *Dyscritella cylindrica* (CROCKFORD) which was reported from the Ulladulla mudstone of Ulladulla, New South Wales, Eastern Australia and illustrated by the text figure of camera lucida diagrams in the general appearance, especially, in the very thin wall of the immature region and the angle at which the zooecia bend to the mature zone. The difference between the present form and the Australian type specimen is only in that the diaphragms are not shown entirely in the present form but rarely developed in the mature region of the type specimen.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. no. 5048-B), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Dyscritella takauchiensis SAKAGAMI, n. sp.

Pl. 13, Figs. 4-11; Pl. 14, Fig. 5

Zoarium slender and ramose, its diameter 1.3 mm to 1.7 mm. Zooecial tube in tangential section oval and its diameter 0.16 mm to 0.21 mm. Interspaces between zooecial tubes near surface 0.05 mm to 0.10 mm. Tubes bend gradually from immature to mature region. Immature region of tube very short. In each point of intersection of zooecial wall one acanthopore is usually present. Diameter of acanthopore 0.064 mm to 0.090 mm. No diaphragm is shown in zooecial tube.

Remarks:—The present form differs from *Dyscritella iwaizakiensis* SAKAGAMI, n. sp. which occurred from the h member of the Iwaizaki limestone in the shorter diameter of zoarium and shorter immature region of tube.

Occurrence and horizon:—The Takauchi limestone (Reg. nos. 8112-A (holotype), 8105-A, 8110-B, 8111-A, 8130-B, 8137-A), and Kawahigashi (Reg. no. 8010-B), which belong to the *Lepidolina-Yabeina* zone.

Dyscritella sp. indet.

Pl. 13, Fig. 12

A single longitudinal section. Diameter of zoarium about 1 mm and the zooecium about 0.10 mm.

The present form is replaced by secondary mineralization and the inner structure can not be determined with certainty.

Occurrence and horizon:—The Kawahigashi (Reg. no. 8012-B), which belongs to the *Lepidolina-Yabeina* zone.

Genus *Stenopora* LONSDALE, 1844

Type species:—*Stenopora tasmaniensis* LONSDALE, 1844.

Diagnosis:—Ramose or massive. Zooecia thick walled, with well-developed monilae; without diaphragms. A megacanthopore on distal side of each zooecial tube and many micracanthopores between tubes, mostly at zooecial angles; mesopores lacking. (BASSLER, 1953, p. G101)

Range:—Mississippian to Permian.

Stenopora sp. indet. A

Pl. 14, Figs. 1, 2

Zoarium slender cylindrical, its diameter 2.6 mm to 2.7 mm. Zooecial tube oval in tangential section, 0.16 mm to 0.18 mm in diameter. Interspaces between the zooecial tubes measure 0.07 mm to 0.16 mm longitudinally. Monilae well developed in mature region of wall. Acanthopores seem to be numerous but are uncertain in arrangement.

Remarks:—The present form is not unlike *Stenopora* sp. which YANG (1958) reported from the Chinghsichung limestone (=Maokou limestone, Upper Permian) in the general appearance, but differs in the diameter of zoarium. The present form may be a new species, however, the specific name must wait until a larger number of well-preserved specimens accumulate.

Occurrence and horizon:—The Kuzuu limestone (Reg. nos. 6208-B, 6208-C), which belongs to the lower part of the *Parafusulina* zone.

Stenopora sp. indet. B

Pl. 14, Fig. 4

A single oblique section. Zoarium attached with *Sulcoretepora* sp.. Zooecium tubular, its length and diameter about 1 mm and 0.14 mm, respectively. Mesopore commonly present, its diameter about 0.064 mm. Numerous acanthopores irregularly disposed. Monilae developed in the mature region of wall.

Occurrence and horizon:—The Kuzuu limestone (Reg. no. 6207-C), which belongs to the lower part of the *Parafusulina* zone.

Genus *Leioclema* ULRICH, 1882

Type species:—*Callopora punctata* HALL, 1858.

Diagnosis:—Incrusting, ramose, or massive. Zooecia without beaded walls; apertures petaloid; diaphragms complete. Mesopores tabulate; megacanthopores common. (BASSLER, 1953, p. G103)

Range:—Ordovician to Permian.

Leioclema globosa CROCKFORD

Pl. 15, Fig. 2

1957. *Lioclema globosa* CROCKFORD, Commonwealth of Aust. Dept. Nat. Dev. Bull. 34, p. 55, pl. 14, figs. 2-4.

A single longitudinal section. Zoarium incrusting and attaching to brachiopod or pelecypod shells. Zooecium spherical in tangential section, its maximum diameter measures 0.30 mm and 0.28 mm in average. Longest part of zooecial tube measures 3.3 mm. In each point of intersection of zooecial wall one acanthopore is usually present. Diaphragms numerous and very closely spaced in zooecial tube, and 12 to 16 occur in each zooecial tube. They are thin, complete, and straight or slightly concave.

Remarks:—The present form well agrees with *Leioclema globosa* which CROCKFORD (1957) described from the Nura Nura member of the Poole Sandstone in the general features.

Occurrence and horizon:—Kamiyatsuse (Reg. no. 5544-A), which belongs to the *Parafusulina* zone.

Genus *Coeloclemis* GIRTY, 1911

Type species:—*Coeloclemis tumida* GIRTY, 1911.

Diagnosis:—Hollow epithecate stems. Like *Anisotrypa* but lacks diaphragms and has acanthopores. (BASSLER, 1953, p. G102)

Range:—Mississippian to Permian.

Coeloclemis minima SAKAGAMI, n. sp.

Pl. 14, Figs. 6, 7

Zoarium thin, lamellate, 1 mm to 1.3 mm in thickness. Zooecial tube relatively short, its length and width 1 mm to 1.3 mm and 0.18 mm to 0.21 mm, respectively. Zooecial wall thin in immature region, but thickened in mature

region. Monilae well developed in mature region of wall. Mesopore commonly developed, about 0.10 mm in diameter. Acanthopores can be divided distinctly into megacanthopores and micracanthopores; one megacanthopore usually present in each point of intersection of zooecial wall, micracanthopores irregularly disposed. Diaphragm lacking.

Remarks:—*Coeloclemis* was established as a subgenus by GIRTY in 1911, and later BASSLER (1941) to raised it to generic rank. The present form can be distinguished from the type species *C. tumida* GIRTY which was reported from the Fayetteville Shale of Arkansas, United States of America by the smaller size of zooecial diameter and existence of monilae. This may be a first discovery of a Permian *Coeloclemis*.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. nos. 5089-A (holotype), 5074-B), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Genus *Tabulipora* YOUNG, 1883

Type species:—*Tabulipora scotica* LEE, 1912.

Diagnosis:—Like *Stenopora* but has centrally perforate diaphragms. (BASSLER, 1953, p. G105)

Range:—Carboniferous to Permian.

Tabulipora cf. *maculosa* NIKIFOROVA

Pl. 15, Figs. 5, 6

1938. *Tabulipora maculosa* NIKIFOROVA, Paleont. USSR, Vol. IV, Part 5, Fasc. 1, pp. 52-54, 220-221, pl. IV, figs. 1-3, pl. V, figs. 1-6.
1955. *Tabulipora maculosa* SHULGA-NESTERENKO, Trudy Paleont. Inst., Akad. Nauk SSSR, Tom. LVII, p. 88, pl. 1, fig. 1.
1955. *Tabulipora maculosa* MOROZOVA, Trudy Paleont. Inst., Akad. Nauk SSSR, Tom. LVIII, pp. 19, 20.

Zoarium a cylindrical stem about 7 mm in diameter. In tangential section, zooecium polygonal in immature region, circular or oval in mature region, its diameter varies from 0.19 mm to 0.30 mm and about 6 zooecia per 2 mm measured in any direction. In longitudinal section, zooecial tubes gradually curving from the center to periphery. Zooecial wall thin in immature region, about 0.014 mm in thickness, becoming thick in mature region, varies from 0.08 mm to 0.14 mm. Thick walls in mature region rather short, and show weak monilae. Mesopore commonly observed, varies from 0.05 mm to 0.11 mm in diameter. One megacanthopore usually present in each point of intersection of zooecial walls and a few micracanthopores disposed in one row in each interspace of megacanthopore. Two kinds of diaphragms—one thicker and unilaterally perforated, and other very thin, platy and centrally perforated. Diaphragms more numerous in mature region than in immature region.

Remarks:—The present form agrees with *Tabulipora maculosa* NIKIFOROVA.

which was reported from the upper Carboniferous of U. S. S. R. in the general appearance, except for the slightly smaller size of zoarial diameter in the present form.

Occurrence and horizon:—The Omi limestone (Reg. nos. 6505-A, 6506-A), which belongs to the lower part of the *Pseudoschwagerina* zone.

Tabulipora? sp. indet.

Pl. 15, Fig. 1

A single ill-preserved section. Form of zoarium is unknown with certainty. Diameter of zooecium 0.24 mm to 0.32 mm, usually 5 in 2 mm and interspaces between zooecia 0.11 mm to 0.19 mm. One mesopore usually present in each point of intersection of zooecial wall. Acanthopores numerous and uniform in size, about 0.02 mm in diameter. A few perforated diaphragms developed.

Remarks:—The present form may be referable to the genus *Tabulipora*, however, the specific name must wait until a larger number of specimens accumulate.

Occurrence and horizon:—Kamiyatsuse (Reg. no. 5508-A), which belongs to the *Parafusulina* zone.

Order CRYPTOSTOMATA VINE, 1883

Family FENESTELLIDAE KING, 1850

Genus *Fenestella* LONSDALE, 1839

Type species:—*Fenestella subantiqua* D'ORBIGNY, 1849

Diagnosis:—Zoarium funnel- or fan-shaped. Zooecia in 2 rows on each branch with 2 to 8 apertures in a single row adjoining one fenestrule. Front of branches with or without median keel and acanthopore spines present or absent. (BASSLER, 1953, p. G120)

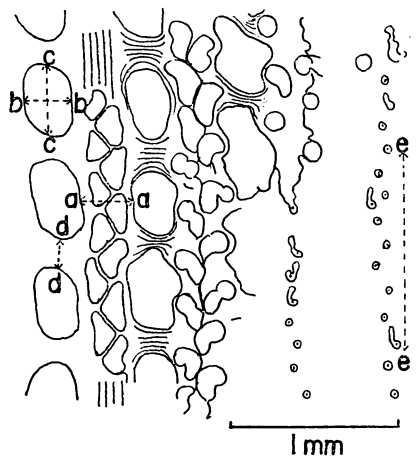
Range:—Ordovician to Permian.

Fenestella (*Minilya*) *rhomboidea* NIKIFOROVA

Pl. 16, Fig. 1, 2

1938. *Fenestella rhomboidea* NIKIFOROVA, Paleont. USSR, Vol. IV, Part 5, Fasc. 1, pp. 90-92, pl. 13, figs. 5-7, text figs. 59-61.

Zoarium fan-shaped, consists of straight branches connected by dissepiments at regular intervals. Branch 0.30 mm to 0.32 mm in width and 16 to 18 in 10 mm horizontally. Width of dissepiment 0.16 mm to 0.19 mm. Fenestrule ellipsoidal or rectangular with rounded corners in outline, its width and length 0.24 mm to 0.30 mm and 0.45 mm to 0.48 mm, respectively. Number of fenestrules 18 to 19 in 10 mm vertically. Zooecial apertures 18 to 19 in 5 mm length of one row, usually 2 apertures per fenestrule; sharply triangular at middle level of branch and circular at upper level. Zooecial tube bending outward.



Text figure 4. *Fenestella* (*Minilya*) *rhomboidea* NIKIFOROVA. Tangential section, holotype (Reg. no. 5201). a-a: Width of branch, b-b: Width of fenestrule, c-c: Length of fenestrule, d-d: Width of dissepiment, e-e: Nodes in 5 mm of length of branch.

Meshwork formula:—16-18/18-19//18-19/35?*

Remarks:—The present form has not been found free, but the well preserved and oriented section is sufficient for study. The present form well agrees with *Fenestella rhomboidea* which NIKIFOROVA reported from the zone of *Pseudofusulina anderssoni* (Chernaiarechka zone) at Kazarmennyi Kamen of U. S. S. R. (by ELIAS and CONDRA, 1957) in the general appearance. The present form differs from *Fenestella* (*Minilya*) *duplaris* CROCKFORD which was reported from the Western Australia in the width of branch, number of fenestrules in 10 mm and number of zooecia in 10 mm.

Occurrence and horizon:—The d member of the Iwaizaki limestone (Reg. no. 5201), which belongs to the upper part of the *Parafusulina* zone.

Fenestella nomatae SAKAGAMI, n. sp.

Pl. 15, Fig. 3

Zoarium consists of straight branches connected by dissepiment at regular intervals. Width of branch 0.24 mm to 0.26 mm, and 20 to 22 in 10 mm horizontally. Fenestrules elliptical in outline, its width and length 0.29 mm to 0.32 mm and 0.40 mm to 0.45 mm, respectively, and 16 to 17 in 10 mm length of branch. Width of dissepiment 0.13 mm to 0.18 mm. Zooecial aperture 16 to 17 in 5 mm length of one row, usually 2 apertures per fenestrule and triangular with rounded corners at lower level of branch, but becomes irregularly rectangular or bean-shaped at middle level of branch. Zooecial tube bending outward.

Meshwork formula:—20-22/16-17//16-17/?

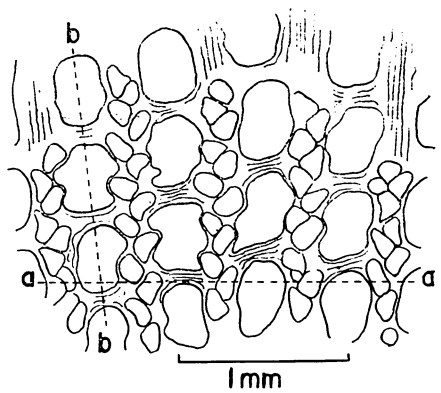
Remarks:—The present form has not been found free and the description is from only thin sections. Recently, ELIAS and CONDRA (1957) published a key to the Pennsylvanian-Permian sections and groups of *Fenestella*, and the list of groups of *Fenestella* and of their species. The present form may be included in their Group XII, and is nearest to *Fenestella parviuscula* BASSLER

* 16-18: branches in 10 mm of width of zoarium, 18-19: fenestrules in 10 mm of length of zoarium, 18-19: zooecia in 5 mm of length of branch, 35?: nodes in 5 mm of length of branch.

which is a synonym of *F. horologia* BRETNALL by CROCKFORD (1957) from the Bitauni and Basleo beds of Timor in the meshwork formula. However, the present form differs from *F. parviuscula* in the micrometric measurements.

The present species is named after Miss. Keiko NOMATA who was a student of our University for her kind assistance in collecting the bryozoan specimens.

Occurrence and horizon:—The Takauchi limestone (Reg. no. 8125-A (holotype)), which belongs to the *Lepidolina-Yabeina* zone.



Text figure 5. *Fenestella nomatae* SAKAGAMI, n. sp., Tangential section, holotype (Reg. no. 8125-A). a-a: Branches in 10 mm of width of zoarium, b-b: Fenestrules in 10 mm of length of zoarium.

Fenestella cf. *retiformis* (SCHLOTHEIM)

Pl. 17, Figs. 1-3

1926. *Fenestella retiformis* LIKHAREV, Bull. Com. Géol., Leningrad, Vol. 43 (for 1924), pp. 1012-1027, pl. 14, figs. 1-5, 7, 8, 10, pl. 15, figs. 2-4, 6, text-figs. 1-3.
1936. *Fenestella retiformis* SHULGA-NESTERENKO, Akad. Nauk, USSR., Poliarnaia Komissiia, Trudy, Vol. 28, pp. 240, 271.

Zoarium about 40 mm to 50 mm wide and 15 mm to 20 mm long, and probably fan-shaped but lacks proximal part. Branches averages as wide as to slightly less than fenestrules. Width of branch 0.30 mm in average and 17 to 18 in 10 mm horizontally. Fenestrules elliptical in outline, its width and length 0.36 mm to 0.45 mm and 0.40 mm to 0.69 mm, respectively, and 15 to 16 in 10 mm length of branch. Width of dissepiment 0.30 mm to 0.45 mm. Zooecial aperture 22 to 23 in 5 mm length of one row, usually 3 apertures per fenestrule and sharply pentagonal to triangular at middle level of branch.

Meshwork formula:—17-18/15-16//22-23/?

Remarks:—The present form agrees with *Fenestella retiformis* (SCHLOTHEIM) which was reported from the upper Permian of U. S. S. R. in the essential characters. However, the slight differences between the present form and the Russian specimens in the number of zooecial aperture in 5 mm length of one row are recognized.

Occurrence and horizon:—Kamiyatsuse (Reg. nos. S2-A, S1-A), which belongs to the *Parafusulina* zone.

Fenestella sp. indet. A

Pl. 15, Fig. 4

The form of zoarium is unknown owing to the fragmentary condition of the material. Width of branch very narrow, 0.16 mm in average and probably 25 to 27 in 10 mm horizontally. Fenestrule elongate rectangular with rounded corners in outline and its width and length about 0.22 mm and 0.50 mm to 0.70 mm, respectively. Number of fenestrules about 12 in 10 mm length of branch. Width of dissepiment 0.13 mm in average. Zooecial tube probably about 11 in 5 mm length of one row, usually 2 apertures per fenestrule and elongated trapezoidal at lower to middle level of branch.

Meshwork formula:—25-27/12?//11?/?

Remarks:—The present form is represented by a single tangential section of a small fragment insufficient for decision of the species. Zooecial tube elongated trapezoidal in tangential section and the very narrow width of the branch are its essential characters.

Occurrence and horizon:—The Kawahigashi limestone (Reg. no. 8010-C), which belongs to the *Lepidolina-Yabeina* zone.

Fenestella sp. indet. B

Pl. 17, Figs. 4, 5

The form of zoarium is unknown but probably was fan-shaped. Width of branch 0.21 mm to 0.22 mm and 20 to 24 in 10 mm horizontally. Fenestrules elliptical in outline, its width and length 0.21 mm to 0.35 mm and 0.50 mm to 0.70 mm, respectively, and 13 to 15 in 10 mm length of branch. Width of dissepiment 0.11 mm to 0.16 mm. Zooecial tube 16 to 18 in 5 mm length of one row, usually 3 apertures per fenestrule and trapezoidal at lower level of branch, but it shows bean-like shape at the upper level.

Meshwork formula:—20-24/13-15//16-18/?

Remarks:—The present form may be included in the Group V (group of *Fenestella retiformis* SCHLOTHEIM) of ELIAS and CONDRA (1957), however, there is found no similarity with any species in that group. The present form may be a new species, however, the specific name must wait until more well-preserved specimens accumulate.

Occurrence and horizon:—The Kawahigashi limestone (Reg. nos. 8013-C, 8015-A, 8022-B), which belongs to the *Lepidolina-Yabeina* zone.

Fenestella sp. indet. C

Pl. 16, Figs. 3-5

Zoarium consists of straight branches connected by dissepiment at regular intervals. Width of branch 0.24 mm to 0.27 mm and 24 to 28 in 10 mm horizontally. Fenestrules ellipsoidal, somewhat elongated in outline, its width and

Table 3. Determination of the Genus *Fenestella*.

Species	Localities	Branches in 10 mm of zoarium	Fenestrules in 10 mm of zoarium	zooecia in 5 mm of branch	Nodes in 5 mm of branch	Section of zooecium	Width of branch (in mm)	Width of fenestrule (in mm)	Length of fenestrule (in mm)	Width of disspiment (in mm)	Diameter of zooecial aperture (in mm)	Distance between zooecial apertures (in mm)	Diameter of node (in mm)	Distance between nodes (in mm)	Number of zooecia per fenestrule
F. (*M.*) *rhomboidea* NIKIFOROVA	Iwaizaki (d)	16–18	18–19	18–19	35?	triangular	0. 30–0. 32	0. 24–0. 30	0. 45–0. 48	0. 16–0. 19	0. 08–0. 10	0. 13–0. 16	0. 032	0. 14	2
F. nomatae SAKAGAMI, n. sp.	Takauchi	20–22	16–17	16–17	?	triangular	0. 24–0. 26	0. 29–0. 32	0. 40–0. 45	0. 13–0. 18	—	—	—	—	2
F. cf. *retiformis* (SCHLOTHEIM)	Kamiyatsuse	17–18	15–16	22–23	?	sharply pentagonal to triangular	0. 32–0. 38	0. 36–0. 46	0. 40–0. 69	0. 13–0. 21	0. 08–0. 10	0. 10–0. 13	—	—	3
F. sp. indet. A	Kawahigashi	25–27	12?	11?	?	trapezoidal	0. 16	0. 22	0. 50–0. 71	0. 13	—	—	—	—	2
F. sp. indet. B	Kawahigashi	20–24	13–15	16–18	?	trapezoidal at lower level, bean-like shaped at upper level	0. 21–0. 22	0. 21–0. 35	0. 50–0. 71	0. 11–0. 16	—	—	—	—	3
F. sp. indet. C	Takauchi	24–28	14–17	20–22	?	triangular or pentagonal	0. 24–0. 27	0. 16–0. 24	0. 33–0. 51	0. 18–0. 26	—	—	—	—	2. 5–3

Table 4. Determination of the Genus *Polypora*.

Species	Localities	Branches in 10 mm of zoarium	Fenestrules in 10 mm of zoarium	Zooecia in 5 mm of branch	Number of row of zooecia	Section of zooecium	Width of branch (in mm)	Width of fenestrule	Length of fenestrule (in mm)	Width of dissepiment (in mm)	Diameter of zooecial aperture (in mm)	Distance between zooecial apertures (in mm)	Shape of aperture	Number of zooecia per fenestrule
P. fujimotoi SAKAGAMI, n. sp.	Kamiyatsuse	10–14	6–11	13–16	5	rhomboidal or irregularly hexagonal	0. 65–0. 70	0. 34–0. 38	0. 54–1. 21	0. 24–0. 39	0. 10–0. 11	0. 18–0. 27	oval	3
P. hataii SAKAGAMI, n. sp.	Kamiyatsuse	10–12	3. 5–4	12	5	elongated rhomboidal	0. 60–0. 70	0. 38–0. 49	1. 70–2. 50	0. 38–0. 49	0. 10	0. 33	oval	6
P. endoi SAKAGAMI, n. sp.	Kamiyatsuse	8–11	8–10	14–15	6	rhomboidal with rounded corners	0. 81	0. 57	0. 72	0. 55–0. 85	0. 10	0. 13–0. 24	oval	3
P. sugiyamae SAKAGAMI, n. sp.	Kamiyatsuse	5–6	3	13–15	7–8	rhomboidal	1. 02–1. 70	0. 59–0. 94	2. 10–3. 10	0. 60–1. 10	0. 08–0. 10	0. 16–0. 18	oval	7–8
P. toyokoae SAKAGAMI, n. sp.	Kamiyatsuse	5–6	5	10–11	5–6	rhomboidal	0. 81–1. 12	0. 70–1. 00	1. 06–1. 60	0. 69–0. 80	0. 10	0. 16–0. 24	oval	4
P. cf. *kutorgae* STUCKENBERG	Takauchi	6–7	4	12	4	oval	0. 80–1. 00	0. 60–0. 90	1. 50–2. 20	0. 56	0. 15–0. 18	—	oval	6
P. longifenestrula SAKAGAMI, n. sp.	Takauchi	5–6	2?	13	6–7	rhomboidal	1. 10	0. 66–0. 93	3. 50–4. 50	0. 26–0. 46	—	—	oval	numerous
P. elongata SAKAGAMI, n. sp.	Takauchi	7–8	3	13	4	oval to rhomboidal	0. 56–0. 70	0. 56–0. 64	2. 50–3. 00	0. 32–0. 48	0. 15	—	oval	numerous
P. sp. indet. A	Kawahigashi	9–10	4–5	10	3	elongated rhomboidal	0. 56–0. 64	0. 48–0. 64	1. 80	0. 41	—	—	?	5–6
P. sp. indet. B	Kawahigashi	8	5	15	4–5	rhomboidal	0. 70–0. 81	0. 74	1. 80	0. 37	—	—	?	5–6

length 0.16 mm to 0.24 mm and 0.33 mm to 0.51 mm, respectively, and 14 to 17 in 10 mm length of branch. Width of dissepiment 0.18 mm to 0.26 mm. Zooecial aperture 20 to 22 in 5 mm length of one row, usually 2.5 to 3 apertures per fenestrule and rounded triangular or pentagonal, but occasionally oval or bean-shaped in tangential section.

Meshwork formula:—24-28/14-17//20-22/?

Remarks:—The present form somewhat resembles *Fenestella retiformis* (SCHLOTHEIM) in the general appearance, however, it differs in the meshwork formula.

Occurrence and horizon:—The Takauchi limestone (Reg. nos. 8016-B, 8107-A, 8114-A), which belongs to the *Lepidolina-Yabeina* zone.

Genus *Polypora* M'COY, 1844

Type species:—*Polypora dendroides* M'COY, 1844

Diagnosis:—Like *Fenestella* but has 3 to 8 rows of zooecia on each branch; median keel absent but may be represented by row of nodes. (BASSLER, 1953, p. G125)

Range:—Ordovician to Permian.

Polypora fujimotoi SAKAGAMI, n. sp.

Pl. 19, Figs. 1-6; Pl. 20, Fig. 1

Form of zoarium unknown. Branches nearly straight, about 0.70 mm in width, and 10 to 14 in 10 mm horizontally. Fenestrules elliptical or elongated rectangular with rounded corners in outline, its width and length 0.34 mm to 0.38 mm and 0.54 mm to 1.25 mm, respectively. Number of fenestrules 6 to 11 in 10 mm vertically. Width of dissepiment 0.24 mm to 0.39 mm. Zooecial apertures arranged in alternating longitudinal series, 5 rows on each branch and project into fenestrules, with well developed peristomes; 13 to 16 apertures in 5 mm of one row and usually 3 apertures per fenestrule. Zooecial aperture oval in shape and its diameter 0.10 mm to 0.11 mm. Distance between apertures measured along longitudinal row about 0.18 mm to 0.27 mm. Zooecial tube rhomboidal or irregularly hexagonal in shape in tangential section.

Meshwork formula:—10-14/6-11//13-16/5*

Remarks:—The present form somewhat resembles *Polypora fovea* CROCKFORD which was reported from the Noonkanbah Series of Western Australia in the measurements, but differs in the appearance of celluliferous surface.

The present species is named in honour of Professor Haruyoshi FUJIMOTO of the Yamagata University for his kind guidance and encouragement.

Occurrence and horizon:—Kamiyatsuse (Reg. nos. S-2A (holotype), S-2B,

* 10-14: branches in 10 mm of width of zoarium, 7-11: fenestrules in 10 mm of length of zoarium, 13-16: zooecia in 5 mm of length of branch, 5: number of rows of zooecia.

S-7, S-16 and S-32), which belongs to the *Parafusulina* zone.

Polypora hataii SAKAGAMI, n. sp.

Pl. 20, Fig. 2

Form of zoarium unknown. Branches nearly straight, 0.60 mm to 0.70 mm in width and 10 to 12 in 10 mm horizontally. Fenestrule elongated rectangular with rounded corners in outline, its width and length 0.38 mm to 0.49 mm and 1.70 mm to 2.50 mm, respectively. Number of fenestrules 3.5 to 4 in 10 mm, vertically. Width of dissepiment 0.38 mm to 0.49 mm. Zooecial apertures arranged in alternating longitudinal series and 5 rows on each branch; 12 in 5 mm of one row and usually 6 apertures per fenestrule. Zooecial aperture oval in shape and its diameter about 0.10 mm. Distance between apertures measured along longitudinal row about 0.33 mm. In tangential section, zooecial tube elongatedly rhomboidal in shape.

Meshwork formula:—10-12/3.5-4//12/5.

Remarks:—The present form can be easily distinguished from *Polypora fujimotoi* SAKAGAMI, n. sp. by the more elongate fenestrule but the other characters are very similar.

The present form is named in honour of Professor Kotora HATAI of the Tohoku University for his kind guidance and encouragement.

Occurrence and horizon:—Kamiyatsuse (Reg. no. S-1 (holotype)), which belongs to the *Parafusulina* zone.

Polypora endoi SAKAGAMI, n. sp.

Pl. 20, Figs. 3-5

Zoarium fan-shaped and nearly flat. Branches straight, average 0.81 mm wide and 8 to 11 in 10 mm horizontally. Fenestrules ellipsoidal and its width and length about 0.57 mm and 0.72 mm, respectively. Number of fenestrules 8 to 10 in 10 mm, vertically. Width of dissepiment 0.55 mm to 0.85 mm. Zooecial apertures are arranged in alternating longitudinal series 6 rows on each branch; 14 to 15 in 5 mm of one row and usually 3 apertures per fenestrule. Zooecial aperture oval in shape and its diameter about 0.10 mm. Distance between zooecial apertures measured along longitudinal row 0.13 mm to 0.24 mm. In tangential section, zooecial tube rhomboidal with rounded corners in shape.

Meshwork formula:—8-11/8-10//14-15/6

Remarks:—It is not necessary to compare with the previously described species and the present one can be easily determined as a species new to science by the meshwork formula. The present species is named in honour of Dr. Riuji ENDÔ of Saitama Prefecture who kindly helped me in collection of bryozoan literatures.

Occurrence and horizon:—Kamiyatsuse (Reg. nos. S-3B (holotype) and S-15), which belongs to the *Parafusulina* zone.

Polypora sugiyamae SAKAGAMI, n. sp.

Pl. 21, Figs. 1-6

Form of zoarium unknown owing to state of materials. Branches straight or nearly straight, 1.02 mm to 1.70 mm wide and 5 to 6 in 10 mm, horizontally. Fenestrules ellipsoidal or elongated rectangular with rounded corners in outline. Its width and length usually 0.59 mm to 0.94 mm, occasionally 1.10 mm, and 2.10 mm to 3.10 mm, respectively. Number of fenestrules 3 in 10 mm, vertically. Width of dissepiment 0.60 mm to 1.10 mm. Zooecial apertures arranged in alternation longitudinal series and 7 to 8 rows on each branch; 13 to 15 in 5 mm of one row, 7 to 8 apertures per fenestrule. Zooecial aperture oval in shape and its diameter 0.08 mm to 0.10 mm. Distance between zooecial apertures measured along longitudinal row 0.16 mm to 0.18 mm. In tangential section, zooecial tube rhomboidal in shape.

Meshwork formula:—5-6/3//13-15/7-8

Remarks:—The present form resembles *Polypora megastoma* KONINCK which WAAGEN and PICHL reported from the Middle *Products* limestone of India in the general appearance, but differs in the width of fenestrule and number of fenestrules in 10 mm longitudinal length. The present form is named in honour of the late Dr. Toshio SUGIYAMA who studied some Paleozoic Bryozoa in Japan.

Occurrence and horizon:—Kamiyatsuse (Reg. nos. S-6 (holotype), S-14A and S-34), which belongs to the *Parafusulina* zone.

Polypora toyokoae SAKAGAMI, n. sp.

Pl. 21, Fig. 7; Pl. 22, Figs. 6, 7

Zoarium rapidly spreading and fan-shaped. Width of branch 0.81 mm to 1.12 mm and 5 to 6 branches in 10 mm, horizontally. Fenestrules irregularly rectangular or rhomboidal and its width and length 0.70 mm to 0.10 mm and 1.06 mm to 1.60 mm, respectively; 5 fenestrules in 10 mm, vertically. Width of dissepiment 0.69 mm to 0.80 mm. Zooecial apertures arranged in alternating longitudinal series, usually 5 rows on each branch, but 6 rows before bifurcation; 10 to 11 in 5 mm of one row and 4 apertures per fenestrule. Zooecial aperture oval in shape and its diameter about 0.10 mm. Distance between apertures measured along longitudinal row 0.16 mm to 0.24 mm. In tangential section, zooecial tube rhomboidal in shape.

Meshwork formula:—5-6/5//10-11/5-6

Remarks:—The rapidly spreading zoarium and relatively narrow and long dissepiment are characteristic of this species.

The present species is named after Mrs. Toyoko SAKAGAMI, the writer's beloved wife who helped him in many ways during the course of study.

Occurrence and horizon:—Kamiyatsuse (Reg. nos. S-21A (holotype) and S-21B), which belongs to the *Parafusulina* zone.

Polypora cf. *kutorgae* STUCKENBERG

Pl. 18, Fig. 1

1895. *Polypora kutorgae* STUCKENCERG, Mém. Com. Géol., St. Petersburg, Vol. 10, Fasc. 3, pp. 165 and 238, pl. 22, fig. 6.
1938. *Polypora kutorgae* NIKIFOROVA, Paleontology of USSR., Vol. IV, Pt. 4, Fasc. 1, pp. 128, 129; 244, pl. 21, figs. 4, 5; pl. 26, figs. 8-10.

A single tangential section. Zoarium fan-shaped. Branches nearly straight 0.80 mm to 1.00 mm wide and 6 to 7 in 10 mm horizontally. Fenestrules elliptical to elongated rectangular with rounded corners in outline. Width and length of fenestrule 0.60 mm to 0.90 mm and 1.50 mm to 2.20 mm, respectively. Number of fenestrules 4 in 10 mm vertically. Width of dissepiment about 0.56 mm. Zooecial tube lozenge in lower level of branch, but becoming rapidly oval or circular in middle and upper levels. Zooecial apertures arranged in alternating longitudinal series, usually 4 rows on each branch; 12 in 5 mm of one row and usually 6 apertures per fenestrule.

Mesnwork formula:—6-7/4//12/4

Remarks:—The present form agrees with *Polypora kutorgae* STUCKENBERG which NIKIFOROVA (1938) reported from the lower Permian of Timan, Russia in the general characters except for the somewhat narrower width of branch.

Occurrence and horizon:—The Takauchi limestone (Reg. no. 8127-A), which belongs to the *Lepidolina-Yabeina* zone.

Polypora longifenestrula SAKAGAMI, n. sp.

Pl. 17, Fig. 7; Pl. 18, Fig. 2

Zoarium dividing into branches and about 1.1 mm in width. Branches connected with each other by slender dissepiments which measure 0.26 mm to 0.46 mm in width. Fenestrule very elongate and length 0.66 mm to 0.93 mm and 3.3 mm to 4.5 mm, respectively. Zooecia arranged in alternating longitudinal series, usually 6 to 7 rows on each branch. Zooecial tube rhomboidal in lower and middle levels of branch, but becoming oval in upper level; about 13 in 5 mm of one row.

Meshwork formula:—5-6/2?//13/6-7

Remarks:—The present form resembles *Polypora gigantea* WAAGEN and PICHL which was reported from the Middle *Productus* limestone of India, but differs by the narrower width of fenestrule and larger number of branches in 10 mm of zoarium.

Occurrence and horizon:—The Takauchi limestone (Reg. Nos. 8121-A (holotype) and 8124-A), which belongs to the *Lepidolina-Yabeina* zone,

Polypora elongata SAKAGAMI, n. sp.

Pl. 17, Fig. 6

A single tangential section. Zoarium slender, about 0.7 mm in width and connected to each other by dissepiment. Fenestrule elongate, its width and length 0.56 mm to 0.64 mm and 2.5 mm to 3.0 mm, respectively. Dissepiment about 0.16 mm in width. Zooecia arranged in alternating longitudinal series, 4 rows on each branch. Zooecial tube irregularly rhomboidal or oval in outline, Diameter of zooecial aperture about 0.15 mm; about 13 in 5 mm of one row.

Meshwork formula:—7-8/3//13/5

Remarks:—The present form is not unlike *Polypora magnafenestrata* CROCKFORD which was reported from Eastern Australia in general appearance, but differs by the generally smaller sizes in the measurements, especially, in the width of branch and diameter of zooecial aperture.

Occurrence and horizon:—The Takauchi limestone (Reg. no. 8135-B (holotype)), which belongs to the *Lepidolina-Yabeina* zone.

Polypora sp. indet. A

Pl. 18, Fig. 3

Form of zoarium unknown. Branch straight, 0.56 mm to 0.64 mm wide and 9 to 10 in 10 mm horizontally. Fenestrules elongated elliptical in outline, its width and length 0.48 mm to 0.64 mm and about 1.8 mm, respectively. Number of fenestrules 4 to 5 in 10 mm vertically. Width of dissepiment about 0.41 mm in average. Zooecial tubes arranged in alternating longitudinal series and usually 3 rows on each branch; about 10 in 5 mm of one row and 5 to 6 apertures per fenestrule.

Meshwork formula:—9-10/4-5//10/4

Remarks:—The present form agrees with *Polypora triseriata* CROCKFORD which was reported from the Permian of Eastern Australia in the measurements. However, the present material is insufficient for the specific discrimination owing to the ill-preserved section.

Occurrence and horizon:—Kawahigashi (Reg. no. 8013-D), which belongs to the *Lepidolina-Yabeina* zone.

Polypora sp. indet. B

Pl. 18, Fig. 4

Form of zoarium unknown. Branch straight, 0.70 mm to 0.81 mm wide and 8 in 10 mm horizontally. Fenestrules elongated elliptical in outline, its width and length 0.74 mm and 1.80 mm in average, respectively. Number of fenestrules 5 in 10 mm vertically. Width of dissepiment about 0.37 mm. Zooecial tubes arranged in alternating longitudinal series and 4 or 5 rows on each branch; about 15 in 5 mm of one row and 5 to 6 apertures per fenestrule.

Meshwork formula:—8/5//15/4-5

Remarks:—The present form is nearest to *Polypora dichotoma* CROCKFORD

which was reported from the Permian of Eastern Australia in the meshwork formula and micrometric measurements. However, the specific name must wait until better preserved specimens accumulate.

Occurrence and horizon:—Kawahigashi (Reg. no. 8016-C), which belongs to the *Lepidolina-Yabeina* zone.

Genus *Thamniscus* KING, 1849

Type species:—*Keratophytes dubius* SCHLOTHEIM, 1820

Diagnosis:—Like *Polypora* but dissepiments far apart or nearly absent. (BASSLER, 1953, p. G126)

Range:—Silurian to Permian.

Thamniscus cf. *dubius* (SCHLOTHEIM)

Pl. 22, Fig. 1

1885. *Thamniscus dubius* WAAGEN and PICHL, Palaeont. Indica, Ser. 13, Vol. 1, p. 808, pl. 93, fig. 4.

1929. *Thamniscus dubius* BASSLER, Paläont. Timor, xvi Lief., xxviii, p. 80, pl. CCXLV (21), fig. 12.

A few tangential sections. Zoarium consists of diverged branches with 6 to 7 rows of zooecia, its width about 1.1 mm. Zooecial tubes arranged regularly in alternating longitudinal series. Zooecium subspherical at lower level, sharply rhomboidal at middle level and spherical at upper level. Diameter of zooecium about 0.16 mm.

Remarks:—The present form is similar to *Thamniscus dubius* which was reported from the Middle *Productus* limestone of the Salt Range by WAAGEN and PICHL and from the Permian of Timor by BASSLER. However, the detailed comparison must be reserved.

Occurrence and horizon:—Kamiyatsuse (Reg. no. 5543-A), which belongs to the *Parafusulina* zone.

Thamniscus? *problematicus* SAKAGAMI, n. sp.

Pl. 22, Fig. 2

A single tangential section. Zoarium laterally branching, occasionally anastomosing, and about 1.5 mm in width. Branch consists of zooecial tubes of 4 rows surrounded by thick dense fibrous tissue. Fibrous tissue measures 0.32 mm to 0.35 mm thick in tangential section. Zooecial tubes arranged regularly in alternating longitudinal series, nearly straight in tubes of inner 2 rows, but bending outward in rows of both sides. Diameter of zooecial tube about 0.16 mm and interspaces between zooecial tubes measure about 0.40 mm at near surface; 4 zooecial apertures in 2 mm of one row.

Remarks:—The present form may be referred to the genus *Thamniscus* in the general characters, however, there is a certain difference in the occa-

sionally anastomosing zoarium. The present form is quite unlike any previously described species in the genera *Thamniscus, Anastomopora, Reteporidra* and *Protoretepora*. It may be necessary to establish a new genus for the present species, however, until a larger number of specimens accumulate, the present species is referred to the genus *Thamniscus* with question.

Occurrence and horizon:—The Omi limestone (Reg. no. 6507-A (holotype)), which belongs to the lower part of the *Pseudoschwagerina* zone.

Family ACANTHOCLADIIDAE ZITTEL, 1880

Genus *Acanthocladia* KING, 1849

Type species:—*Keratophytes anceps* SCHLOTHEIM, 1820

Diagnosis:—Coarse stipes with 3 or more rows of zooecia; short oblique side branches closely and regularly spaced, commonly without dissepiments. (BASSLER, 1953, p. G127)

Range:—Pennsylvanian to Permian.

Acanthocladia sp. indet.

Pl. 23, Fig. 6

A single tangential section. Zoarium consists of main branch about 0.8 mm in width and diverged straight lateral branchlet about 0.6 mm in width at intervals of 0.24 mm to 0.40 mm with 5? branchlets in 5 mm. Zooecial apertures arranged in alternating longitudinal series and 3 or 4 rows. Diameter of zooecium measures 0.08 mm to 0.10 mm, 23? in 5 mm of one row of main branch.

Remarks:—This minute *Acanthocladia* is insufficient for determination of species owing to the section not being well oriented.

Occurrence and horizon:—Kasamatsu of Kyushu (Reg. no. 9024-B), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Genus *Septopora* PROUT, 1859

Type species:—*Septopora cestriensis* PROUT, 1859

Diagnosis:—Primary and secondary branches numerous, the latter joined to adjacent primaries; 2 rows of zooecia on all branches; back with scattered pores; union of secondaries (pinnae) may form dissepiment-like structures with apertures. (BASSLER, 1953, p. G128)

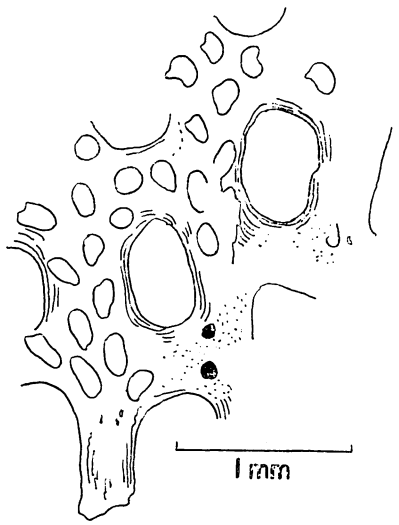
Range:—Mississippian to Permian.

Septopora kamakurae SAKAGAMI, n. sp.

Pl. 22, Figs. 3-5

Zoarium composed of straight branches with dissepiments which usually bear 2 or 3 zooecia. Branches 0.40 mm to 0.48 mm wide and 10 to 13 in 10 mm horizontally. Width of dissepiment 0.30 mm to 0.43 mm. Fenestrules oval in

outline, its width and length 0.32 mm to 0.40 mm and 0.57 mm to 0.68 mm, respectively, and usually 10 in 10 mm vertically. Zooecial tube lozenge shaped at lower level of branch, but circular at upper level, its diameter about 0.13 mm; about 17 to 18 apertures in 5 mm and usually 3 apertures per fenestrules.



Text figure 6. *Septopora kamakurae* SAKAGAMI, n. sp., Tangential section, holotype (Reg. no. 8117-A).

Meshwork formula:—10-13/10//17-18*

Remarks:—The present form well agrees with *Septopora wederi* NIKIFOROVA (1926) wnich was reported from the lower Carboniferous of Turkestan, in the meshwork formula and number of zooecia in the dissepiments, but differs by the broader widths of branch and dissepiments, and narrower width of fenestrule.

The present species is named after Mr. Kunio KAMAKURA who was a student in our Department for his kind help in collecting bryozoan specimens.

Occurrence and horizon:—The Takauchi limestone (Reg. nos. 8117-A (holotype), 8103-B, 8112-B), which belongs to the *Lepidolina-Yabeina* zone.

Septopora kawamatae SAKAGAMI, n. sp.

Pl. 23, Figs. 2-4

Zoarium composed of straight branches with dissepiments which usually bearing 2 or 3 zooecia. Branches about 0.45 mm wide and 16 to 17 in 10 mm horizontally. Dissepiments depressed, range from two-thirds to nearly as wide as branches. Fenestrules elongate rectangular with rounded corners in outline, its width and length about 0.33 mm and 0.82 mm, respectively, and usually 8.5 in 10 mm vertically. Zooecial apertures circular and rather large, its diameter about 0.13 mm; 13 apertures in 10 mm and usually 3 apertures per fenestrule.

Meshwork formula:—16-17/8.5//13

Remarks:—The present form can be distinguished from the previously described species. It differs from *Septopora kamakurae* SAKAGAMI, n. sp. in both the meshwork formula and micrometric measurements except for the number of zooecia in the dissepiments. The present species is named after Miss. Yoshiko KAWAMATA, one of our students for her kind help in collecting the bryozoan specimens.

Occurrence and horizon:—Kamiyatsuse (Reg. nos. S-24A (holotype), S-24B),

* 10-13: branches in 10 mm of width of zoarium, 10: fenestrules in 10 mm of length of zoarium, 17-18: zooecia in 5 mm of length of branch.

which belongs to the *Parafusulina* zone.

Septopora sp. indet.

Pl. 23, Fig. 1

Zoarium composed of straight branches with dissepiments usually bearing 2 or 3 zooecia. Branches about 0.41 mm wide and 10 to 11 in 10 mm horizontally. Width of dissepiment 0.33 mm to 0.37 mm. Fenestrules oval in outline, its width and length about 0.48 mm to 0.59 mm and about 0.74 mm, respectively, and usually 12 in 10 mm vertically. Zooecial tube circular, its diameter about 0.14 mm; 15 to 17 apertures in 5 mm and usually 3 apertures per fenestrules.

Meshwork formula:—10-11/12//15-17

Remarks:—The present form resembles closely *Septopora kamakurae* SAKAGAMI, n. sp., but slightly differs in the micrometric measurements. The specific name must be reserved until better preserved specimens accumulate.

Occurrence and horizon:—Kawahigashi (Reg. no. 8022-C), which belongs to the *Lepidolina-Yabeina* zone.

Genus *Synocladia* KING, 1849

Type species:—*Retepora virgulacea* PHILLIPS, 1829

Diagnosis:—Like *Septopora* but branches coarser and bearing 3 or more rows of zooecia. (BASSLER, 1953, p. G128)

Range:—Mississippian to Permian.

Synocladia sp. indet.

Pl. 23, Fig. 5

A single tangential section of a fragment. Zoarium composed of straight branches with dissepiments. Branches 0.64 mm wide and 8 in 10 mm horizontally. Dissepiment about 0.48 mm wide, usually bearing 4 or 5 zooecia. Fenestrules irregularly rectangular in outline, and its width 0.64 mm to 1.00 mm, and the length cannot be measured.

Remarks:—The present form differs from the previously described species in the general appearance. The present form may be a new species, however, the specific name must wait until a larger number of better preserved specimens accumulate.

Occurrence and horizon:—The Takauchi limestone (Reg. no. 8125-C), which belongs to the *Lepidolina-Yabeina* zone.

Genus *Penniretepora* D'ORBIGNY, 1849

Type species:—*Retepora pluma* PHILLIPS, 1836

Diagnosis:—Slender main stem and short, regularly spaced, oblique side branches without dissepiments; 2 rows of zooecia on stem and branches.

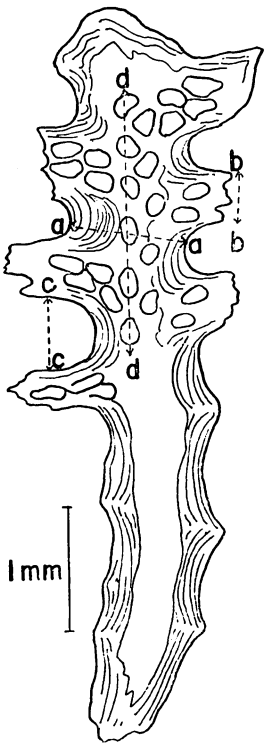
(BASSLER, 1953, p. G128)

Range:—Devonian to Permian.

Pennniretepora iwaizakiensis SAKAGAMI, n. sp.

Pl. 24, Fig. 3

A single tangential section. Zoarium consists of broad straight main branch about 1 mm in width, short lateral branchlets extending alternately at an angle of 80 degrees and at intervals of 0.37 mm to 0.48 mm with about 6 branchlets in 5 mm. Width of lateral branchlet about 0.48 mm. Median section of zooecium oval or tetragonal with rounded corners, its diameter about 0.22 mm, 14 to 15 in 5 mm in one row of main branch. Interspaces between zooecial tube 0.11 mm to 0.15 mm.



Text figure 7. *Pennniretepora iwaizakiensis* SAKAGAMI, n. sp., Tangential section, holotype (Reg. no. 5018-C). a-a: Width of main branch, b-b: Width of lateral branchlet, c-c: Interval between lateral branchlets, d-d: Zooecia in 5 mm in one row of main branch.

Remarks:—The present form resembles *Pennniretepora crassicaulis* (BASSLER) which was reported from the Permian of Timor. However, a comparison between the two species is difficult from BASSLER's description and illustration because of no observation is made by him of the thin section of *P. crassicaulis*. However, the present form can be distinguished from the Timor species by the differences in micrometric measurements. The broad straight main branch and oval or tetragonal zooecial tube in section and characteristic of this species.

Occurrence and horizon:—The h member of Iwaizaki limestone (Reg. no. 5018-C (holotype)), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Pennniretepora rectodichotoma SAKAGAMI, n. sp.

Pl. 24, Fig. 4

A single tangential section. Zoarium consists of straight main branch about 0.44 mm in width, short lateral branchlets extending alternately at 45 degrees to the right side of main branch and the supplementary angle to left side. Branchlets of right and left sides making a straight line. Intervals between lateral branchlets about 0.41 mm with 8 branchlets in 5 mm. Width of lateral branchlet about 0.35 mm. Median section of zooecium showing oval or ellipsoidal form, and diameter of

Table 5. Determination of the Genus *Pennirelepora*.

Species	Localities	Number of lateral branchlets in 5 mm of main branch	Distance between lateral branchlets (in mm)	Width of main branch (in mm)	Width of lateral branchlet (in mm)	Number of zooecia in 5 mm of main branch	Diameter of zooecial tube (in mm)	Distance between zooecial tube (in mm)	Angle between branchlet and main branch (in degree)
P. iwaizakiensis SAKAGAMI, n. sp.	Iwaizaki (h)	6	0.37–0.48	1.04	0.48	14–15	0.22	0.11–0.15	80
P. rectodichotoma SAKAGAMI, n. sp.	Iwaizaki (h)	8	0.41	0.44	0.35	17?	0.10–0.11	0.28?	45, 135*
P. tenuis SAKAGAMI, n. sp.	Iwaizaki (h)	9	0.24	0.48	0.22–0.26	16	0.10	0.22	45
P. akiyamae SAKAGAMI, n. sp.	Iwaizaki (h)	8–9	0.49	0.57	0.24–0.27	15–16	0.10–0.11	0.21	90
P. sikii SAKAGAMI, n. sp.	Takauchi	6	0.16–0.32	0.64	0.32–0.64	16	0.10	0.19–0.24	80–90
P. zigzag SAKAGAMI, n. sp.	Kawahigashi	3	1.10	0.52	0.33–0.37	16	0.15–0.19	?	50–80
P. kamiyatsusensis SAKAGAMI, n. sp.	Kamiyatsuse	9	0.40	0.58	0.30	22	0.10	0.13–0.14	90
P. akagii SAKAGAMI, n. sp.	Morono	4	0.50	0.80	0.56	12–13	0.16–0.19	0.07–0.19	50
P. sp. indet.	Takauchi	6–7	0.40–0.72	0.53	0.32	20	0.13	0.10–0.16	80–90

* 45: angle of the right side, 135: angle of the left side.

zooecium about 0.11 mm, about 17 in 5 mm in one row of main branch.

Remarks:—The present species is considered to be referable to the genus *Penniretepora* and is new to science, notwithstanding that only one ill-preserved specimen is at hand, by the mode of divergence of the lateral branchlets.

Occurrence and horizon:—The h member of Iwaizaki limestone (Reg. no. 5064-A (holotype)), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Penniretepora tenuis SAKAGAMI, n. sp.

Pl. 24, Fig. 1

A single tangential section. Zoarium consists of straight main branch about 0.48 mm in width, short lateral branchlets extending alternately at 45 degrees and at intervals of about 0.23 mm with 9 branchlets in 5 mm. Width of lateral branchlet 0.22 mm to 0.26 mm. Median section of zooecium triangular in form. Diameter of zooecium at near surface about 0.10 mm, 16 in 5 mm in one row of main branch. Interspaces between zooecial tube about 0.22 mm.

Remarks:—The present form resembles *Penniretepora pulcella* (BASSLER) which was reported from Timor, however, it differs by the larger number of lateral branchlets in 5 mm of branch and narrower distance between the lateral branchlets in 5 mm of branch and narrower distance between the lateral branchlets. Zooecial form of *P. pulcella* in section has not been figured by BASSLER.

Occurrence and horizon:—The h member of Iwaizaki limestone (Reg. no. 5063-C (holotype)), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Penniretepora akiyamae SAKAGAMI, n. sp.

Pl. 24, Fig. 2

A single tangential section. Zoarium consists of straight main branch about 0.57 mm in width, short lateral branchlets extending alternately at right angle and at intervals of about 5 mm with 8 to 9 branchlets in 5 mm. Width of lateral branchlet 0.24 mm to 0.27 mm. Median section of zooecium bean-like in form. Diameter of zooecium about 0.11 mm, 15 in 5 mm in one row of main branch. Interspaces between zooecial tube at near surface about 0.21 mm.

Remarks:—The present form is similar to *Penniretepora tenuis* SAKAGAMI, n. sp. in the micrometric measurements. However, the present form differs from *P. tenuis* in the angle between the main branch and lateral branchlet, and form of zooecium in section. The specific name is dedicated to the late Mr. Teruyuki AKIYAMA of the Kesen-numa High School, Miyagi Prefecture, who kindly helped me in collecting bryozoa from the Iwaizaki limestone and Kamiyatsuse.

Occurrence and horizon:—The h member of Iwaizaki limestone (Reg. no. 5073-B (holotype)), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Pennirétepora sikii SAKAGAMI, n. sp.

Pl. 24, Fig. 6

A single tangential section. Zoarium consists of straight main branch about 0.64 mm in width, short lateral branchlets extending alternately at an angle of 80 to 90 degrees and at intervals of 0.31 mm to 0.40 mm with about 6 branchlets in 5 mm. Zoarium surrounded by thick fibrous tissue. Width of lateral branchlet 0.32 mm to 0.64 mm. Median section of zooecium oval, its diameter about 0.10 mm, about 16 in 5 mm of one row of main branch. Interspaces between zooecial tube 0.19 mm to 0.24 mm.

Remarks:—The present form resembles *Pennirétepora akiyamae* SAKAGAMI, n. sp. in the general appearance, however, it differs by the smaller number of lateral branchlets in 5 mm of main branch, wider lateral branchlet and shorter distance between lateral branchlets. The specific name is dedicated to Mr. Tsunemasa SIKI of the Kyoto University who helped me in collecting bryozoan specimens from the Takauchi limestone.

Occurrence and horizon:—The Takauchi limestone (Reg. no. 8134-A (holotype)), which belongs to the *Lepidolina-Yabeina* zone.

Pennirétepora zigzag SAKAGAMI, n. sp.

Pl. 24, Fig. 7

A single tangential section. Zoarium pinnate, consists of zigzaged main branch about 0.52 mm in width, short lateral branchlet extending alternately at angles of 50 to 80 degrees and at intervals of about 1.1 mm with 3 branchlets in 5 mm. Width of lateral branchlet 0.33 mm to 0.37 mm. Median section of zooecium oval or trapezoidal with rounded corners, its diameter 0.15 mm to 0.19 mm, 16 in 5 mm in one row of main branch.

Remarks:—The present zigzaged form differs from all previously described species.

Occurrence and horizon:—Kawahigashi (Reg. no. 8001-B (holotype)), which belongs to the *Lepidolina-Yabeina* zone.

Pennirétepora kamiyatsusensis SAKAGAMI, n. sp.

Pl. 24, Fig. 8

A single obverse surface was obtained. Zoarium consists of straight main branch about 8 mm long and 0.58 mm wide, lateral branchlets extending alternately at right angle and at intervals of about 0.40 mm with 9 branchlets in 5 mm. Width of lateral branchlet about 0.30 mm. Median section of zooecium

spherical or oval in form. Zooecial aperture 22 in 5 mm in one row of main branch.

Remarks:—The present form resembles *Penniretepora akiyamae* SAKAGAMI, n. sp., but differs in the zooecial form at the median section and number of zooecia in 5 mm of main branch.

Occurrence and horizon:—Kamiyatsuse (Reg. no. S-14B (holotype)), which belongs to the *Parafusulina* zone.

Penniretepora akagii SAKAGAMI, n. sp.

Pl. 24, Fig. 9

A single tangential section. Zoarium consists of broad straight main branch about 0.8 mm in width, short lateral branchlets extending alternately at an angle of about 50 degrees and at intervals of about 0.50 mm with 4 branchlets in 5 mm. Width of lateral branchlet about 0.56 mm. Median section of zooecium oval, its diameter 0.16 mm to 0.19 mm, 12 to 13 in 5 mm in one row of main branch. Interspaces between zooecial tube 0.07 mm to 0.19 mm.

Remarks:—The strong, wide main branch, oval zooecial tube in median section characterize this species. The present form is similar with *Penniretepora invisa* (TRIZNA) which was reported from the *Schwagerina anderssoni* bed of Baschkirian Ural, U. S. S. R. in the micrometric measurements. However, the present form can be distinguished from *P. invisa* in the angle between the main branch and lateral branchlet (50 degrees instead of 90 degrees), and absence of hemisepta.

The specific name is dedicated to Mr. Saburo AKAGI of the Tokyo University of Education who helped me in collecting bryozoa from the Taishaku limestone.

Occurrence and horizon:—Morono of the Taishaku limestone (Reg. no. 8506-A (holotype)), which belongs to the upper part of the *Pseudoschwagerina* zone.

Penniretepora sp. indet.

Pl. 24, Fig. 5

A single tangential section. Zoarium consists of straight main branch about 0.53 mm in width, short lateral branchlets extending alternately at an angle of 80 to 90 degrees and at intervals of 0.40 mm to 0.72 mm with 6 to 7 branchlets in 5 mm. Width of lateral branchlet about 0.32 mm. Median section of zooecium oval or lozenge with rounded corners, its diameter about 0.13 mm, about 20 in 5 mm of one row of main branch. Interspaces between zooecial tube 0.10 mm to 0.16 mm.

Remarks:—The present form differs from *Penniretepora iwaizakiensis* SAKAGAMI, n. sp. by the narrower widths of the main branch and lateral branchlets, larger number of zooecia in 5 mm of main branch and in the zooecial form in

section.

Occurrence and horizon:—The Takauchi limestone (Reg. no. 8117-C), which belongs to the *Lepidolina-Yabeina* zone.

Family RHABDOMESIDAE VINE, 1883

Genus *Rhabdomeson* YOUNG and YOUNG, 1874

Type species:—*Millepora gracilis* PHILLIPS, 1841.

Diagnosis:—Differs from *Rhombopora* in having a hollow axial epithecate tube from which zooecia extend obliquely outward. (BASSLER, 1953, p. G131)

Range:—Mississippian to Permian.

Rhabdomeson nakazawae SAKAGAMI, n. sp.

Pl. 25, Figs. 1, 2

Zoarium cylindrical, ramose branches about 1.3 mm to 2 mm in diameter with central axial tube about 0.2 mm in width. Zooecial apertures disposed regularly in longitudinal and diagonal rows. Zooecium 0.13 mm to 0.16 mm in diameter and 5 zooecia in 2 mm measuring along the longitudinal row and 7 in the same space diagonally. Two kinds of acanthopores—megacanthopore and micracanthopore present. One or two megacanthopores usually placed in each point of intersection of zooecial wall. Several micracanthopores arranged between megacanthopores in one row and surround each zooecial aperture. Superior hemiseptum poorly developed at inner edge of tube in mature region.

Remarks:—The present form resembles *Rhabdomeson bispinosa* CROCKFORD which was reported from the Callytharra Series, Western Australia in the general appearance, but differs by the larger number of micracanthopores. The present form also resembles *Rhabdomeson consimile* BASSLER which was reported from the uppermost Permian in contact with the Triassic, south of Kampong Somelihoe near Bitauni, Timor by BASSLER (1929), however, the present form can be distinguished by the narrower central tube and smaller diameter of zooecial tube.

The specific name is dedicated to Dr. Keiji NAKAZAWA of the Kyoto University who helped me in many ways during my bryozoan study.

Occurrence and horizon:—The Takauchi limestone (Reg. no. 8135-C (holotype)), which belongs to the *Lepidolina-Yabeina* zone.

Genus *Saffordotaxis* BASSLER, 1952

Type species:—*Rhombopora incrassata* ULRICH, 1888.

Diagnosis:—Like *Rhombopora* but a row of megacanthopores surrounds each apertures. (BASSLER, 1953, p. G134)

Range:—Mississippian to Permian.

Saffordotaxis morikawae SAKAGAMI, n. sp.

Pl. 25, Figs. 3-5

Zoarium slender cylindrical stem, its diameter about 2 mm. Zooecial tube elongated S-shaped in typical longitudinal section, circular in tangential section. Its diameter 0.14 mm to 0.16 mm and usually about 5 in 2 mm measuring longitudinally. Zooecial apertures may regularly disposed in longitudinal row and interspaces between zooecial tubes at near surface about 0.16 mm to 0.18 mm. Numerous relatively small megacanthopores around zooecial tube regularly arranged in one row but occasionally irregularly arranged and its diameter about 0.03 mm.

Remarks:—The present form is not unlike *Saffordotaxis wanneri* (BASSLER) which was reported from the Basleo bed of Timor, but can be distinguished by the smaller size of zoarium, diameter of zooecium and megacanthopore.

The specific name is dedicated to Dr. Rokuro MORIKAWA of the Saitama University who recently studied the Iwaizaki limestone.

Occurrence and horizon:—The d member of the Iwaizaki limestone (Reg. nos. 5210-A (holotype), 5202-A), which belongs to the upper part of the *Parafusulina* zone.

Genus *Rhombopora* MEEK, 1872

Type species:—*Rhombopora lepidodendroides* MEEK, 1872.

Diagnosis:—Solid slender branching stems, thick-walled in mature region. Zooecia with few diaphragms, no hemisepta; oval apertures within sloping hexagonal vestibules aligned in regular oblique rows. Micracanthopores around each aperture and a megacanthopore at distal edge of each; mesopores lacking. (BASSLER, 1953, p. G134)

Range:—Devonian to Permian.

Rhombopora? sp. indet.

Pl. 18, Figs. 5, 6

A single oblique section and a few transverse sections. Zoarium may be a cylindrical stem, its diameter 2.0 mm to 2.3 mm. Zooecial tube circular in tangential section, its diameter 0.16 mm to 0.22 mm. Zooecial aperture may be regularly disposed in longitudinal row and interspaces between zooecial tubes at near surface about 0.16 mm. Micracanthopores around zooecial tube irregularly arranged and megacanthopore indistinct but may be disposed at distal edge of each zooecium.

Remarks:—A few poorly oriented sections are at hand and they are insufficient for observations of the specific characters. More better oriented specimens are necessary for specific discrimination.

Occurrence and horizon:—The Kuzuu limestone (Reg. nos. 6208-A, 6209-B), which belongs to the lower part of the *Parafusulina* zone.

Genus *Clausotrypa* BASSLER, 1929

Type species:—*Clausotrypa separata* BASSLER, 1929

Diagnosis:—Like *Streblotrypa* but zooecia arise from axial line in ascending spirals; mesopores closed by laminated tissue. (BASSLER, 1953, p. G132)

Range:—Mississippian to Permian.

Clausotrypa exillis SAKAGAMI, n. sp.

Pl. 25, Fig. 6

A single longitudinal section. Zoarium ramose, its diameter 1.3 mm to 1.4 mm. Zooecia arise from a central axis with elongate S-shape. Diameter of zooecial aperture 0.10 mm to 0.13 mm and 5 in 2 mm longitudinally. Interspaces between zooecial tubes in mature zone are filled by dense fibrous tissue. Acanthopore numerous. Mesopore and diaphragm absent.

Remarks:—The present form resembles *Clausotrypa minor* which BASSLER reported from Timor in some characters. However, the present form differs from the Timor species by the smaller size of zoarium and absence of diaphragm.

Occurrence and horizon:—The h member of the Iwaizaki limestone (Reg. no. 5026-A (holotype)), which belongs to the upper part of the *Lepidolina-Yabeina* zone.

Genus *Streblascopora* BASSLER, 1952

Type species:—*Streblotrypa fasciculata* BASSLER, 1929.

Diagnosis:—Like *Streblotrypa* but has axial bundle of parallel tubes. (BASSLER, 1953, p. G135)

Range:—Permian.

Streblascopora delicatula SAKAGAMI, n. sp.

Pl. 25, Figs. 7-10; Pl. 26, Figs. 1-18; Pl. 27, Figs. 1-5

Zoarium slender and ramose, its diameter 1.3 mm to 2.2 mm. Central bundle of small parallel tubes is surrounded by zooecial tubes. Number of tubes in central bundle about 40 to 80 in transverse sections. Zooecial tube circular or oval in tangential section, its diameter 0.11 mm to 0.16 mm. Apertures 4 in 2 mm longitudinally. Length of zooecium from bundle to aperture 0.56 mm to 1.10 mm. Mesopores between 2 or 3 rows with 3 to 5 in each row longitudinally, its inner diameter 0.017 mm to 0.034 mm. Diaphragm lacking, but superior and inferior hemisepta commonly developed.

Remarks:—The present form somewhat resembles *Streblascopora germana* (BASSLER) which BASSLER reported from the Permian Basleo and Amarassi beds of Timor. However, the present form differs from *S. germana* by the smaller zoarium, larger number of tubes in central bundle and 2 or 3 rows of

mesopores instead of 3 or 4 rows. CROCKFORD (1944, 1957) discussed that *S. germana* appears to be identical with *S. marmionensis* ETHERIDGE. The present form also resembles *S. pulchra* which FRITZ reported from Vancouver Island, however, it can be distinguished from the Vancouver species by the larger number of tubes in the central bundle.

In Japan, the present species occurs from the d and h members of the Iwaizaki limestone, Kawahigashi, Takauchi and Kasamatsu. The specimens from Kawahigashi and Takauchi are identical in the micrometric measurements, however, the zooecia of the Iwaizaki specimens are slightly shorter than that of the above mentioned two localities. The Kasamatsu specimens also may be included in the present new species.

Occurrence and horizon:—The d member of the Iwaizaki limestone (Reg. nos. 5209-A, 5218-A), h member of the Iwaizaki limestone (Reg. nos. 5018-B, 5062-A, 5072-A, 5073-A, 5079-A, 5088-A, 5090-B), Kawahigashi (Reg. nos. 8003-A, 8004-A, 8005-A, 8010-A, 8010-B, 8010-C, 8011-A, 8011-B, 8013-A (holotype), 8018-A, 8018-B), Takauchi limestone (Reg. nos. 8102-A, 8103-A, 8104-A, 8111-A, 8114-A, 8135-A) and Kasamatsu (Reg. nos. 9022-A, 9030-A, 9030-B), which belong to the upper part of the *Parafusulina* to *Lepidolina-Yabeina* zone.

Genus *Hayasakapora* SAKAGAMI, 1960

Type species:—*Hayasakapora erectoradiata* SAKAGAMI, 1960.

Diagnosis:—Zoarium slender and ramose. Zooecia straight and arise radially at right angles from linear axis. Several minute acanthopore-like substances developed at margin of zooecia. Mesopore and diaphragm absent.

Range:—Carboniferous? to Permian.

Hayasakapara matsudae SAKAGAMI, n. sp.

Pl. 27, Figs. 15, 16

Zoarium cylindrical branch, its diameter about 2.3 mm to 2.4 mm. Zooecial tube straight and arise radially at right angles from linear axis. They appear regularly in longitudinally intersecting rows in tangential section of near surface and surrounded by thick dense fibrous tissue. Aperture 5.5 to 6 in 2 mm of one row. Length and width of zooecial tube about 1.1 mm and 0.13 mm, respectively. Interspaces between zooecial tubes 0.19 mm to 0.26 mm in longitudinal direction. Seven acanthopore-like substances at margin of zooecial aperture, 0.012 mm in diameter, occur at fibrous tissue of near surface in tangential section.

Remarks:—The present form is quite identical with the type species of *H. erectoradiata* SAKAGAMI, which occurred from the h member of the Iwaizaki limestone in its essential characters except for the larger diameter of zoarium.

The present species is named after Mr. Hideo MATSUDA who was a student of our University for his kind help in collecting bryozoan specimens.

Occurrence and horizon:—The d member of the Iwaizaki limestone (Reg. nos. 5212-A (holotype), 5211-A), which belongs to the upper part of the *Parafusulina* zone.

Hayasakapora taishakuensis SAKAGAMI, n. sp.

Pl. 28, Figs. 1-4

Zoarium slender and diverged branch-like, its diameter about 2.5 mm to 3 mm. Zooecial tubes straight and arise radially at right angles from linear axis. They appear regularly in longitudinally intersecting rows in tangential section of near surface and surrounded by dense fibrous tissue. Aperture 5.5 to 6.5 in 2 mm of one row. Length and width of zooecial tube 1.1 mm to 1.3 mm and 0.13 mm to 0.16 mm, respectively. Interspaces between zooecial tubes 0.24 mm to 0.32 mm in longitudinal direction, 0.13 mm to 0.19 mm in diagonal direction. About nine acanthopore-like substances at margin of zooecial aperture usually disposed, and its diameter about 0.017 mm. Numerous very minute pores, 0.006 mm in diameter, occur at fibrous tissue of near surface in tangential section.

Remarks:—The present form can be distinguished from the type species of the genus, *H. erectoradiata* SAKAGAMI, and *H. matsudae* by the larger diameter of zoarium, and 9 acanthopore-like substances instead of 7.

Occurrence and horizon:—Morono of the Taishaku limestone (Reg. nos. 8505-A (holotype), 8503-A, 8505-B, 8507-A, 8508-A, 8508-B), which belongs to the *Pseudoschwagerina* zone.

Hayasakapora? sp. indet.

Pl. 27, Figs. 7-11

Zoarium slender and diverged branch-like, its diameter 1.0 mm to 1.4 mm. Zooecia straight and arise radially at right angles from linear axis. Apertures 10 in 2 mm longitudinally. Length and diameter of zooecium 0.45 mm to 0.58 mm and 0.16 mm to 0.21 mm, respectively. Mesopore and diaphragm lacking. Interspaces between zooecial tubes measure 0.05 mm to 0.08 mm. Acanthopore-like substance can not be observed.

Remarks:—In the present form, acanthopore-like substances at margin of zooecial aperture which are one of the important characters of the genus *Hayasakapora* cannot be observed. However, the present form shows the other characters of the genus, namely, the mode of growth of zooecia arising from the linear axis and so on. Therefore, the present form is referred to the genus *Hayasakapora* with question.

Occurrence and horizon:—The Takauchi limestone (Reg. nos. 8102-A, 8104-C), Kawahigashi limestone (Reg. no. 8025-C) and Kamiyatsuse (Reg. nos. 5521-B, 5523-A), which belong to the *Parafusulina* to *Lepidolina-Yabeina* zones.

Family SULCORETEPORIDAE BASSLER, 1935

Genus *Sulcoretepora* D'ORBIGNY, 1849

Type species:—*Flustra parallela* PHILLIPS, 1836.

Diagnosis:—Narrow ribbon-like branches with subparallel, nonporiferous margins. Zooecia prostrate proximally, erect distally, with more or less distinct hemisepta and generally prominent lunarium. Interspaces on surface smooth, granulose, or finely striate, but in worn specimens may appear pitted, showing vesicles. (BASSLER, 1953, p. G142)

Range:—Devonian to Permian.

Sulcoretepora nipponica SAKAGAMI, n. sp.

Pl. 28, Figs. 5-8; Pl. 29, Figs. 1-3; Pl. 30, Figs. 1-7

Zoarium bifoliote, branching in plane of mesotheca, and elongated rugby ball-form in transverse section. Mesotheca apparently a closely joined double layer, reaching surface at edge of zoarium. Width and thickness of zoarium measure 3.6 mm and 1.3 mm to 1.5 mm, respectively, in average. Zooecium tubular and rounded, proximally parallel to mesotheca, making rapidly large angle in mature region. Zooecial aperture ellipsoidal, arranged longitudinally 9 rows in common, well developed peristomes and usually 3 in 2 mm longitudinally. Longer and shorter diameter of zooecial aperture about 0.31 mm and 0.17 mm, respectively. In tangential section, zooecial tube spherical in outline, 0.16 mm to 0.18 mm in diameter. Interspaces between adjacent apertures about 0.40 mm to 0.64 mm longitudinally. One or two rows of vesicular tissue generally occur in interspaces between zooecial tubes, however, about one half of near surface are covered by the dense tissue.

Remarks:—The present form differs from the previously described species. In the present species, the Iwaizaki specimens have somewhat thicker fibrous tissue than that from Kamiyatsuse. However, this slight difference is not so important, so they are included in the same species.

Occurrence and horizon:—Kamiyatsuse (Reg. nos. S-37 (holotype), S-9, S-38 (surfaces), 5520-A, 5521-B, 5533-A, 5536-A, 5537-A, 5538-A, 5539-A), and d member of the Iwaizaki limestone (Reg. nos. 5202-A, 5212-A, 5216-A), which belong to the *Parafusulina* zone.

Sulcoretepora sp. indet.

Pl. 29, Figs. 4-6

Surface of the present form is represented by a fragment of a bifoliate branching zoarium. Mesotheca apparently a closely joined double layer, reaching surface at edge of zoarium. Width and thickness of zoarium measure 4 mm to 5 mm and about 1.5 mm, respectively. Zooecium tubular, proximally parallel to mesotheca in immature region, making rapidly large angle in ma-

ture region. Zooecial tube circular or oval in tangential section, 0.12 mm to 0.14 mm in diameter. Zooecial aperture arranged regularly in longitudinal direction of branch, commonly 9 rows. Distance from center to center of the zooecial apertures measures 0.5 mm to 0.6 mm and 3.5 apertures in 2 mm of one row. Vesicular tissue poorly developed in immature region but is covered by thick dense fibrous tissue in mature region.

Remarks:—The present form differs from *Sulcoretepora nipponica* SAKAGAMI, n. sp. by the thicker dense tissue and smaller diameter of zooecial tube. However, the ill-preserved specimens at hand are insufficient for specific determination.

Occurrence and horizon:—The Omi limestone (Reg. nos. 6500-B (surface), 6501-A, 6501-B, 6501-C, 6501-D), which belongs to the lower part of the *Pseudoschwagerina* zone.

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Table 6. Distribution of Japanese Permian Bryozoa.

Species \ Localities	Omi limestone	Morono (Taishaku)	Kuzuu limestone	Kamiyatsuse	Iwaizaki limestone (d)	Iwaizaki limestone (h)	Kawahigashi	Takauchi limestone	Kasamatsu (Kyushu)
Fusulinid Zones	*Pseudoschwagerina* zone		*Parafusulina* zone			*Lepidolina-Yabeina* zone			
Fistulipora cf. *timorensis* BASSLER					+	+		+	
Fistulipora iwaizakiensis SAKAGAMI, n. sp.						+			
Fistulipora kesenumensis SAKAGAMI, n. sp.				+					
Fistulipora takauchiensis SAKAGAMI, n. sp.								+	
Fistulipora megastoma SAKAGAMI, n. sp.				+					
Fistulipora regularis SAKAGAMI, n. sp.			+						
Fistulipora kumaensis SAKAGAMI, n. sp.									+
Fistulipora sp. indet. A						+		+	
Fistulipora sp. indet. B									+
Fistulipora sp. indet. C					+				
Fistulipora sp. indet. D			+						
Fistulipora sp. indet. E	+								
Meekopora densa SAKAGAMI, n. sp.						+			
Meekopora delicata SAKAGAMI, n. sp.				+	+				
Prismopora deformis SAKAGAMI, n. sp.								+	+
Prismopora kuzuensis SAKAGAMI, n. sp.			+						
Coscinotrypa minor SAKAGAMI, n. sp.	+								
Coscinotrypa ? sp. indet.						+			
Ramipora ambigua SAKAGAMI, n. sp.						+			
Goniocladia intricata SAKAGAMI, n. sp.						+			
Batostomella yamazakii SAKAGAMI, n. sp.						+			
Botostomella igoi SAKAGAMI, n. sp.						+			
Batostomella microstoma SAKAGAMI, n. sp.						+			
Batostomella spinigera BASSLER					+				
Batostomella sp. indet.				+					
Dyscritella iwaizakiensis SAKAGAMI, n. sp.						+			
Dyscritela cylindrica (CROCKFORD) ?						+			
Dyscritella takauchiensis SAKAGAMI, n. sp.							+	+	
Dyscritella sp. indet.							+		
Stenopora sp. indet. A			+						
Stenopora sp. indet. B			+						
Leioclema globosa CROCKFORD				+					
Coeloclemis minima SAKAGAMI, n. sp.						+			
Tabulipora cf. *maculosa* NIKIFOROVA	+								
Tabulipora ? sp. indet.				+					
Fenestella (*Minilya*) *rhomboidea* NIKIFOROVA					+				
Fenestella nomatae SAKAGAMI, n. sp.								+	
Fenestella cf. *retiformis* (SCHLOTHEIM)				+					
Fenestella sp. indet. A							+		
Fenestella sp. indet. B							+		
Fenestella sp. indet. C								+	
Polypora fujimotoi SAKAGAMI, n. sp.				+					
Polypora hataii SAKAGAMI, n. sp.				+					
Polypora endoi SAKAGAMI, n. sp.				+					
Polypora sugiyamae SAKAGAMI, n. sp.				+					
Polypora toyokoae SAKAGAMI, n. sp.				+					
Polypora cf. *kutorgae* STUCKENBERG								+	
Polypora longifenestrula SAKAGAMI, n. sp.								+	
Polypora elongata SAKAGAMI, n. sp.								+	
Polypora sp. indet. A							+		
Polypora sp. indet. B							+		
Thamniscus cf. *dubius* (SCHLOTHEIM)				+					
Thamniscus ? *problematicus* SAKAGAMI, n. sp.	+								
Acanthocladia sp. indet.									+
Septopora kamakurae SAKAGAMI, n. sp.								+	
Septopora kawamatae SAKAGAMI, n. sp.				+					
Septopora sp. indet.							+		
Synocladia sp. indet.								+	
Penniretepora iwaizakiensis SAKAGAMI, n. sp.						+			
Penniretepora rectodichotoma SAKAGAMI, n. sp.						+			
Penniretepora tenuis SAKAGAMI, n. sp.						+			
Penniretepora akiyamae SAKAGAMI, n. sp.						+			
Penniretepora sikii SAKAGAMI, n. sp.								+	
Penniretepora zigzag SAKAGAMI, n. sp.							+		
Penniretepora kamiyatsusensis SAKAGAMI, n. sp.				+					
Penniretepora akagii SAKAGAMI, n. sp.		+							
Penniretepora sp. indet.								+	
Rhabdomeson nakazawae SAKAGAMI, n. sp.								+	
Saffordotaxis morikawae SAKAGAMI, n. sp.					+				
Rhombopora ? sp. indet.			+						
Clausotrypa exillis SAKAGAMI, n. sp.						+			
Streblascopora delicatula SAKAGAMI, n. sp.					+	+	+	+	+
Hayasakapora erectoradiata SAKAGAMI						+			
Hayasakapora matsudae SAKAGAMI, n. sp.					+				
Hayasakapora taishakuensis SAKAGAMI, n. sp.		+							
Hayasakapora ? sp. indet.				+			+	+	
Sulcoretepora nipponica SAKAGAMI, n. sp.				+	+				
Sulcoretepora sp. indet.	+								

Plates 1—30

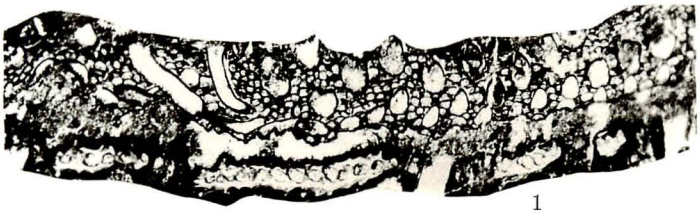
All figures illustrated in the Plates 1-30 are unretouched microphotographs taken by S. SAKAGAMI.

Plate 1

Explanation of Plate 1

Figs. 1-8. *Fistulipora* cf. *timorensis* BASSLER

1, Oblique section, Reg. no. 5207-A, ×10, 2, Longitudinal section, Reg. no. 5214-A, ×10, Loc.: The d member of the Iwaizaki limestone; 3, Longitudinal section, Reg. no. 8113-B, ×10, 4, Tangential section, Reg. no. 8113-A, ×10, Loc.: The Takauchi limestone; 5, 7, Longitudinal sections, Reg. nos. 5093-B and 5085-A, respectively, ×10, 6, Tangential section, Reg. no. 5090-A, ×10, 8, Obliquely tangential section, Reg. no. 5093-A, ×10, Loc.: The h member of the Iwaizaki limestone.



1

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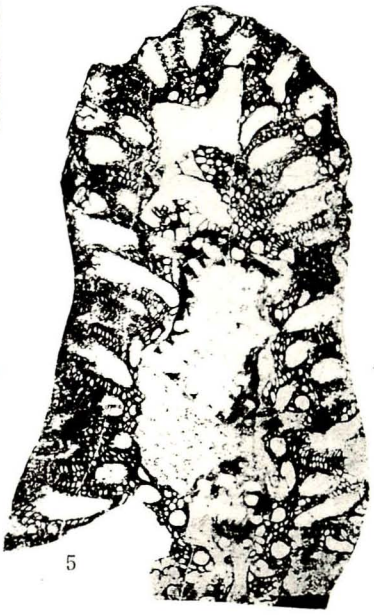

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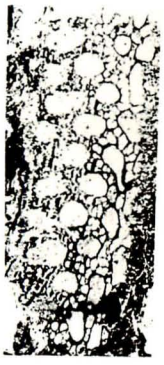

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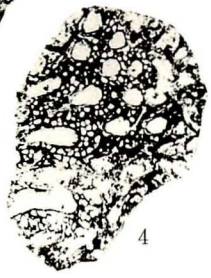

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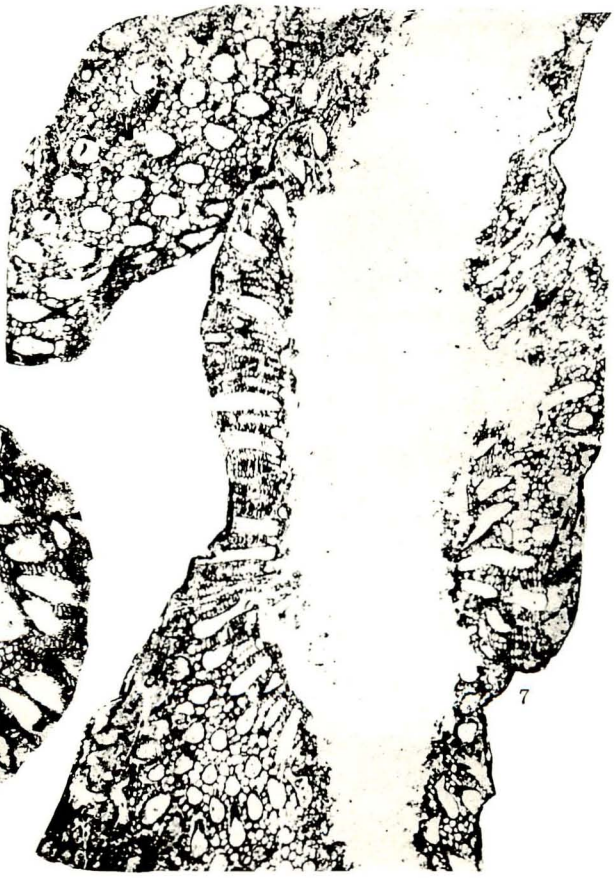

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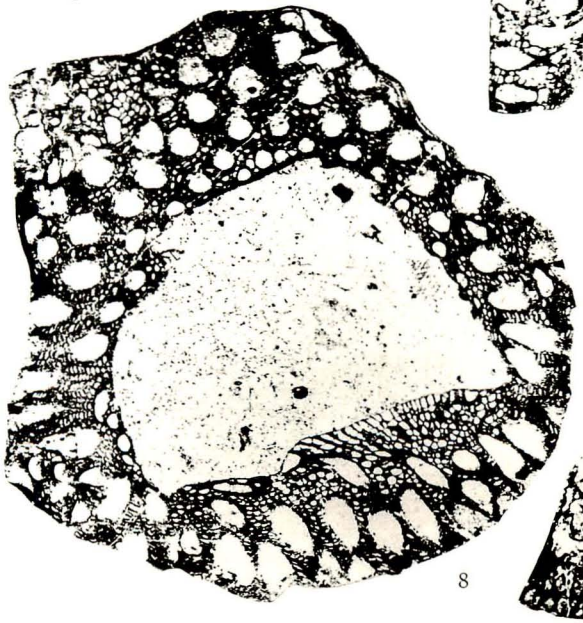

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Plate 2

Explanation of Plate 2

Figs. 1–3. *Fistulipora iwaizakiensis* SAKAGAMI, n. sp.
Oblique sections, Reg. nos. 5068-A (holotype), 5074-A and 5066-A, respectively, ×10, Loc.: The h member of Iwaizaki limestone.

Figs. 4, 5. *Fistulipora kesenumensis* SAKAGAMI, n. sp.
4, Longitudinal section, Reg. no. 5531-A (holotype), ×10, 5, Obliquely tangential section, Reg. no. 5509-A, ×10, Loc.: Kamiyatsuse.


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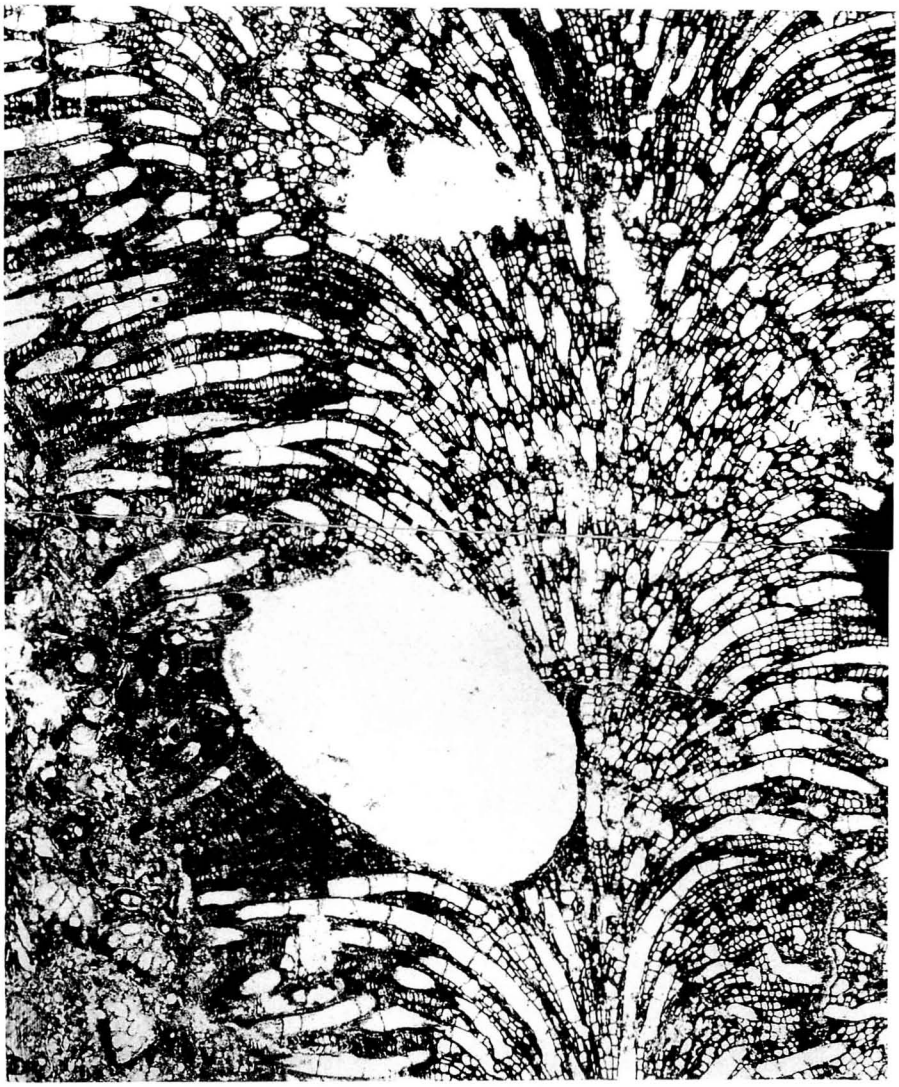
Plate 3

Explanation of Plate 3

Figs. 1-2. *Fistulipora takauchiensis* SAKAGAMI, n. sp.
1, Longitudinal section, Reg. no. 8120 (holotype), ×10, 2, Enlarged part of Fig. 1, ×20, Loc.: The Takauchi limestone.



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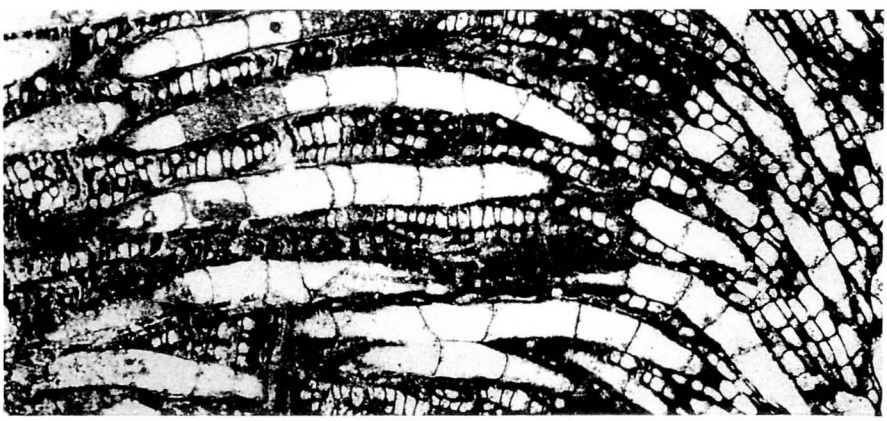

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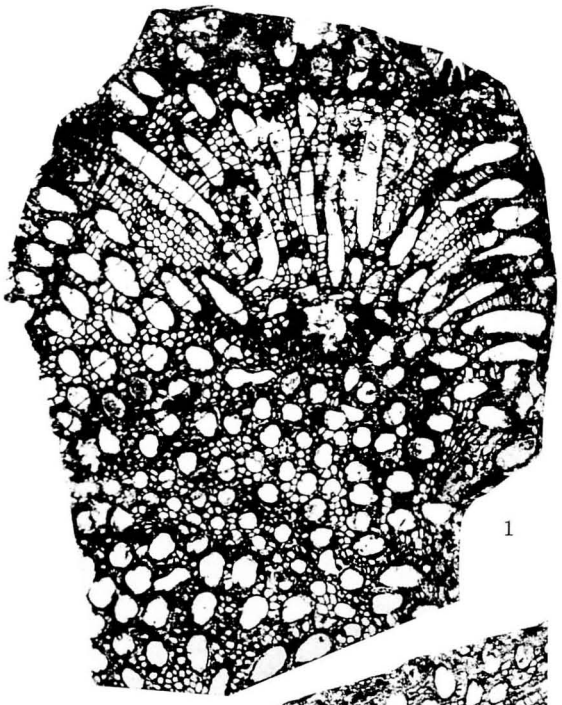
Plate 4

Explanation of Plate 4

Figs. 1–5. *Fistulipora takauchiensis* SAKAGAMI, n. sp.
1–3, Obliquely longitudinal sections, Reg. nos. 8137-A, 8130-A and 8119-A, respectively, ×10; 4, 5, tangential sections, Reg. nos. 8118-A and 8119-B, respectively, ×10 and ×20. Loc.: The Takauchi limestone.



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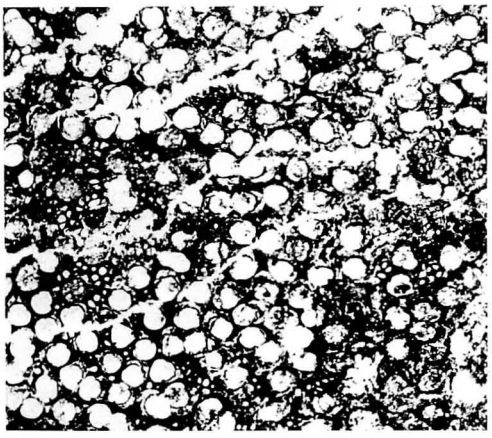

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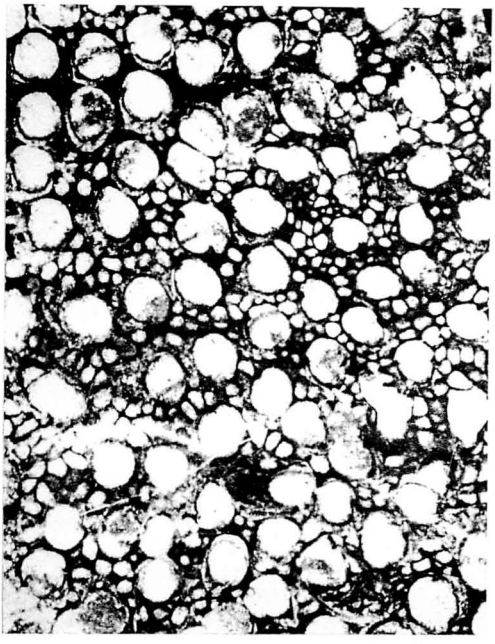

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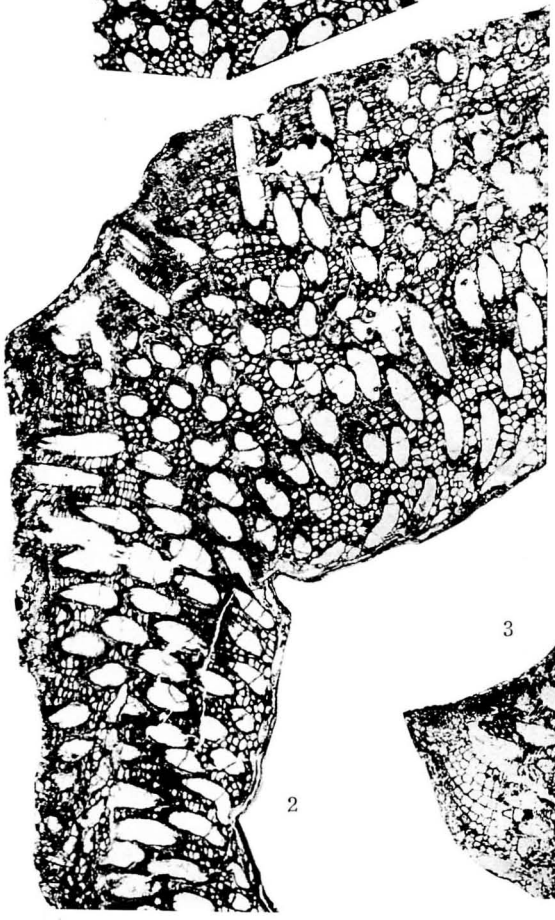

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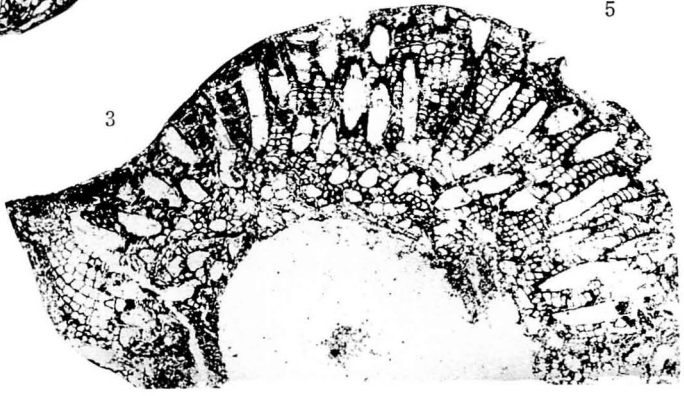

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Plate 5

Explanation of Plate 5

Figs. 1, 2. *Fistulipora megastoma* SAKAGAMI, n. sp.
1, Obliquely longitudinal section, Reg. no. 5531-A, ×10, 2, Tangential section, Reg. no. 5521-A, ×10, Loc.: Kamiyatsuse.

Fig. 3. *Fistulipora* sp. indet. B
Oblique section, Reg. no. 9027-A, ×10, Loc.: Kasamatsu.

Figs. 4-6. *Fistulipora* sp. indet. C
4, Obliquely longitudinal section, Reg. no. 5212-A, ×10,
5, Obliquely tangential section, Reg. no. 5218-A, ×10, 6, Longitudinal section, Reg. no. 5203-A, ×10, Loc.: The d member of the Iwaizaki limestone.

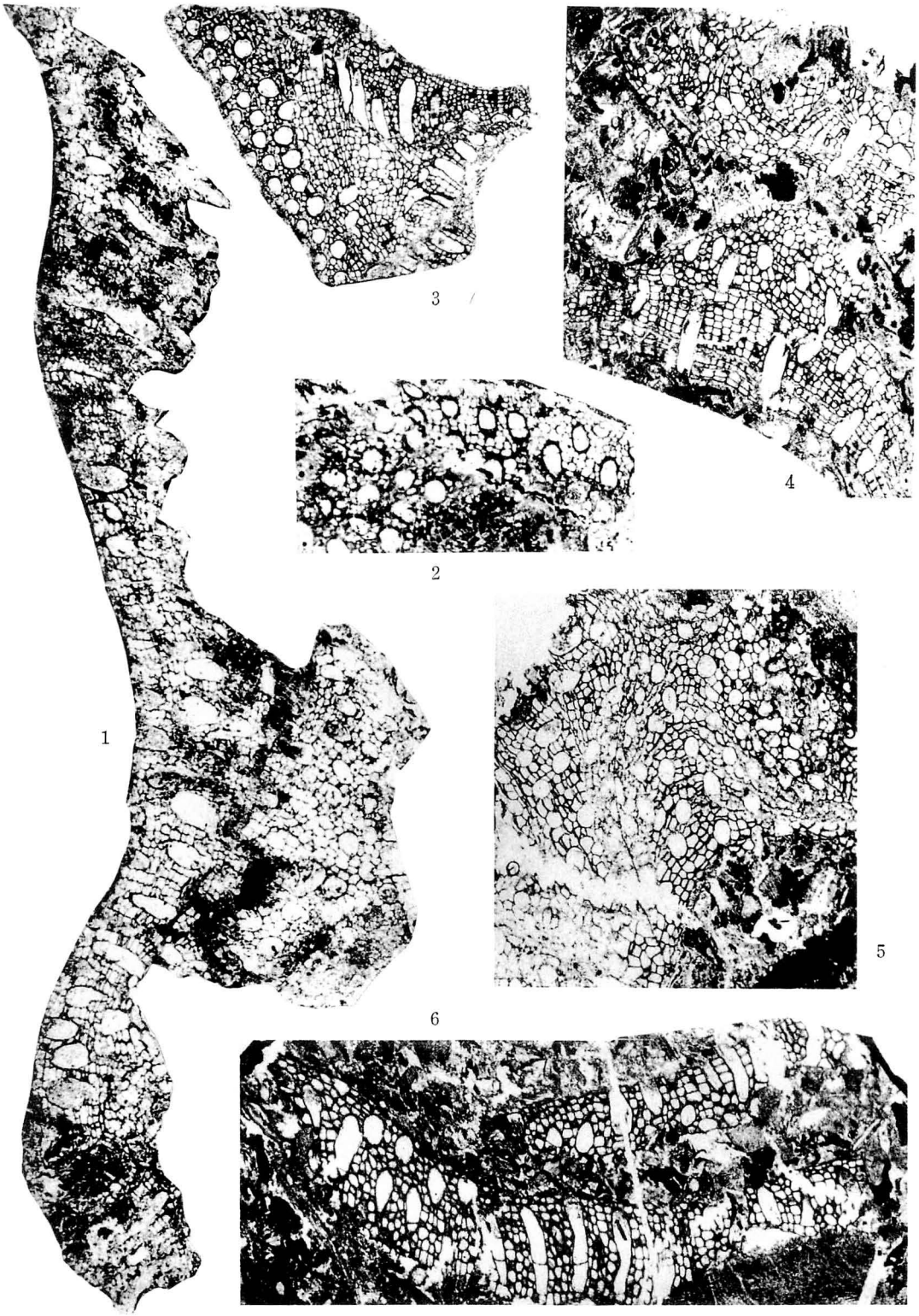
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Plate 6

Explanation of Plate 6

Figs. 1-4. *Fistulipora* sp. indet. A

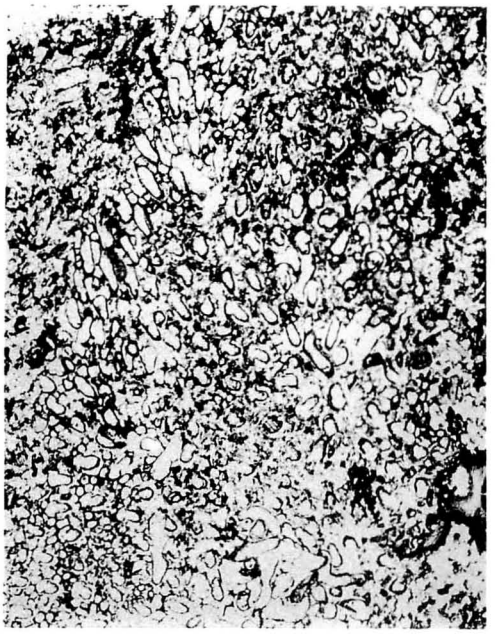
1, 4, Obliquely tangential sections, Reg. nos. 8103-A and 5076-A, respectively, ×10, 2, 3, Enlarged parts of Figs. 1 and 4, respectively, ×20, Loc.: 1, 2, The Takauchi limestone; 3, 4, The h member of the Iwaizaki limestone.

Figs. 5, 6. *Fistulipora kumaensis* SAKAGAMI, n. sp.

5, Longitudinal section, Reg. no. 9027-A, ×10, 6, Tangential section, Reg. no. 9028-A, ×10, Loc.: Kasamatsu.

Fig. 7. *Fistulipora* sp. indet. E

Obliquely longitudinal section, Reg. no. 6515-A, ×10, Loc.: The Omi limestone.



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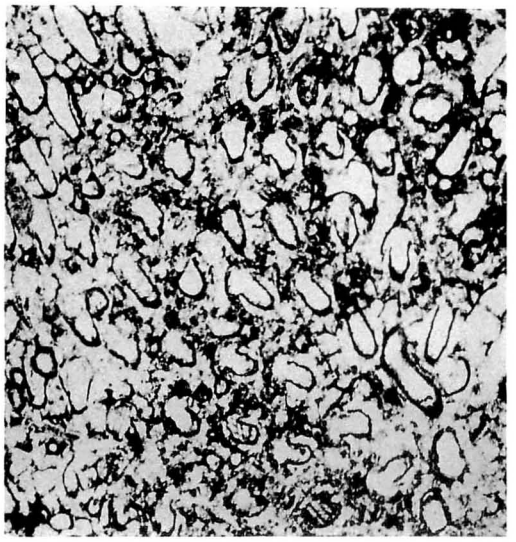

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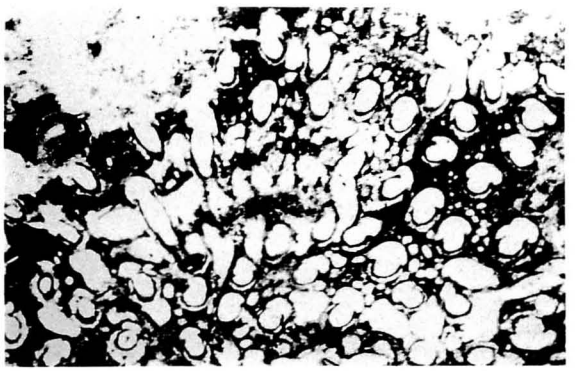

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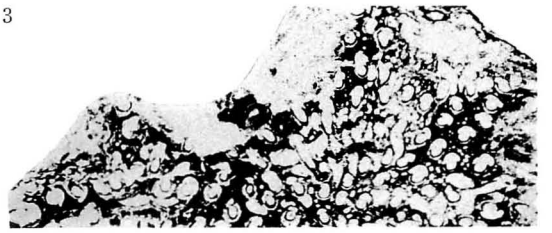

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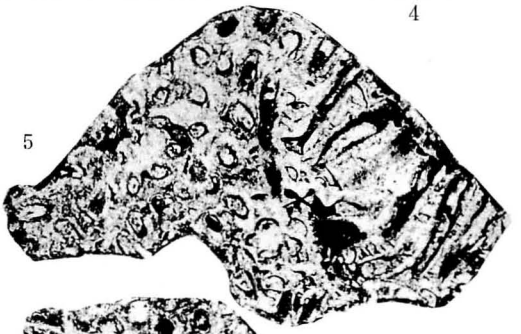

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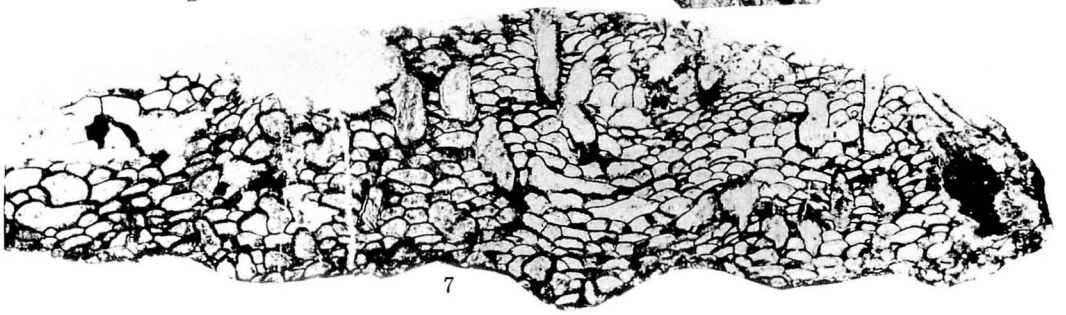

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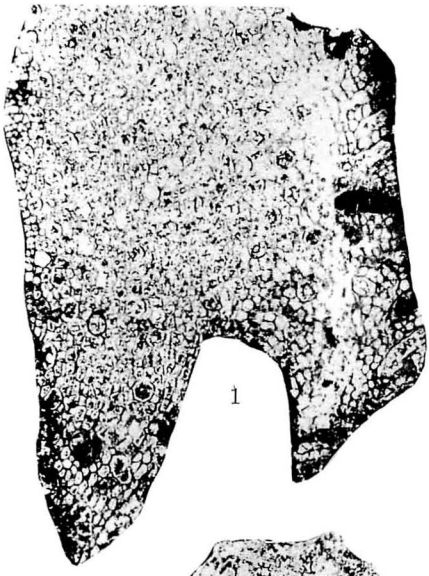
Plate 7

Explanation of Plate 7

Figs. 1-3, *Fistulipora regularis* SAKAGAMI, n. sp.
1, 3, Tangential sections, Reg. nos. 6206-A and 6203-A, respectively, ×10, 2, Longitudinal section, Reg. no. 6209-A (holotype), ×10, Loc.: The Kuzuu limestone.

Figs. 4, 5. *Fistulipora* sp. indet. D
4, Tangential section, Reg. no. 6203-B, ×10, 5, Obliquely longitudinal section, Reg. no. 6207-A, ×10, Loc.: The Kuzuu limestone.

Figs. 6, 7. *Meekopora densa* SAKAGAMI, n. sp.
Longitudinal sections, Reg. nos. 5043-A (holotype), and 5041-B, respectively, ×20, Loc.: The h member of the Iwaizaki limestone.



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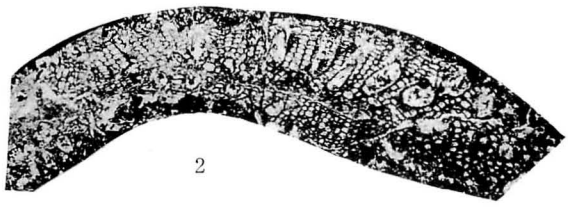

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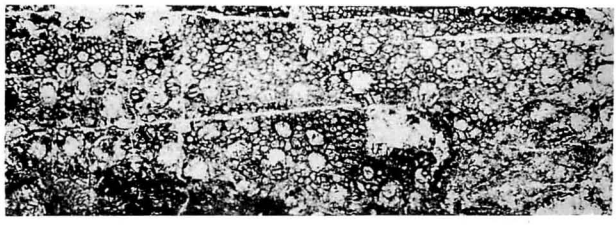

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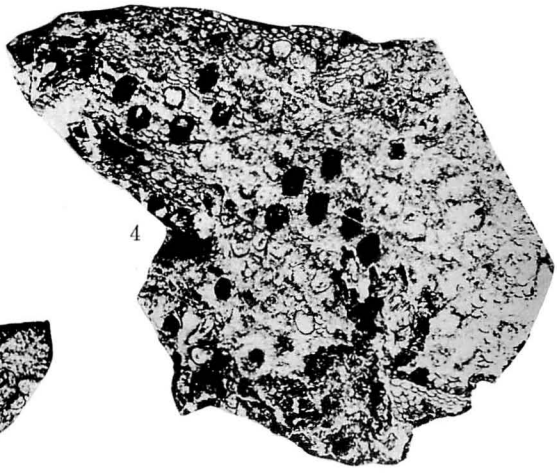

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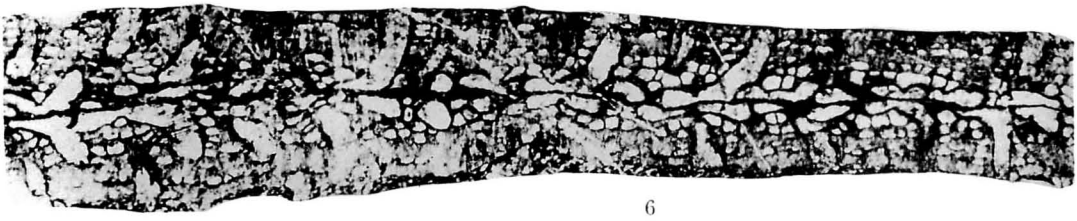

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Plate 8

Explanation of Plate 8

Figs. 1, 2. *Meekopora delicata* SAKAGAMI, n. sp.
Longitudinal sections, Reg. nos. 5223-A and 5540-A (holotype), respectively, ×10, Loc.: The d member of the Iwaizaki limestone and Kamiyatsuse, respectively.

Figs. 3-6. *Prismopora deformis* SAKAGAMI, n. sp.
3, 4, Transverse section, Reg. no. 8101-D (holotype), ×20 and ×10, respectively, Loc.: The Takauchi limestone. 5, 6, Transverse section, Reg. no. 9024-A, ×20 and ×10, respectively, Loc.: Kasamatsu.

Figs. 7-9. *Prismopora kuzuensis* SAKAGAMI, n. sp.
7, 8, Transverse sections, Reg. nos. 6210-A (holotype) and 6202-A, respectively, 9, Longitudinal section, Reg. no. 6202-B, ×10, Loc.: The Kuzuu limestone.

Figs. 10-12. *Coscinotrypa minor* SAKAGAMI, n. sp.
10, Tangential section, Reg. no. 6509-A, 11, 12, Obliquely transverse sections, Reg. nos. 6508-A and 6508-B, respectively, ×10, Loc.: The Omi limestone.


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Plate 9

Explanation of Plate 9

Figs. 1, 2. *Ramipora ambigua* SAKAGAMI, n. sp.
1, Longitudinal section, Reg. no. 5004-A (holotype), ×10, 2, Enlarged part of Fig. 1, ×20, Loc.: The h member of the Iwaizaki limestone.

Figs. 3, 4. *Coscinotrypa minor* SAKAGAMI, n. sp.
3, Surface specimen, Reg. no. 6500-A (holotype), ×5, 4, Obliquely transverse section, Reg. no. 6509-B, ×10, Loc.: The Omi limestone.

Figs. 5, 6. *Coscinotrypa*? sp. indent.
Oblique sections, Reg. nos. 5013-B and 5052-B, respectively, ×10, Loc.: The h member of the Iwaizaki limestone.

Figs. 7, 8. *Batostomella yamazakii* SAKAGAMI, n. sp.
Transverse sections, Reg. nos. 5006-B and 5009-A, respectively, ×10, Loc.: The h member of the Iwaizaki limestone.

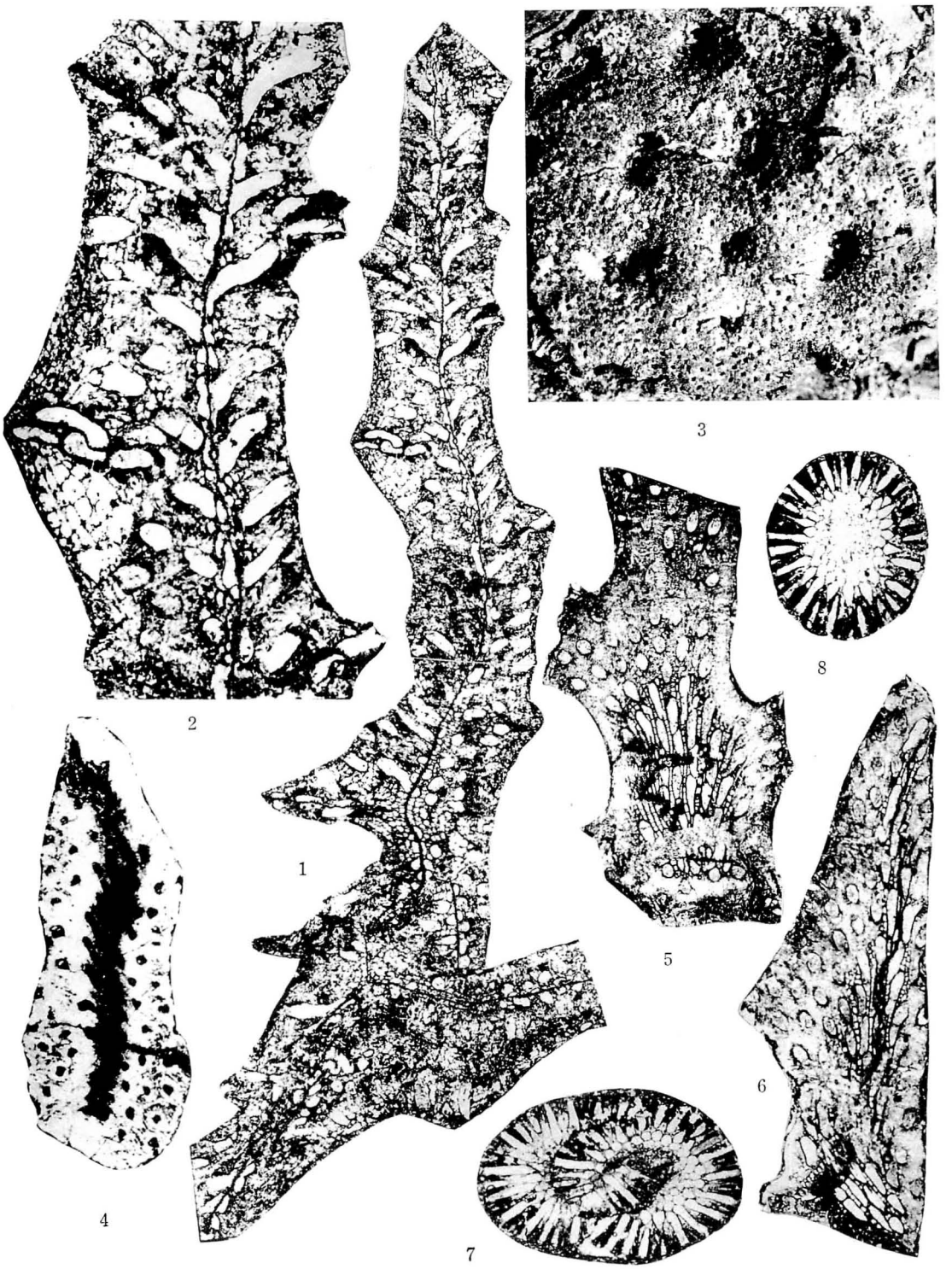

Plate 10

Explanation of Plate 10

Figs. 1–3. *Batostomella yamazakii* SAKAGAMI, n. sp.
Longitudinal sections, Reg. nos. 5006-A (holotype), 5062-A and 5022-A, respectively, ×10, Loc.: the h member of the Iwaizaki limestone.

Fig. 4. *Batostomella microstoma* SAKAGAMI, n. sp.
Longitudinal section, Reg. no. 5071-A (holotype), ×10, Loc.: The h member of the Iwaizaki limestone.

Figs. 5–9. *Batostomella igoi* SAKAGAMI, n. sp.
5–8, Longitudinal and partly tangential sections, Reg. nos. 5093-C (holotype), 5092-A, 5075-B and 5058-B, respectively, ×10, 9, Transverse section, Reg. no. 5060-A, ×10, Loc.: The h member of the Iwaizaki limestone.

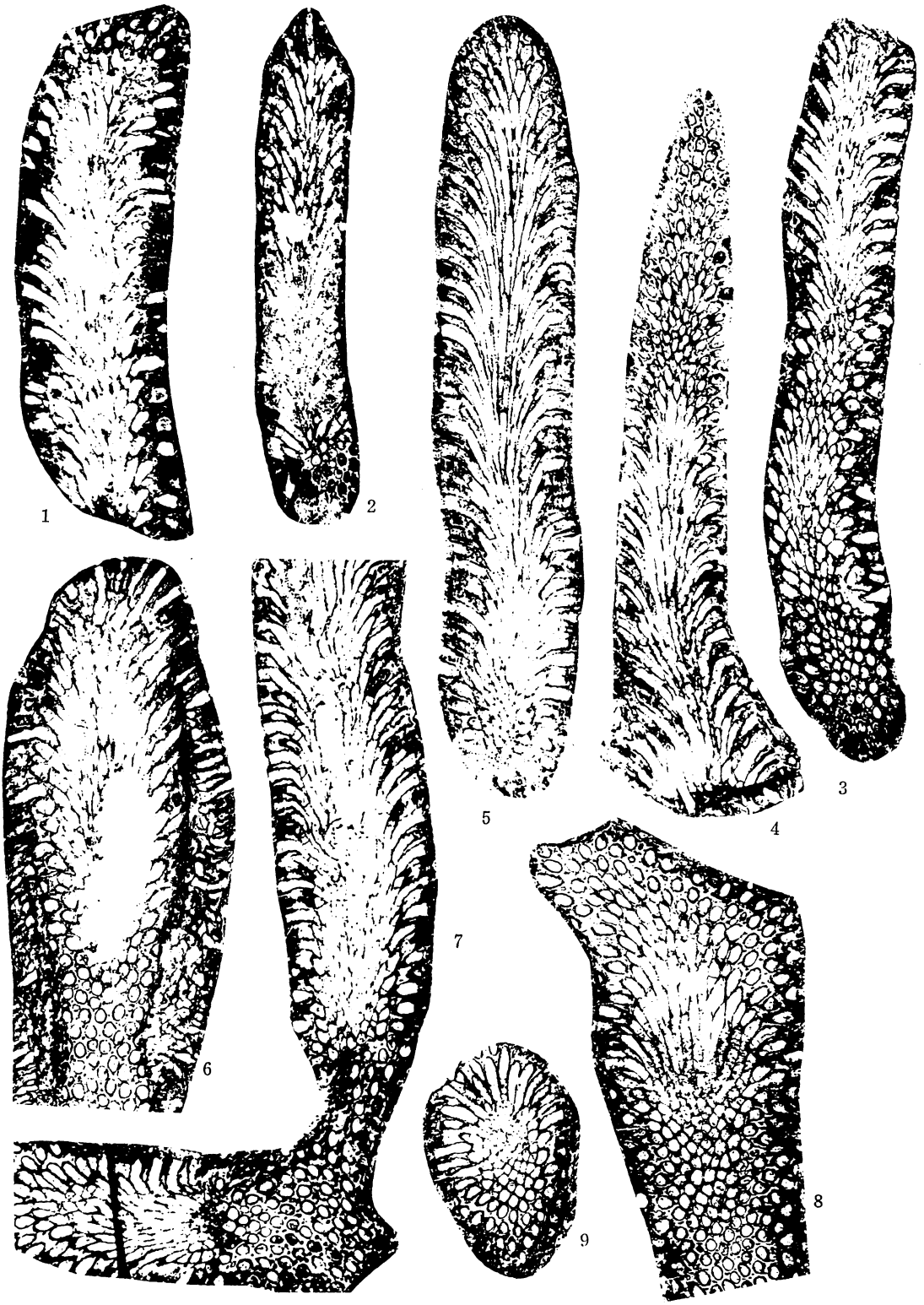
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Plate 11

Explanation of Plate 11

Figs. 1-4. *Dyscritella iwaizakiensis* SAKAGAMI, n. sp.

1, Longitudinal but partly tangential section, Reg. no. 5057-A (holotype), ×10, 2, Enlarged part of Fig. 1, ×20, 3, 4, Transverse sections, Reg. nos. 5057-C, 5057-B, respectively, ×10, Loc.: The h member of the Iwaizaki limestone.

Figs. 5, 6. *Batostomella igoi* SAKAGAMI, n. sp.

5, Longitudinal but partly tangential section, Reg. nos. 5008-A, ×10, 6, Enlarged part of Fig. 5, ×20, Loc.: The h member of the Iwaizaki limestone.

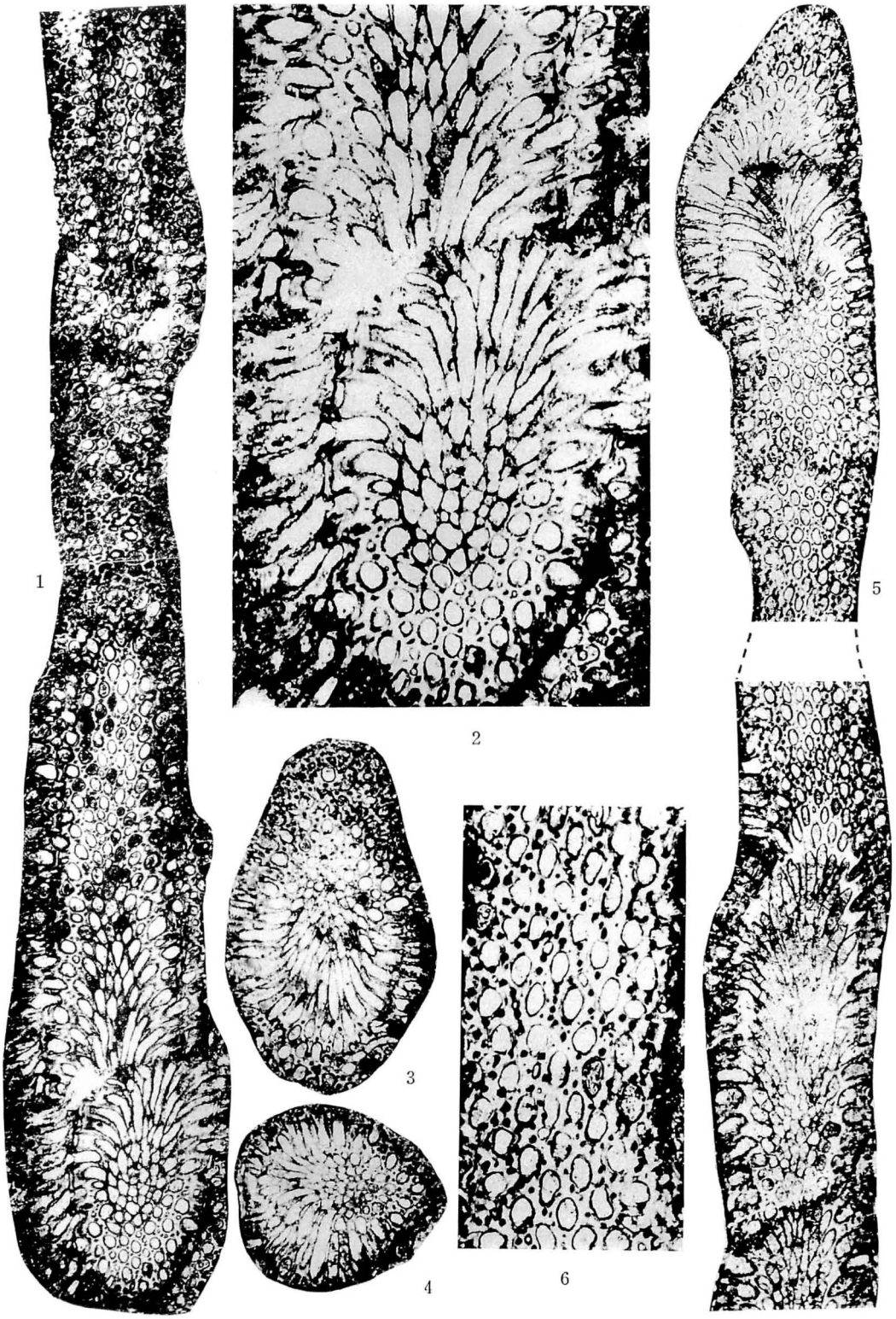
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Plate 12

Explanation of Plate 12

Figs. 1-2. *Dyscritella iwaizakiensis* SAKAGAMI, n. sp.
1, Longitudinal section, Reg. no. 5056-A, ×10, 2, Enlarged part of Fig. 1, ×20, Loc.: The h member of the Iwaizaki limestone.

Figs. 3-6. *Batostomella spinigera* BASSLER
3, Obliquely transverse section, Reg. no. 5206-A, ×10, 4, Longitudinal section of proximal part, showing zoarium attached with foreign substance, Reg. no. 5204-A, ×10, 5, Longitudinal section, Reg. no. 5203-A, ×10, 6, Enlarged part of Fig. 5, ×20. Loc.: The d member of the Iwaizaki limestone.

Figs, 7, 8. *Batostomella* sp. indet.
7, Longitudinal section, Reg. no. 5528-A, ×10, 8, Transverse section, Reg. no. 5524-A, ×10, Loc.: Kamiyatsuse.

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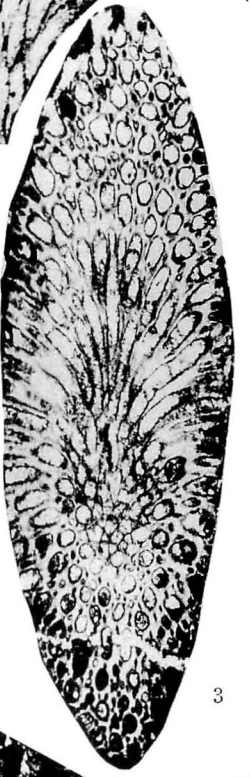

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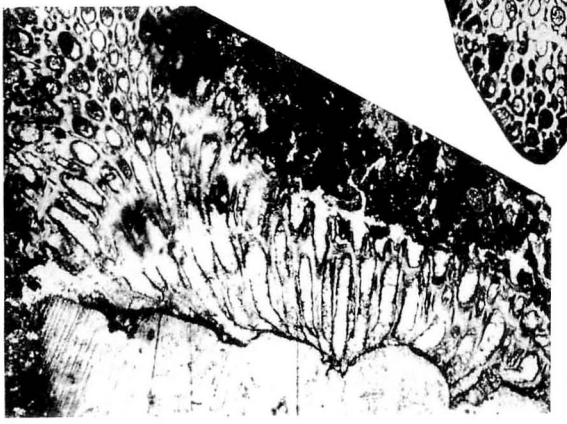

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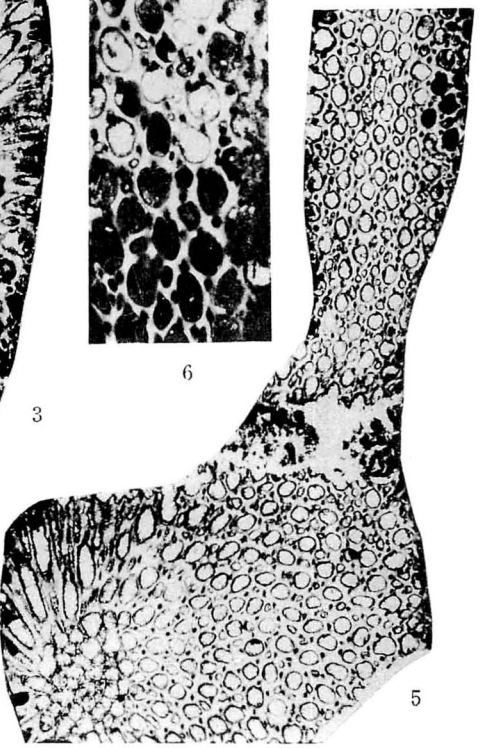

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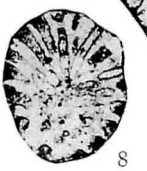

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Plate 13

Explanation of Plate 13

Figs. 1, 2. *Dyscritella iwaizakiensis* SAKAGAMI, n. sp.
Longitudinal sections, Reg. no. 5077-A and 5094-A, respectively, ×10, Loc.: The h member of the Iwaizaki limestone.

Fig. 3. *Dyscritella cylindrica* (CROCKFORD) ?
Typical longitudinal section, Reg. no. 5048-B, ×10, Loc.: The h member of the Iwaizaki limestone.

Figs. 4-11. *Dyscritella takauchiensis* SAKAGAMI, n. sp.
4, 5, Transverse sections, Reg. nos. 8130-B and 8137-B, respectively, ×10, 6, 7, 11, Oblique sections, Reg. no. 8105-A, 8112-A (holotype), 8111-A, respectively, ×10, 8, Longitudinal section, Reg. no. 8136-A, ×10, 10, Transverse section, Reg. no. 8012-B, ×10; Loc.: 4-9, 11, Takauchi limestone, 10, Kawahigashi.

Fig. 12. *Dyscritella* sp. indet.
Longitudinal section, Reg. no. 8012-B, ×10, Loc.: Kawahigashi.

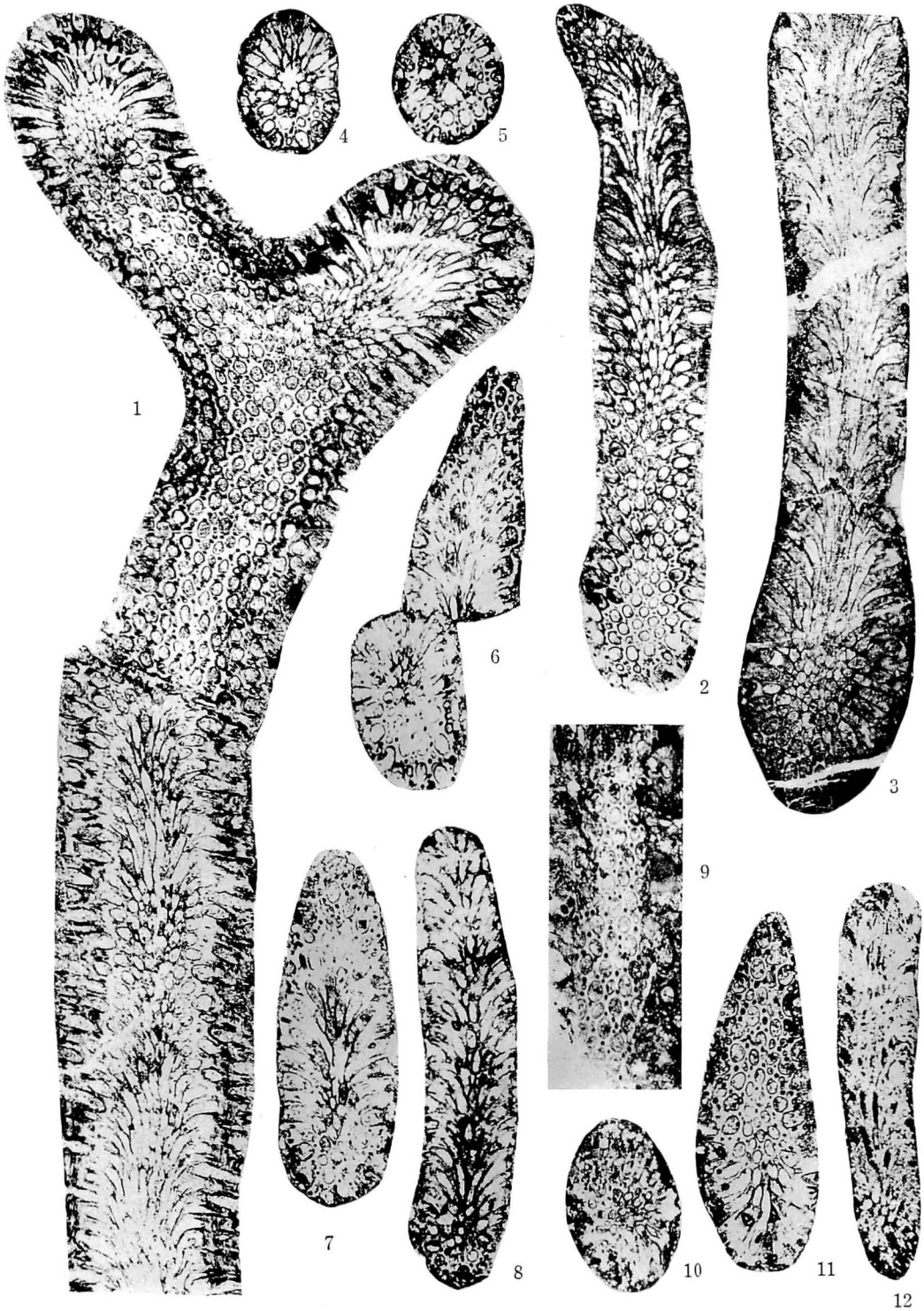
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Plate 14

Explanation of Plate 14

Figs. 1, 2. *Stenopora* sp. indet. A
1, Longitudinal section, Reg. no. 6208-B, ×10, 2, Transverse section, Reg. no. 6208-C, ×10, Loc.: The Kuzuu limestone.

Fig. 3. *Goniocladia intricata* SAKAGAMI, n. sp.
Tangential section, Reg. no. 5033-A (holotype), ×10, Loc.: The h member of the Iwaizaki limestone.

Fig. 4. *Stenopora* sp. indet. B
Showing zoarium attached with *Sulcoretepora* sp. indet., Reg. no. 6207-C, ×10, Loc.: The Kuzuu limestone.

Fig. 5. *Dyscritella takauchiensis* SAKAGAMI, n. sp.
Oblique section, Reg. no. 8110-B, ×10, Loc.: The Takauchi limestone.

Figs. 6, 7. *Coeloclemis minima* SAKAGAMI, n. sp.
6, Longitudinal section, Reg. no. 5089-A (holotype), ×10, 7, Enlarged part of Fig. 6, ×20, Loc.: The h member of the Iwaizaki limestone.

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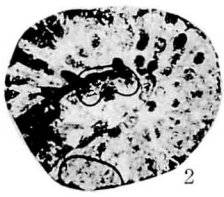

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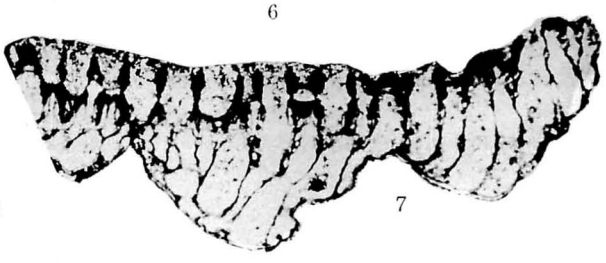

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Plate 15

Explanation of Plate 15

Fig. 1. *Tabulipora* ? sp. indet.
Tangential section, Reg. no. 5508-A, ×10, Loc.: Kamiyatsuse.
Fig. 2. *Leioclema globosa* CROCKFORD
Longitudinal section, Reg. no. 5544-A, ×10, Loc.: Kamiyatsuse.
Fig. 3. *Fenestella nomatae* SAKAGAMI, n. sp.
Tangential section, Reg. no. 8125-A (holotype), ×10, Loc.: The Takauchi limestone.
Fig. 4. *Fenestella* sp. indet. A
Tangential section, Reg. no. 8010-A, ×10, Loc.: Kawahigashi.
Figs. 5, 6. *Tabulipora* cf. *maculosa* NIKIFOROVA
Longitudinal sections, Reg. nos. 6505-A and 6506-A, respectively, ×10, Loc.: The Omi limestone.

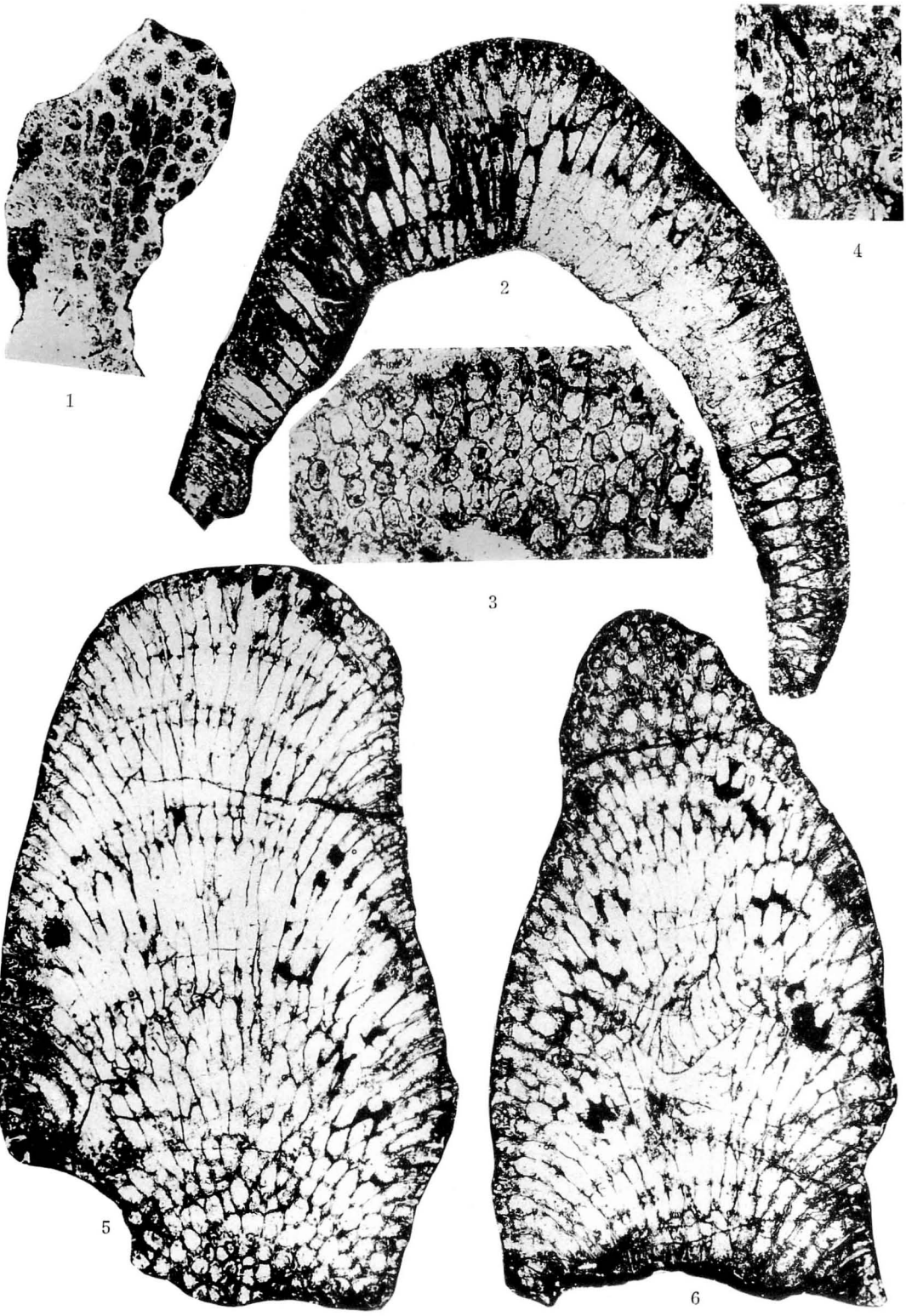
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Plate 16

Explanation of Plate 16

Figs. 1, 2. *Fenestella* (*Minilya*) *rhomboidea* NIKIFOROVA
Tangential sections, Reg. no. 5203, ×10, Loc.: The d member of the Iwaizaki limestone.

Figs. 3-5. *Fenestella* sp. indet. C
Tangential sections, Reg. nos. 8107-A, 8106-B and 8114-A, respectively, ×10, Loc.: The Takauchi limestone.

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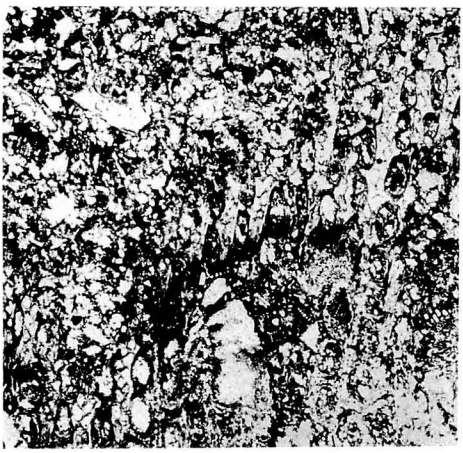

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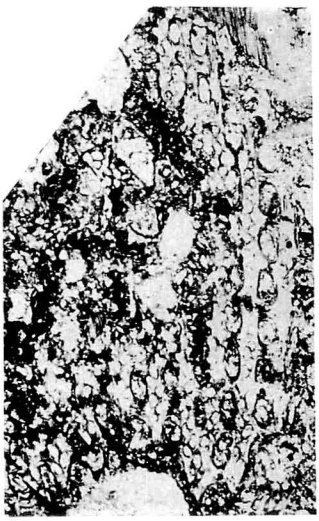

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Plate 17

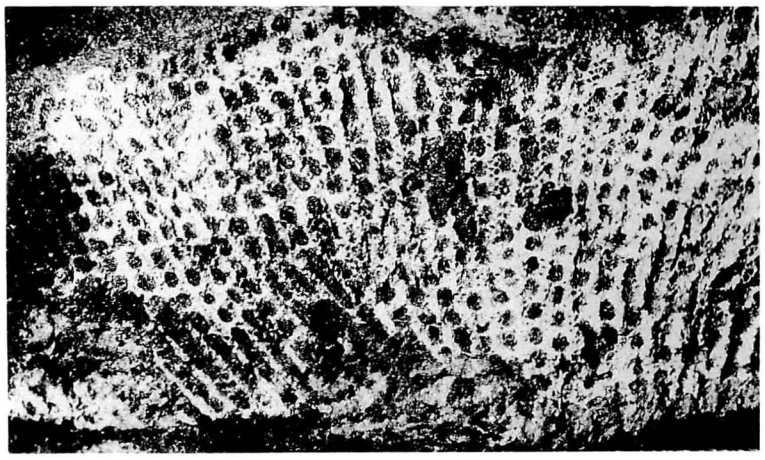
Explanation of Plate 17

Figs. 1-3. *Fenestella* cf. *retiformis* SCHLOTHEIM
1, 2, Obverse surfaces, Reg. nos. S-3 and S-13, respectively, ×5, 3, Enlarged part of Fig. 1, ×10, Loc.: Kamiyatsuse.

Figs. 4, 5. *Fenestella* sp. indet. B
Tangential sections, Reg. nos. 8022-A and 8013-A, respectively, ×10, Loc.: Kawahigashi.

Fig. 6. *Polypora elongata* SAKAGAMI, n. sp.
Tangential section, Reg. no. 8135-B, ×10, Loc.: The Takauchi limestone.

Fig. 7. *Polypora longifenestrula* SAKAGAMI, n. sp.
Tangential section, Reg. no. 8124-A, ×10, Loc.: The Takauchi limestone.



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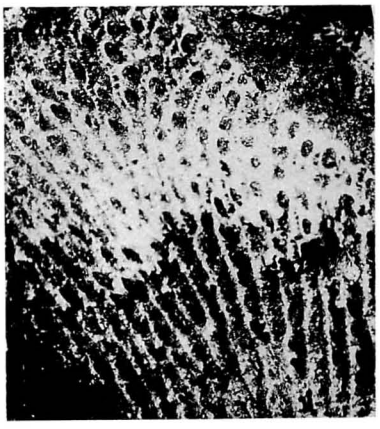

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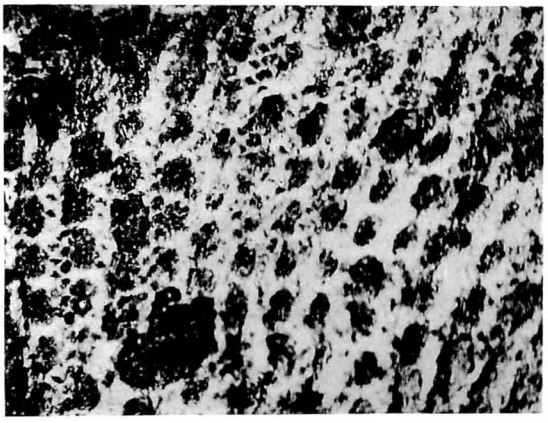

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Plate 18

Explanation of Plate 18

Fig. 1. *Polypora* cf. *kutorgae* STUCKENBERG
Tangential section, Reg. no. 8127-A, ×10, Loc.: The Takauchi limestone.

Fig. 2. *Polypora longifenestrula* SAKAGAMI, n. sp.
Tangential section, Reg. no. 8121-A (holotype), ×10, Loc.: The Takauchi limestone.

Fig. 3. *Polypora* sp. indet. A
Tangential section, Reg. no. 8013-D, ×10, Loc : Kawahigashi.

Fig. 4. *Polypora* sp. indet. B
Tangential section, Reg. no. 8016-C, ×10, Loc.: Kawahigashi.

Figs. 5, 6. *Rhombopora*? sp. indet.
5, Obliquely transverse section, Reg. no. 6208-A, ×10, 6, Transverse section, Reg. no. 6209-B, ×10, Loc.: The Kuzuu limestone.

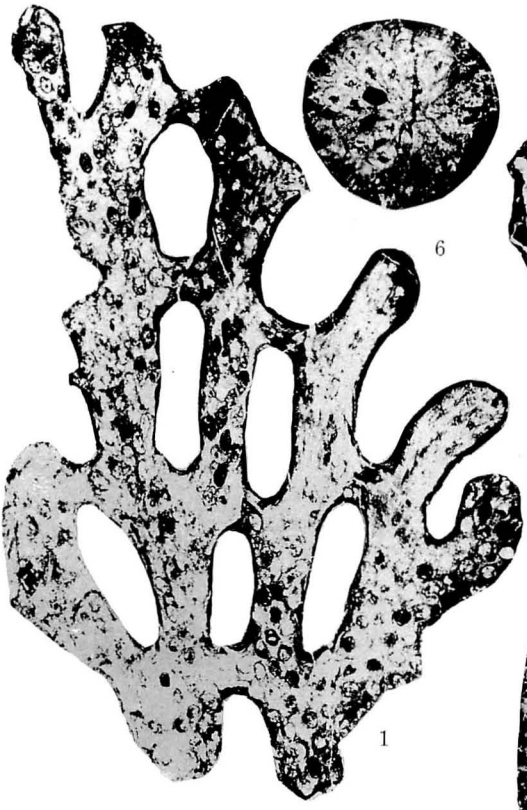

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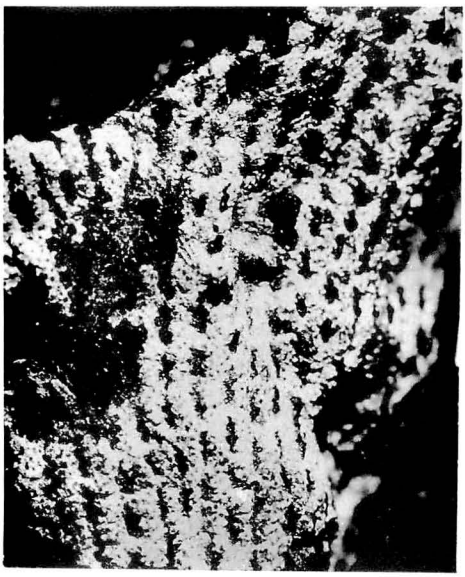
Plate 19

Explanation of Plate 19

Figs. 1-6. *Polypora fujimotoi* SAKAGAMI, n. sp.
1, 3-5, Obverse surfaces, Reg. nos. S-32, S-7, S-2A (holotype) and S-2B, respectively ×5, 2, 6, Enlarged part of Figs. 1 and 5, respectively, ×10, Loc.: Kamiyatsuse.



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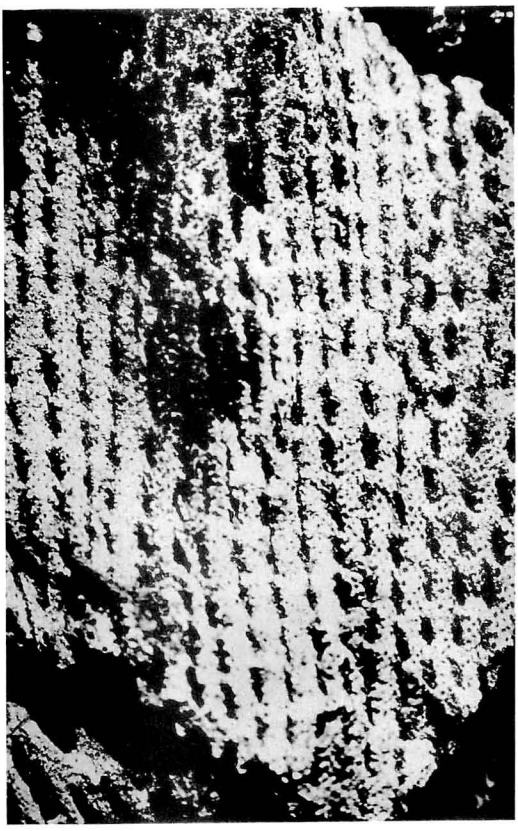

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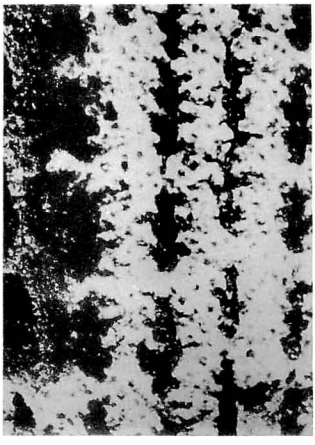

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Plate 20

Explanation of Plate 20

Fig. 1. *Polypora fujimotoi* SAKAGAMI, n. sp.
Obverse surface, Reg. no. S-16, ×5, Loc.: Kamiyatsuse.
Fig. 2. *Polypora hataii* SAKAGAMI, n. sp.
Obverse surface, Reg. no. S-1 (holotype), ×5, Loc.: Kamiyatsuse.
Figs. 3-5. *Polypora endoi* SAKAGAMI, n. sp.
3, Obverse surface, Reg. no. S-3B (holotype), ×5, 4, Enlarged part of Fig. 3, ×10, 5, Reverse surface, Reg. no. S-15, ×5, Loc.: Kamiyatsuse.

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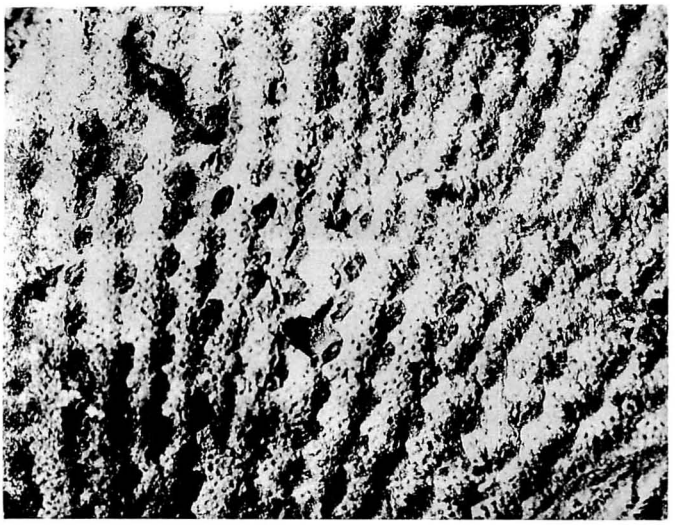

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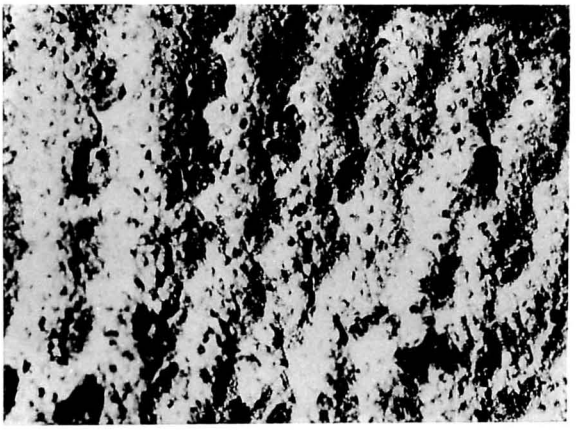

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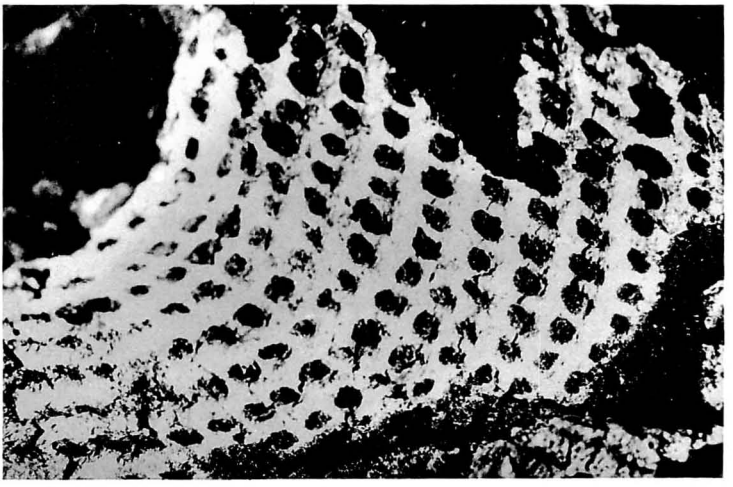

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Plate 21

Explanation of Plate 21

Figs. 1-6. *Polypora sugiyamae* SAKAGAMI, n. sp.
1, 3, 5, Obverse snrfaces, Reg. nos. S-6 (holotype), S-14 and S-34, respectively, ×5, 2, 4, 6, Enlarged parts of Figs. 1, 3, 5, respectively, ×10, Loc.: Kamiyatsuse.
Fig. 7. *Polypora toyokoae* SAKAGAMI, n. sp.
Obverse surface, Reg. no. S-21A (holotype), ×5, Loc.: Kamiyatsuse.


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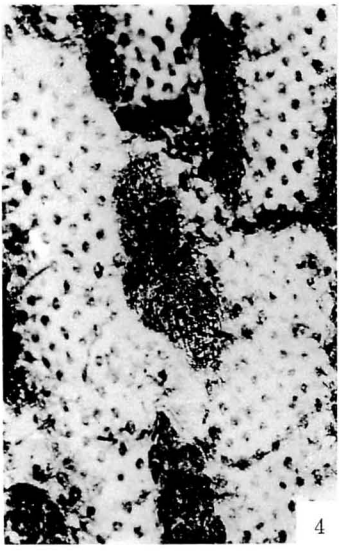
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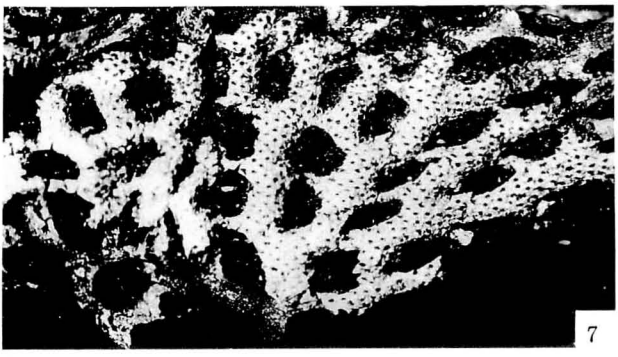
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Plate 22

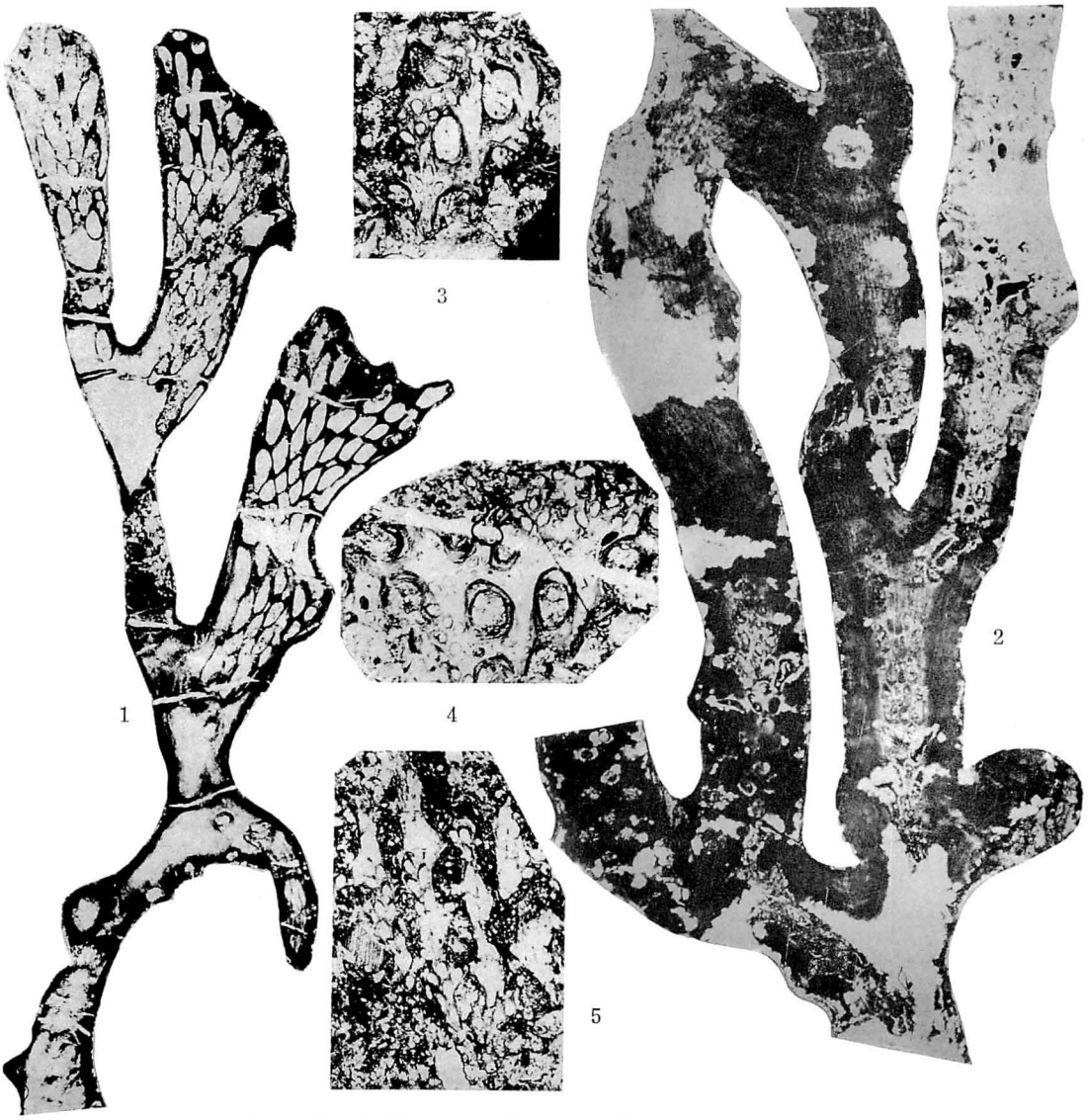
Explanation of Plate 22

Fig. 1. *Thamniscus* cf. *dubius* (SCHLOTHEIM)
Tangential section, Reg. no. 5543-A, ×10, Loc.: Kamiyatsuse.

Fig. 2. *Thamniscus*? *problematicus* SAKAGAMI, n. sp.
Tangential section, Reg. no. 6507-A, ×10, Loc.: The Omi limestone.

Figs. 3-5. *Septopora kamakurae* SAKAGAMI, n. sp.
Tangential sections, Reg. nos. 8117-A (holotype), 8103-B and 8112-B, respectively, ×10, Loc.: The Takauchi limestone.

Figs. 6, 7. *Polypora toyokoae* SAKAGAMI, n. sp.
6, Enlarged part of Fig. 7 of Plate 21, ×10, 7, Reverse surface, Reg. no. S-21B, ×5, Loc.: Kamiyatsuse.



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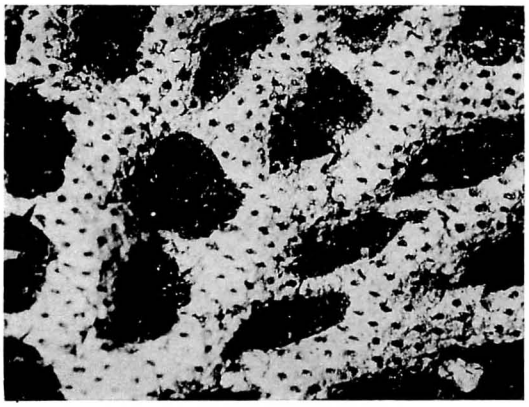

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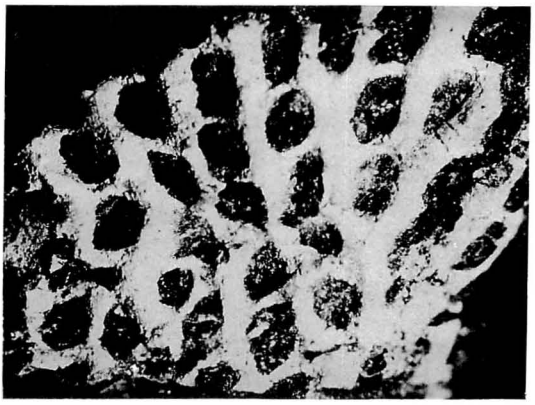

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Plate 23

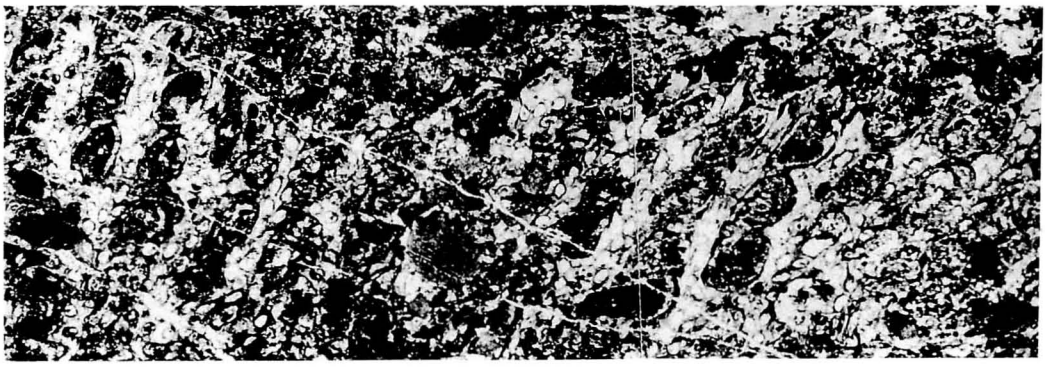
Explanation of Plate 23

Fig. 1. *Septopora* sp. indet.
Tangential section, Reg. no. 8022-C, ×10, Loc.: Kawahigashi.

Figs. 2-4. *Septopora kawamatae* SAKAGAMI, n. sp.
2, 4, Obverse surfaces, Reg. nos. S-24A (holotype) and S-24B, respectively, ×5, 3, Enlarged part of Fig. 2, ×10, Loc.: Kamiyatsuse.

Fig. 5. *Synocladia* sp. indet.
Tangential section, Reg. no. 8125-C, ×10, Loc.: The Takauchi limestone.

Fig. 6. *Acanthocladia* sp. indet.
Tangential section, Reg. no. 9024-B, ×10, Loc.: Kasamatsu.



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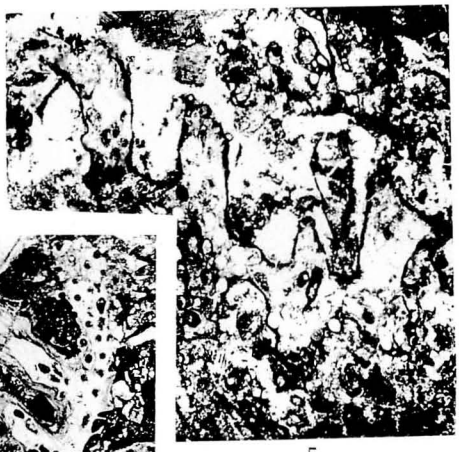

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Plate 24

Explanation of Plate 24

Fig. 1. *Penniretepora tenuis* SAKAGAMI, n. sp.
Tangential section, Reg. no. 5063-C (holotype), ×10, Loc.: The h member of the Iwaizaki limestone.

Fig. 2. *Penniretepora akiyamae* SAKAGAMI, n. sp.
Tangential section, Reg. no. 5073-B (holotype), ×10, Loc.: The h member of the Iwaizaki limestone.

Fig. 3. *Penniretepora iwaizakiensis* SAKAGAMI, n. sp.
Tangential section, Reg. no. 5018-C (holotype), ×10, Loc.: The h member of the Iwaizaki limestone.

Fig. 4. *Penniretepora rectodichotoma* SAKAGAMI, n. sp.
Tangential section, Reg. no. 5064-A (holotype), ×10, Loc.: The h member of the Iwaizaki limestone.

Fig. 5. *Penniretepora* sp. indet.
Tangential section, Reg. no. 8117-C, ×10, Loc.: The Takauchi limestone.

Fig. 6. *Penniretepora sikii* SAKAGAMI, n. sp.
Tangential section, Reg. no. 8134-A (holotype), ×10, Loc.: The Takauchi limestone.

Fig. 7. *Penniretepora zigzag* SAKAGAMI, n. sp.
Tangential section, Reg. no. 8001-B (holotype), ×10, Loc.: Kawahigashi.

Fig. 8. *Penniretepora kamiyatsusensis* SAKAGAMI, n. sp.
Obverse surface, Reg. no. S-14B (holotype), ×10, Loc.: Kamiyatsuse.

Fig. 9. *Penniretepora akagii* SAKAGAMI, n. sp.
Tangential section, Reg. no. 8506-A (holotype), ×10, Loc.: Morono.

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Plate 25

Explanation of Plate 25

Figs. 1, 2. *Rhabdomeson nakazawae* SAKAGAMI, n. sp.
1, Longitudinal section, Reg. no. 8135-C (holotype), ×10, 2, Enlarged part of Fig. 1, Loc.: The Takauchi limestone.

Figs. 3-5. *Saffordotaxis morikawae* SAKAGAMI, n. sp.
3, Longitudinal section, Reg. no. 5210-A (holotype), ×10, 4, 5, Oblique section, Reg. no. 5205-A, ×10 and ×20, respectively, Loc.: The d member of the Iwaizaki limestone.

Fig. 6. *Clausotrypa exillis* SAKAGAMI, n. sp.
Longitudinal section, Reg. no. 5026-A (holotype), ×10, Loc.: The h member of the Iwaizaki limestone.

Figs. 7-10. *Streblascopora delicatula* SAKAGAMI, n. sp.
7, 8, Longitudinal sections, Reg. nos. 8013-A (holotype), and 8010-A, respectively, ×10, 9, Oblique section, Reg. no. 8010-B, ×10, 10, Enlarged part of Fig. 7, ×20, Loc.: Kawahigashi.

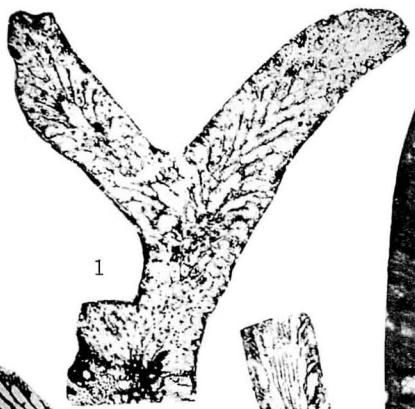
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Plate 26

Explanation of Plate 26

Figs. 1–18. *Streblascopora delicatula* SAKAGAMI, n. sp.
1–3, 5, 7–9, 13, 14, 16–18, Longitudinal sections, Reg. nos. 8011-A, 8010-C, 8018-B, 8003-A, 8011-B, 8114-A, 8135-A, 8104-A, 5072-A, 5018-B, 5088-A and 5090-B, respectively, 4, 6, 10–12, Oblique sections, Reg. nos. 8004-A, 8005-A, 8103-A, 8111-A and 8102-A, respectively, 15, Transverse and tangential sections, Reg. no. 5062-B, ×10. Loc.: 1–7, Kawahigashi; 8–13, The Takauchi limestone; 14–18, The h member of the Iwaizaki limestone.

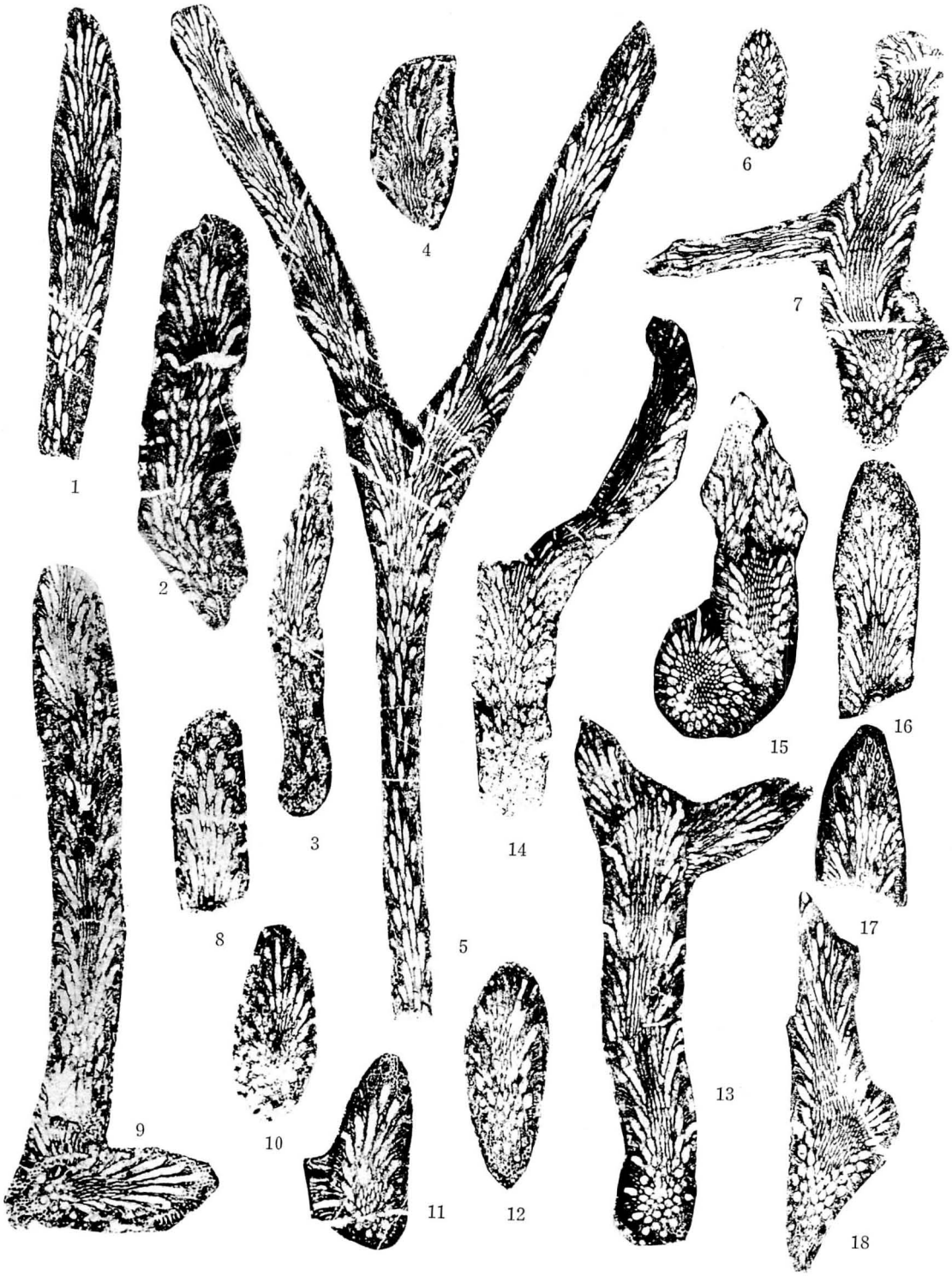
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Plate 27

Explanation of Plate 27

Figs. 1-5. *Streblascopora delicatula* SAKAGAMI, n. sp.
1, Tangential section, Reg. no. 5209-A, 2-4, Transverse sections, Reg. nos. 5218-A, 9030-A and 9030-B, respectively, ×10, 5, Longitudinal section, Reg. no. 9022-A, ×10, Loc.: 1, 2, The d member of the Iwaizaki limestone; 3-5, Kasamatsu.

Figs. 7-11. *Hayasakapora*? sp. indet.
Longitudinal sections, Reg. nos. 8104-C, 8102-A, 5523-A, 5521-B and 8025-C, respectively, ×10. Loc.: 7, 8, The Takauchi limestone; 9, 10, Kamiyatsuse; 11, Kawahigashi.

Figs. 12-14. *Hyasakapora taishakuensis* SAKAGAMI, n. sp.
12, 14, Transverse sections, Reg. nos. 8505-B and 8507-A, respectively, 13, Oblique section of branched part, Reg. no. 8508-B, ×10, Loc.: Morono.

Figs. 15, 16. *Hayasakapora matsudae* SAKAGAMI, n. sp.
15, Transverse section, Reg. no. 5211-A, 16, Longitudinal section, Reg. no. 5215-A, ×10, Loc.: The d member of the Iwaizaki limestone.

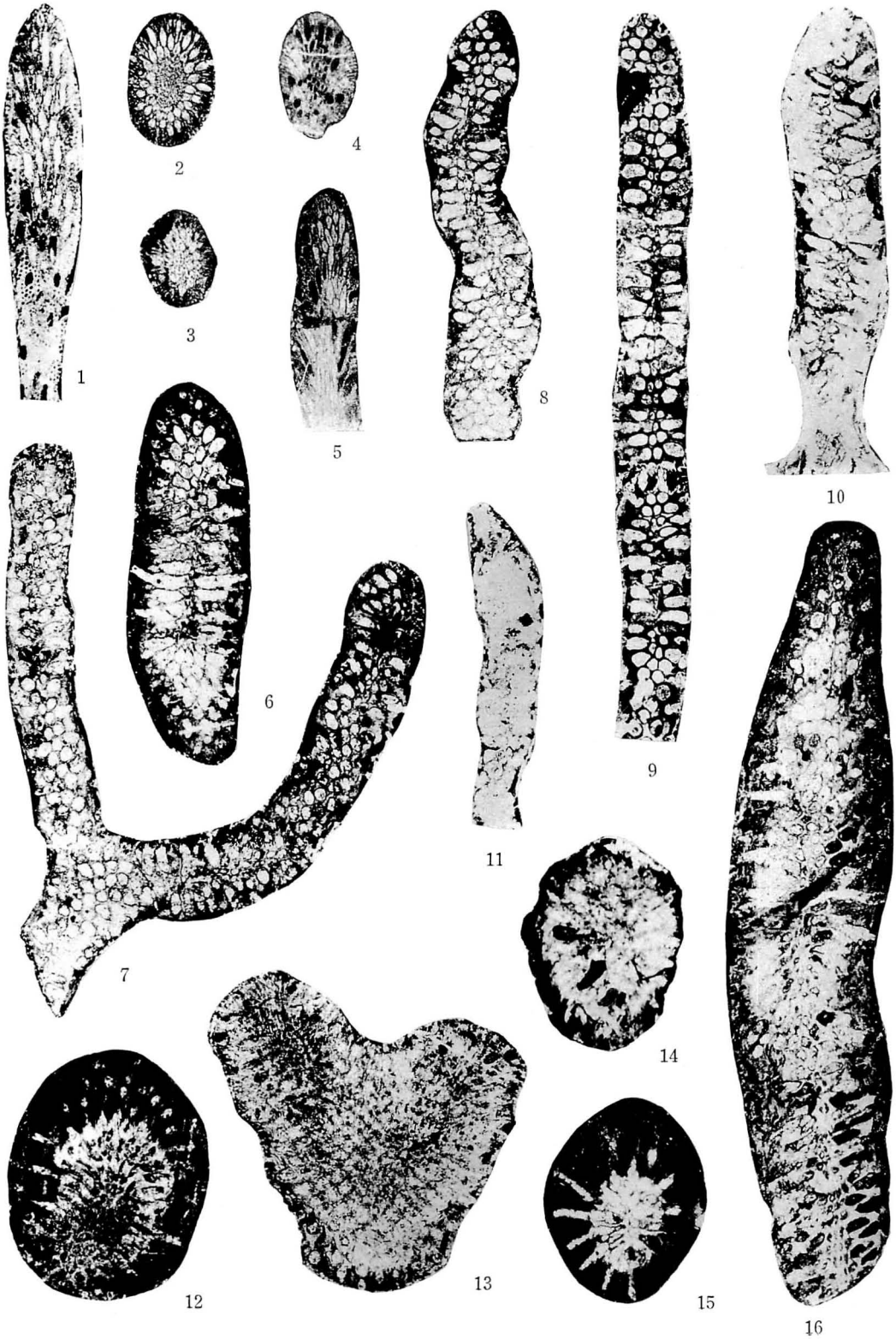
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Plate 28

Explanation of Plate 28

Figs. 1-4. *Hayasakapora taishakuensis* SAKAGAMI, n. sp.
1, 4, Longitudinal sections, Reg. no. 8505-A (holotype), and 8503-A, respectively, ×10, 2, Enlarged part of Fig. 1, ×20, 3, Transverse section, Reg. no. 8508-A, ×10, Loc.: Morono.

Figs. 5-8. *Sulcoretepora nipponica* SAKAGAMI, n. sp.
5, Obliquely longitudinal section, Reg. no. 5537-A, 6-8, Longitudinal sections, Reg. nos. 5521-B, 5520-A and 5511-A, respectively, ×10, Loc.: Kamiyatsuse.

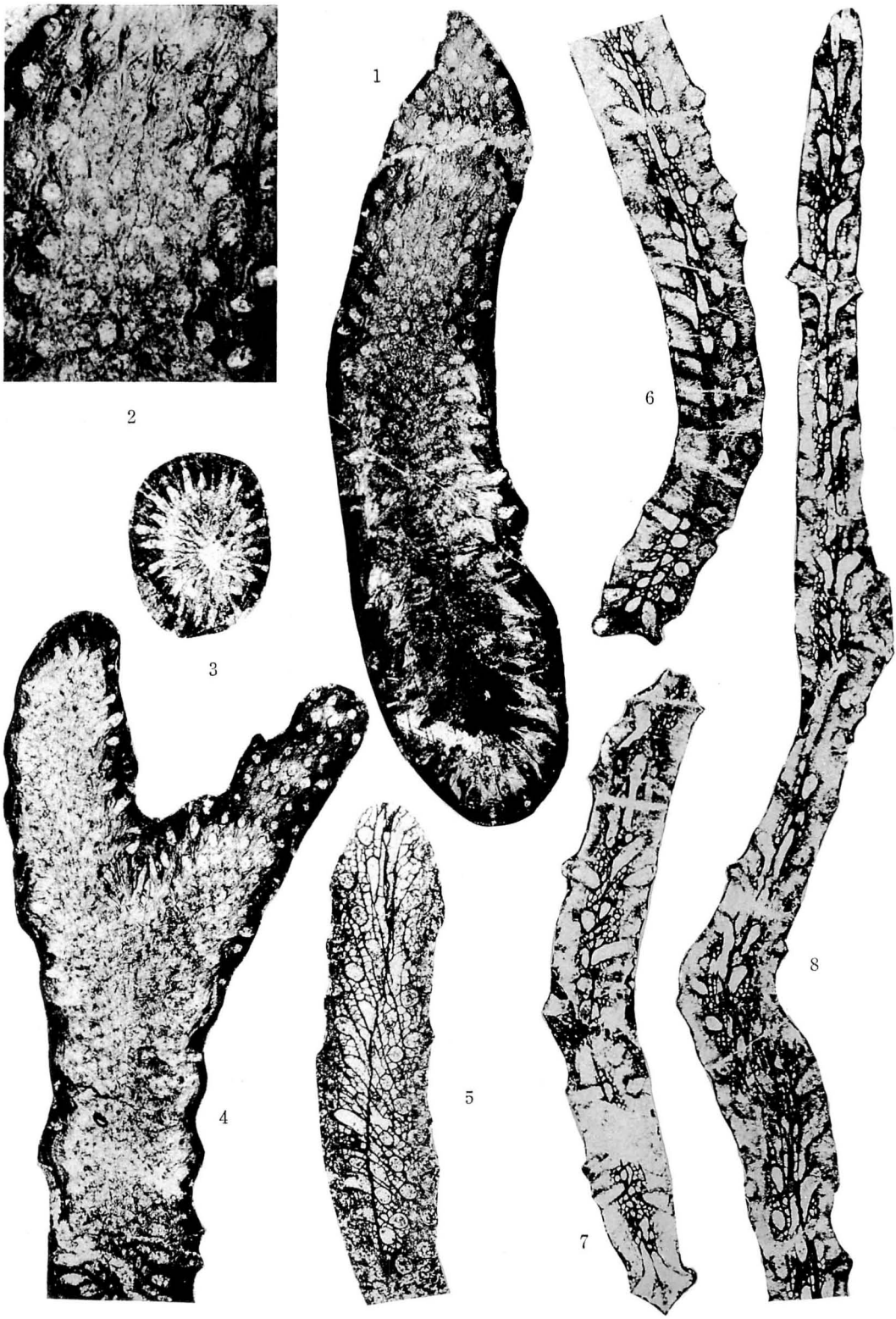
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Plate 29

Explanation of Plate 29

Figs. 1–3. *Sulcoretepora nipponica* SAKAGAMI, n. sp.
Obliquely tangential sections, Reg. nos. 5536-A, 5539-A and 5538-A, respectively, ×10, Loc.: Kamiyatsuse.

Figs. 4–6. *Sulcoretepora* sp. indet.
1, Surface specimen, Reg. no. 6500-B, ×5, 2, Transverse section, Reg. no. 6501-D, ×10, 3, Longitudinal section, Reg. no. 6501-A, ×10, Loc.: The Omi limestone.

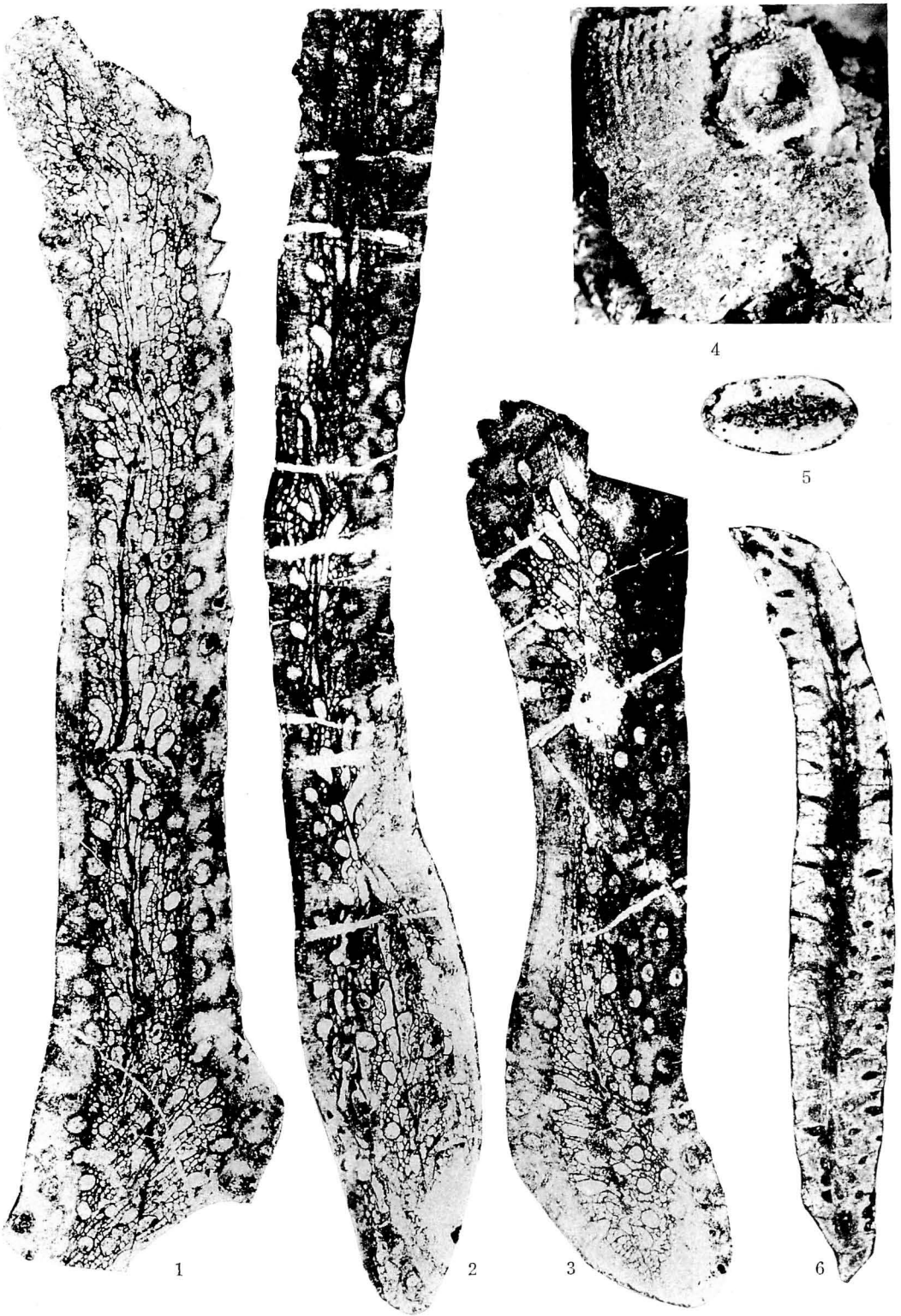
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Plate 30

Explanation of Plate 30

Figs. 1-7. *Sulcoretepora nipponica* SAKAGAMI, n. sp.

1, Surface specimen, Reg. no. S-38, ×2, 2, 3, Surface specimens, Reg. nos. S-9 and S-37 (holotype), respectively, ×5, 4, Enlarged part of Fig. 3, ×10, 5, Transverse section, Reg. no. 5533-A, ×10, 6, Longitudinal section, Reg. no. 5202-A, ×10, 7, Tangential section, Reg. no. 5216-A, ×10, Loc.: 1-5, Kamiyatsuse; 6, 7, The d member of the Iwaizaki limestone.

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