Ibukiphyllum (Rugosa) from the North of Tarui, Gifu Prefecture, Central Japan

Hiroshi FURUTANI*

岐阜県垂井町北部から得られた *Ibukiphyllum*（四射サンゴ）

古谷　裕*

(Abstract)

Topotype specimens of *Ibukiphyllum sekii* (MINATO), the type species of genus *Ibukiphyllum* KATO and MINATO, and *Ibukiphyllum oishiense* n. sp. are described. These specimens were originated from an exotic block of Carboniferous limestone embedded in Mesozoic rocks exposed in the north of Tarui, Gifu Prefecture, Central Japan.

(要　旨)

Ibukiphyllum は群体の四射サンゴで，トラベキュラ構造を示す三次以上のオーダーのセプタ，強い軸構造，軸に向って下向きあるいは水平な床板部を持つことで特徴づけられる．この属の模式種は *Wentzelella sekii* MINATO で，岐阜県不破郡垂井町大石沢より得られた，ただ一個の不完全な標本によって代表されるのみであった．

同地より採集したサンゴ類の中に，いくつかの保存良好な *Ibukiphyllum sekii* を発見したので，模式標本について再検討するとともに，新標本について記載する．*I. sekii* は，この属に含められる種の中では，中程度の大きさのコラライト・薄いセプタ・ややゆるく形成された軸構造等で特徴づけられる．

I. sekii に伴い，新種 *Ibukiphyllum oishiense* が認められる．この種は小型のコラライトを持ち，ロンズダレイア型泡沫組織がほとんど発達せず，密な軸構造を有することで特徴づけられる．

以上2種のサンゴは垂井町北部に発達する頁岩・砂岩を主体とする中生層中の，石灰岩を主とする角礫岩の異地性ブロックから得られたもので，サンゴ化石の地質時代は石炭紀中期の *Fusulinella* 帯に相当する．

Introduction

Genus *Ibukiphyllum* is a pseudopavonid rugose coral with cerioid corallum and the third or more orders of septa. It was established by KATO and MINATO (1974) based on *Wentzelella sekii* MINATO as the type species. *Wentzelella sekii* was first described by MINATO (1955) on the basis of a specimen collected by Takeo SEKI from Oishizawa, Tarui-cho, Fuwa-gun, Gifu Prefecture, Central Japan. However, the type material was represented by only one transverse section of an imperfect corallum. No subsequent material on the type specimen for this species has been added until now. Consequently our knowledge on the type species of genus *Ibukiphyllum* has remained insufficient.

Since 1977 I have studied the Carboniferous and Permian corals obtained from exotic

* Department of Earth Sciences, Nagoya University, Nagoya
Received September 30, 1981.

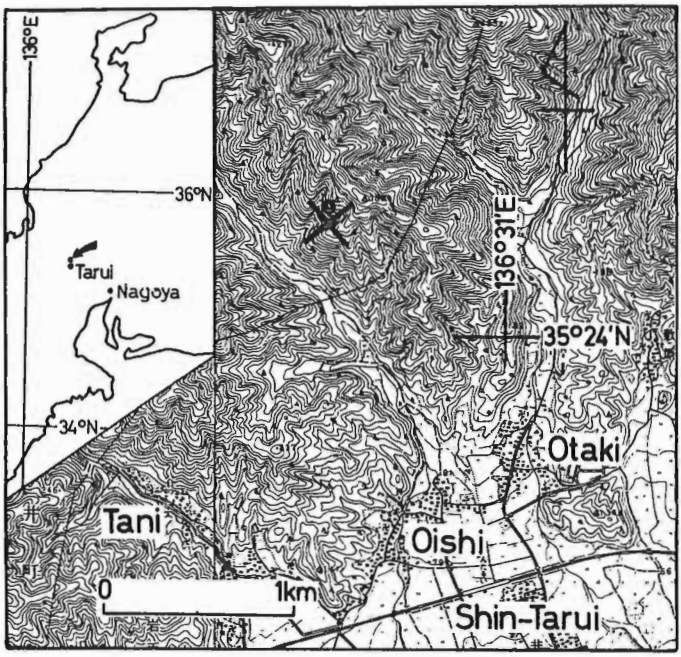


Fig. 1. Map showing the fossil locality (☓). Base map is the 1 : 25,000 "Ogaki" topographic sheet issued by the National Geographical Survey Institute.

blocks of limentone in Mesozoic rocks exposed in the north of Tarui-cho, Fuwa -gun, Gifu Prefecture.

Hitherto some corals have been known to occur in this area. SEKI (1938, 1939) reported *Nagatophyllum satoi* OZAWA ; MINATO (1955), as mentioned above, described *Wentzelella sekii* ; and ISOMI (1955) found *Clisaxophyllum* (=*Echigophyllum*) *awa* MINATO and *Lithostrotion* cf. *somaense* YABE and HAYASAKA in addition to *Nagatophyllum satoi.* Among them, *Nagatophyllum satoi* and *Lithostrotion* cf. *somaense* have never been obtained by me up to the present.

In this paper the topotype specimens of *Ibukiphyllum sekii* and *Ibukiphyllum oishiense* n. sp. actually collected as floats which were certainly derived from one of the limestone blocks (fig. 1) are described.

The following corals have been also obtained in addition to the above mentioned species ; *Amygdalophylloides, Arachnastraea, ? Ivanovia, Pseudopavona, Yokoyamaella* and so forth. These corals will be described by me in near future.

Geological setting and age

Shale, sandstone and chert are developed in somewhat chaotic manner in the northern area of Tarui-cho, where large and small blocks of greenstone and coral-bearing limestone are embedded. SEKI (1938, 1939), ISOMI (1955) and KANUMA *et al.* (1961) interpret these rocks are to be Carboniferous and Permian in age on the basis of such fossils as fusulinids and corals found in the blocks of limestone. Recently TANASE (1980 MS) considers that they are Mesozoic in age based on the plant remains of late Triassic type (NISHIDA *et al.*, 1977) in shale and radiolarians of Jurassic type in siliceous shale (MIZUTANI *et al.*, 1981). And he concludes that the limestone were redeposited blocks in the Mesozoic formations. It was revealed by my own research (FURUTANI, 1979) that the limestone blocks were usually composed mainly of bedded breccia with subordinate amount of interbedded sandstone and chert. And the breccia and sandstone consist of fragments of limestone and basaltic rocks, with matrix of reddish brown dolomite at places. Based on these data, it is

assumed that the breccia and sandstone were formed by reworked fragments of limestone and basaltic rocks in deeper basin where the chert beds were deposited.

The geological age of each fragment of limestone ranges from Middle Carboniferous to Lower Permian time, that is zone of *Fusulinella* to zone of *Pseudofusulina* in fusulinid zonation, and it may be different from fragment to fragment. However, in the large limestone block from which the specimens of *Ibukiphyllum* herein described were derived, fragments of limestone are, when determinable, always Carboniferous in age. Specimens of *Ibukiphyllum* do not occur with fusulinids, which are generally so indicative of age. But some corals related to *Ibukiphyllum* are found associated with *Fusulinella* sp. in a fragment of limestone. Thus it is generally inferred here that *Ibukiphyllum* is *Fusulinella* zone of Middle Carboniferous in age. This is in accordance with the known range of the genus (KATO and MINATO, 1975).

Acknowledgments

I express special thanks to Prof. Makoto KATO of Hokkaido University for valuable discussion, critical reading of the typescript and permission to examine the specimens of *Ibukiphyllum* under his care. I am grateful to Prof. Akira MORISHITA and Dr. Junji ITOIGAWA of Nagoya University for critical readings of the typescript and helpful suggestions during the course of this study. Thanks are also due to Mr. Hiroshi MUKOHARA for kind offer of his collection and Mr. Daiji TANASE of Electric Power Develop Co., Ltd. for his assistance in field work.

Systematic descriptions

Order Rugosa

Family Pseudopavonidae YABE, SUGIYAMA and EGUCHI 1943

Subfamily Taisyakuphyllinae KATO and MINATO 1974

Genus *Ibukiphyllum* KATO and MINATO 1974

Type species : *Wentzelella sekii* MINATO 1955

1974 *Ibukiphyllum* KATO and MINATO, p. 190.

1975 *Ibukiphyllum,* KATO and MINATO, p. 108, 109.

1981 *Ibukiphyllum,* HILL, p. 422.

Generic diagnosis : Cerioid rugose corals with extremely thick septal wall, normal, partly lonsdaleoid dissepiments, tabulae and clinotabulae, and axial structure. Septa are trabecular in nature, and in three or four orders. Increase peripheral.

Remarks : The genus *Ibukiphyllum* may be simply termed as cerioid *Taisyakuphyllum.* But the cerioid nature in *Ibukiphllum* is not always consistent. I have seen in the holotype and one of my specimens of *Ibukiphyllum sekii* that some corallites occasionally become laterally free, so that they, at least in part, appear to represent fasciculate forms. In general, however, growth form may serve as a readily recognizable criterion in the generic classification of pseudopavonids.

Apart from my own material I have examined the holotype of *Wentzelella sekii,* the holotype of *Ibukiphyllum densum* KATO and MINATO and all the specimens of *Ibukiphyllum* in KATO's collection of Omi corals stored at the Dept. Geol. Mineral., Hokkaido Univ. As a result I could recognize three different forms amongst these specimens.

1. Diameter of corallite is large (11–13 mm). Septa thick, numerous. Axial column large and compact. ————*densum*
2. Diametar of corallite is medium to large in size (7–10, rarely 12 mm). Septa thin, numerous. Axial column is variable, dense to loose.————*sekii*
3. Diameter of corallite is small (4–7 mm). Septa thick, less numerous. Axial column is small, dense. ————*oishiense,* n. sp.

Besides the three species above enumerated, there have been 4 other nominal species recognized in the genus (see KATO and MINATO, 1975). Judged from the illustrations of these forms, *? Polythecalis meandroides* SAKAGUCHI and YAMAGIWA resembles *Ibukiphyllum sekii* in the size of corallites (7–12 mm), but differs from the latter in having less numerous major septa, short minor septa and well developed lonsdaleoid dissepiments. A number of peripheral buds in *? Polythecalis meandroides* appear to be similar to a plocoid coral at a glance. *Stylidophyllum quadratum* SAKAGUCHI and YAMAGIWA is comparable to *Ibukiphyllum oishiense* again in the size of corallites (4–6 mm). It differs from *Ibukiphyllum oishiense* in possessing thin, less numerous septa, short minor septa, loosely constructed axial column, and relatively well developed lonsdaleoid dissepiments. *Stylidophyllum kameokense* SAKAGUCHI and YAMAGIWA is a badly preserved form, not very dissimilar to *Sylidophyllum quadratum,* with which it may be synonymous. *Wentzelophyllum sinense* FAN is badly illustrated. Its assignment to *Ibukiphyllum* is still questionable.

Ibukiphyllum sekii (MINATO) 1955
(Pl. 51, Figs. 1, 2, Pl. 52, Figs. 1, 2, Pl. 54, Figs. 1–4)

1955 *Wentzelella sekii* MINATO, p. 108–109, pl. 26, fig. 9, text-figs. 8-D, 1–4.
1965 *"Wentzelella" sekii,* KATO and MINATO, p. 193.
1975 *Ibukiphyllum sekii,* KATO and MINATO, p. 108–109.
1975 *Ibukiphyllum densum* KATO and MINATO, p. 110–111 (partim, reg. no. Omi 405').

Holotype : No. 108, SEKI Coll., Inst. Geol. Paleont., Tohoku Univ.

Material : Four fragmental coralla from Oishizawa, Tarui-cho, Fuwa-gun, Gifu Prefecture, Central Japan. Reg. Nos. ESN 140001, 140002, 140003 and 140004, Ten thin sections in all were prepared from these specimens for study. ESN 140002 was collected by H. MUKOHARA, and the others were collected by myself.

Specific diagnosis : *Ibukiphyllum* with medium to large corallites (7–10 mm), thin and numerous septa. Axial structure is variable in size and density. Small lonsdaleoid dissepiments may develop.

Description : Corallum compound, massive and cerioid. External features unknown. The largest colony (ESN 140001) at hand measures $5 \times 3.5 \times 4$ cm^3 as far as preserved. In another

specimen (ESN 140003) one corallite is seen detached from the rest part of the corallum (Pl. 52, fig. 1).

In transverse section corallites are polygonal. Diameter of mature corallites ranges from 6 to 12 mm, but 7 to 10 mm being common. Wall is very thick, 0.6 to 0.9 mm in thickness in a form of septal wall in which thickened septal ends laterally coalesce to form a distinct stereozone (Pl. 54, fig. 1). Neighboring corallites are bounded by a light colord, thin layer. Dissepimentarium is wide, consists mostly of concentric dissepiments. They are sometimes angulo-concentric, a little domed or small lonsdaleoid especially at the periphery of corallite (Pl. 54, fig. 1). Tabularium is not very well differentiated from the dissepimentarium. Septa are thin, sinuous, and trabecular. They are major, minor and tertiary septa. Quaternary septa are present. The length of minor septa is only a little less than that of the major ones. Thus they are sometimes difficult to discriminate from the major. Major plus minor septa number 38 to 41. Septa are often swollen to form carinae -like projection on both sides of them (pl. 54, figs. 2, 3). Axial ends of septa nearly reach the periphery of axial column. In one peripheral bud (Pl. 52, fig. 1) one septum is elongated to the center of corallite to form a simple columella. No distinct fossula present. Axial structure is variable in size and its construction. In some corallites it is large, lemon -shaped, and amygdalophylloid (KATO 1963) in construction. The size of axial structure is 3.2×2.4 mm in one corallite (Pl. 54, fig. 3) and 1.7×1.1 mm in another. Axial structure is loose in still other corallites where median plate and septal lamellae are sometimes obliterated except for several distinct tabellae (Pl. 52, fig. 1, Pl. 54, fig. 4). Increase is peripheral.

In longitudinal section zonal arrangement of internal features of corallite, namely axial structure, tabularium, dissepimentarium and wall, is very clearly demonstrated. Axial structure is a column which consists of flexuous, sometimes much thickened median plate and arched axial tabellae. Frequently it is very massive. Differentiation between the axial column and the tabularium is usually clear. Tabularium is composed of horizontal or arched, even towards the axial column, tabulae and tabellae, and clinotabulae. Dissepimentarium consists of small to large dissepiments inclined inward, with small elongate dissepiments. It occupies a half or two third of the radius of corallite. Wall is very thick, and is composed by upward divergent trabeculae. Septal trabeculae are vertically arranged in a manner of concave upward (KATO, 1963). Diameter of a trabecula measures 0.1 to 0.14 mm.

Remarks : The exact locality where the holotype specimen was collected is uncertain, except that it was from Oishizawa. My specimens were also obtained as floats in Oishizawa. However the lithologic nature of the specimen containing the holotype is so similar to that of new materials in having reddish brown matrix. The actual exposure of a large block of limestone with similar lithology is close to the place where I collected new specimens of *Ibukiphyllum sekii.* No other blocks of limestone in Oishizawa show the same lithology with the one carries *Ibukiphyllum sekii.* So I assume that all the specimens of *Ibukiphyllum sekii* from Oishizawa must have come from the above mentioned exposure.

Now the holotype of *Ibukiphyllum sekii* is represented by a transverse section which

reveals only several imperfect corallites. No longitudinal characters have been known. But the new materials, which are so identical with the holotype, clearly demonstrate the intraspecific variation, and the characters shown in longitudinal section. *Ibukiphyllum densum* KATO and MINATO has some resemblance to *Ibukiphyllum sekii.* However the latter has smaller corallites and thinner septa compared to the former. For comparison with *Ibukiphyllum meandroides* (SAKAGUCHI and YAMAGIWA), see remarks on the genus *Ibukiphyllum.* A specimen (KATO coll. 405') from Daiseru quarry of Omi was considered as a representative of *Ibukiphyllum densum* by KATO and MINATO (1975). But it has smaller corallite and thinner septa compared to *Ibukiphyllum densum,* and it is identified here as *Ibukiphyllum sekii.*

Ibukiphyllum oishiense n. sp.
(Pl. 52, Figs. 3, 4, Pl. 53, Figs. 1, 2, Pl. 54, Figs. 5–7)

1975 *Ibukiphyllum densum* KATO and MINATO, p.110–111 (partim, reg. no. Omi 341-a)

Holotype : One imperfect corallum (Reg. No. ESN 140005), collected by H. FURUTANI from Oishizawa, Tarui-cho, Fuwa-gun, Gifu Prefecture. Six thin sections were prepared.

Specific diagnosis : *Ibukiphyllum* with small corallites (4–7 mm), thick septa which are less numerous. Axial structure is compact and amygdalophylloid. Lonsdaleoid dissepiments only rarely present.

Description : Corallum compound, massive and cerioid. External features unobservable. Preserved part of the corallum measures $5.5 \times 4 \times 5$ cm^3 and is embedded in reddish brown, tuffaceous matrix, together with other limestone fragments, some of which are oolitic, fusulinid fragments, and small fragments of basaltic rock.

In transverse section corallites are polygonal, commonly pentagonal to hexagonal. Diameter of corallite ranges from 4 to 7 mm. Holotheca is not observed. Wall is a septal wall, 0.5 to 0.65 mm in thickness, and is composed of laterally fused peripheral ends of septa in a form of stereozone (Pl. 54, figs. 5, 6). Each septal end is made up by a single series of trabeculae. Between two neighboring corallites a transparent layer or a dark line is observed (Pl. 54, figs. 5, 6). Septa are trabecular in fine structure, generally thick, somewhat flexuous (Pl. 54, fig. 6). They are in three or more orders. Minor septa are only slightly shorter than the major, and the distinction between the two is sometimes difficult. The number of major and minor septa altogether is 24, 25, 27, 27, 29, 30, 31 ; and so on. And the peripheral ends of septa on the septal wall are in one corallite numbers as many as 101. This means that quaternary septa must be present when I take septal wall into account. Axial ends of septa closely reach or slightly touch the periphery of axial structure. Between neighboring septa concentric dissepiments and cutedges of tabulae are seen distributed. But the distinction between the tabularium and dissepimentarium is not clear. Only occasionally relatively large lonsdaleoid dissepiments are developed. Otherwise septa are continuous. Axial structure is amygdalophylloid, essentially composed of a meidan plate and thickened septal lamellae, and is usually strongly represented with smooth or crenulated peripheral margin (Pl. 54, figs. 6, 7). It is however rarely represented almost by a thick bar-like central prolongation of a septum, or is represented by a relatively small

axis leaving some tabulae space around it. A peripheral bud is seen in a corallite.

In longitudinal section the axial structure is a stout and solid bar with trace of axial tabellae. Tabularium is very narrow, where gently inclined clinotabulae and horizontal tabulae are both present. Dissepimentarium is wide. Dissepiments are steeply inclined and several rows. Elongate dissepiments develop. Wall is thick. In vertical section of a septum, trabeculae are arranged concave upward.

Remarks : The present new species is easily distinguished from *Ibukiphyllum sekii* and *Ibukiphyllum densum* in having much smaller corallites and less numerous septa. Septa in *Ibukiphyllum sekii* are definitely thinner than in *Ibukiphyllum oishiense*. *Ibukiphyllum oishiense* resembles *Ibukiphyllum quadratum* (SAKAGUCHI and YAMAGIWA) (see remarks on *Ibukiphyllum*) but is distinguishable from the latter in having thick, a little more numerous septa, long minor septa and dense axial structure. Lonsdaleoid dissepiments are better developed in *Ibukiphyllum quadratum* compared to *Ibukiphyllum oishiense*.

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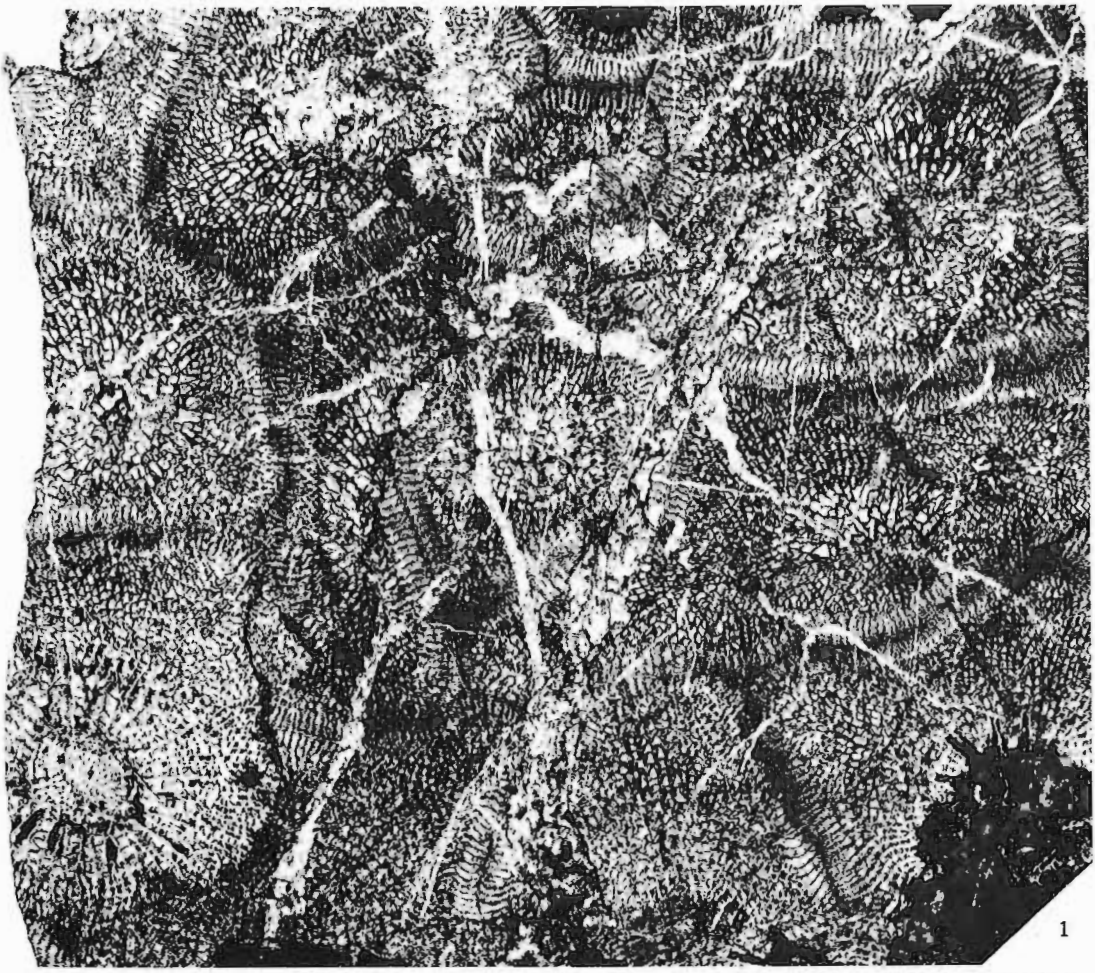
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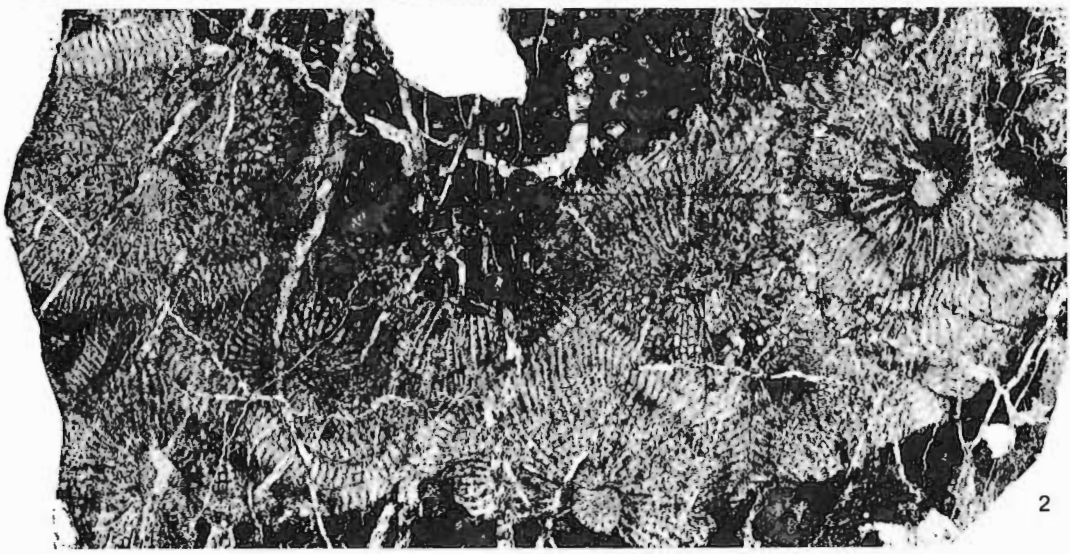
Plate 51

Figs. 1, 2. *Ibukiphyllum sekii* (MINATO)

1. ESN 140001, transverse section, ×5, collected by H. FURUTANI from Oishizawa, Tarui-cho, Fuwa-gun, Gifu Prefecture. Note the variation in the size and shape of axial structure. A peripheral bud is present in a top right corallite.
2. ESN 140002, transverse section, ×4, collected by H. MUKOHARA from the same locality as preceding one.



1



2

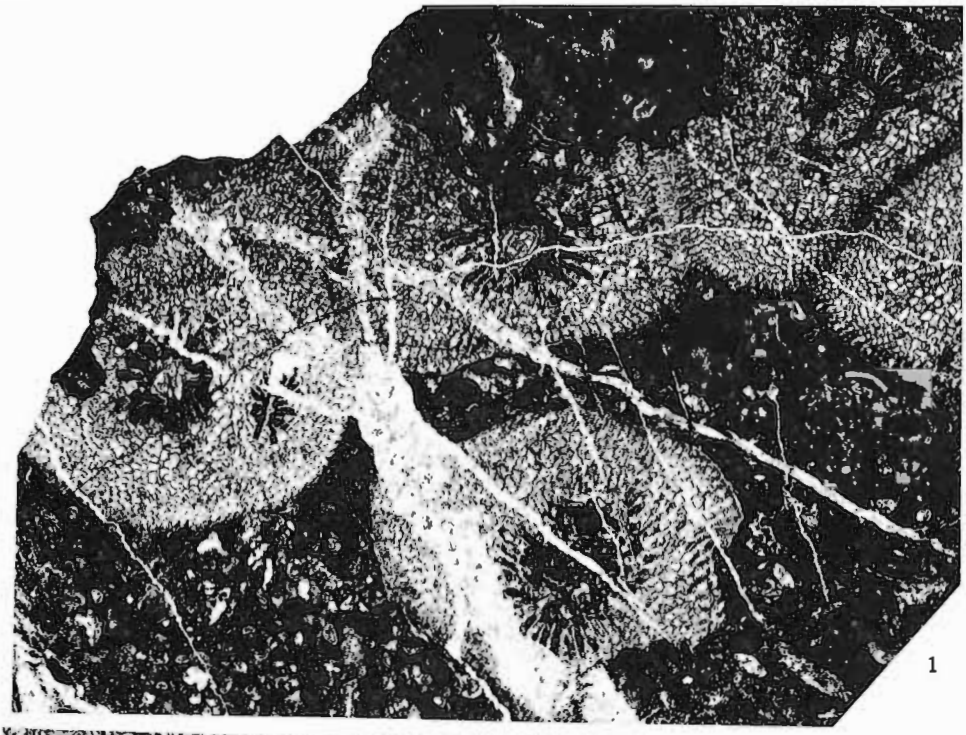
Plate 52

Figs. 1, 2. *Ibukiphyllum sekii* (MINATO)

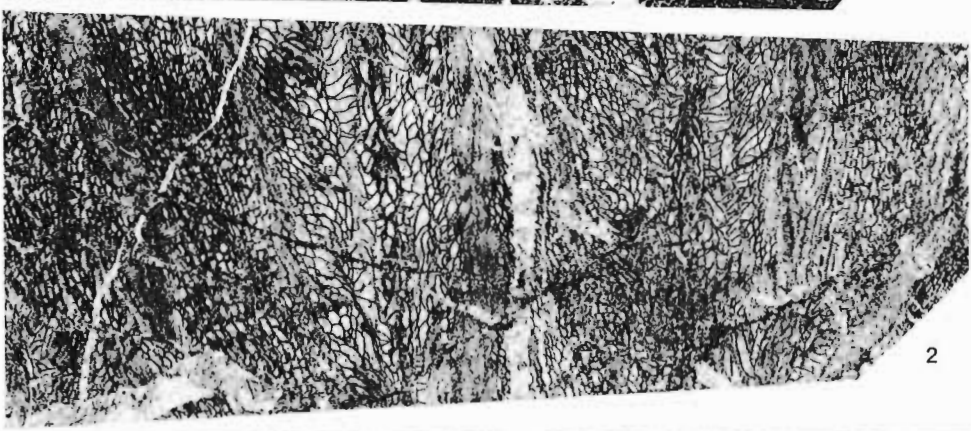
1. ESN 140003, transverse section, ×4, showing a detached corallite. Axial structure is loosely constructed. Collected by H. FURUTANI from Oishizawa, Tarui-cho, Fuwa-gun, Gifu Prefecture.
2. ESN 140001, longitudinal section, ×4, collected by H. FURUTANI from the same locality as preceding one.

Figs. 3, 4. *Ibukiphyllum oishiense* n. sp.

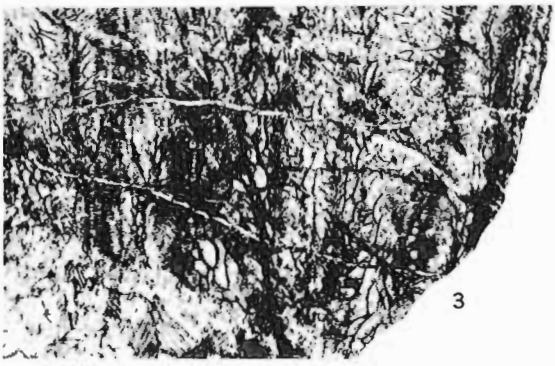
3, 4. ESN 140005 (holotype), longitudinal sections, ×6, collected from the same locality as precedings.



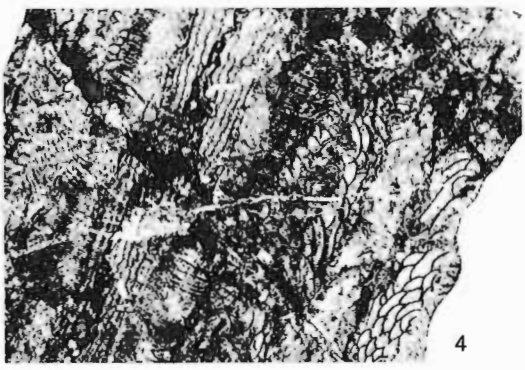
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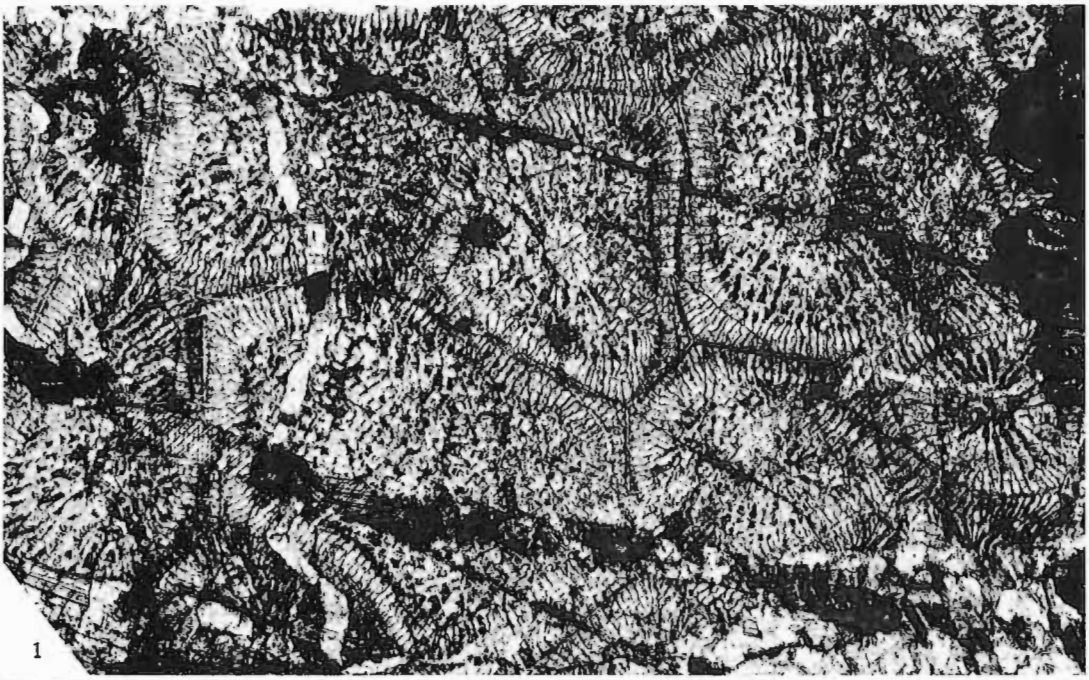


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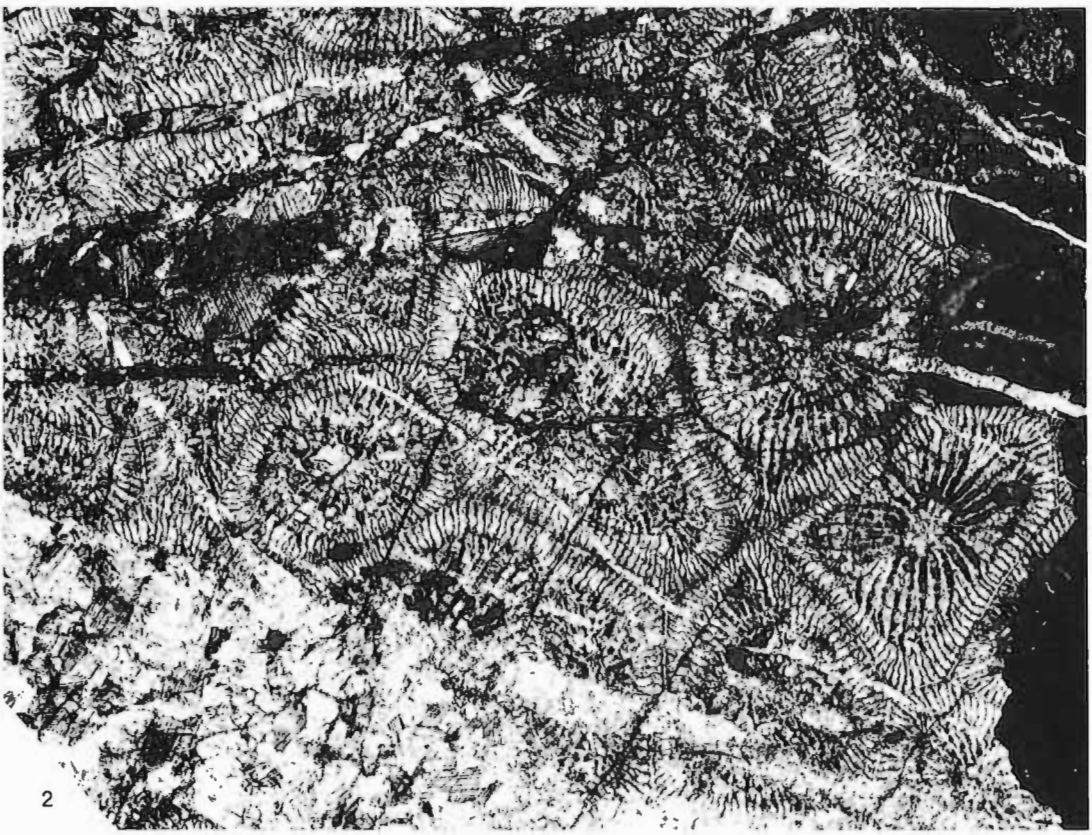
Plate 53

Figs. 1, 2. *Ibukiphyllum oishiense* n. sp.

1, 2. ESN 140005 (holotype), transverse sections, ×6, collected by H. FURUTANI from Oishizawa, Tarui-cho, Fuwa-gun, Gifu Prefecture.
Peripheral budding is observed in the central bottom corallite in fig. 1.



1



2

Plate 54

Figs. 1–4. *Ibukiphyllum sekii* (MINATO)

All figures are enlarged from the same section with Pl. 1, fig. 1 (ESN 140001).

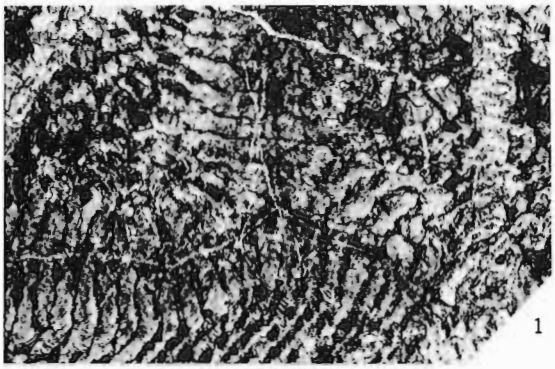
1. Thick septal wall and light colored layer between two corallites. Note lonsdaleoid dissepiments in the upper right corallite.
2. Thin and flexuous septa having carinae-like projection.
3. Amygdalophylloid large axial structure.
4. Loosely constructed axial structure.

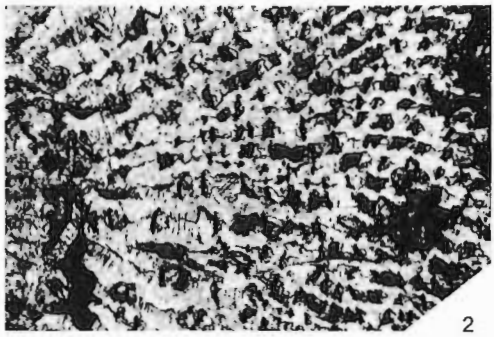
Figs. 5–7. *Ibukiphyllum oishiense* n. sp.

5, 6. ESN 140005 (holotype), enlarged from the same section with pl. 3, fig. 1. 5 ; thick sepeal wall and transparent layer between two corallites. 6 ; septal wall, thick and flexuous septa, and amygdalophylloid axial structure.

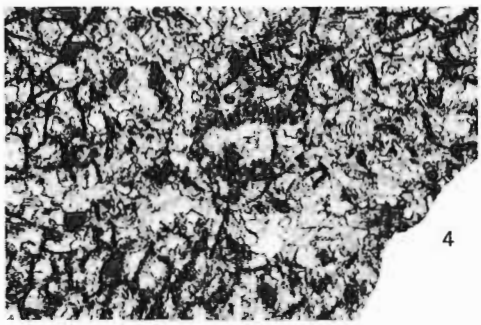
7. ESN 140005 (holotype), enlarged from the same section with pl. 3, fig. 2. Amygdalophylloid axial structure having crenulated peripheral margin, and thick septa.

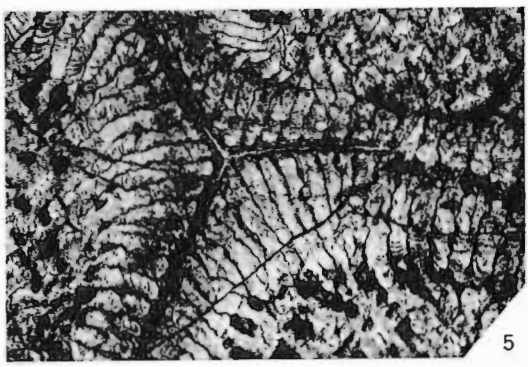
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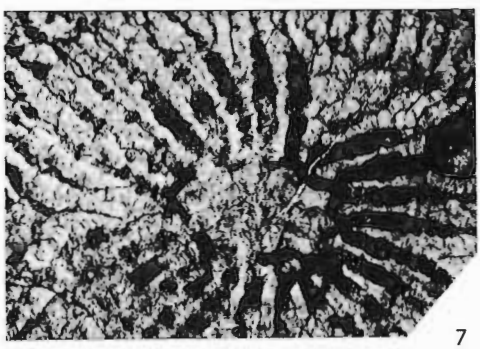

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