

Permian Rugose Corals from Kamisenba, Kuzu Town, Tochigi Prefecture in Japan

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Abstract Permian limestones designated as the Nabeyama Formation are exposed in the Kuzu area, Tochigi Prefecture. The limestones are particularly abundant in fusulinaceans but uncommon in rugose corals. The limestone pebbles in the conglomerate that unconformably overlies the Nabeyama Formation commonly yield rugose corals. *Yatsengia suzukii* sp. nov., *Y. sp. indet.*, and *Waagenophyllum* (*Waagenophyllum*) *akasakense* (Yabe) from the limestone pebbles are here described. These corals were recycled from the Nabeyama Formation.

Key words: Ashio Mountains, Kuzu, Permian, rugose coral, *Waagenophyllum*, *Yatsengia*.

Introduction

Fossiliferous Permian limestones appear mainly in quarry outcrops forming a large horseshoe shaped syncline in the Kuzu area, southern part of the Ashio Mountains in Tochigi Prefecture. The limestones have been designated as the Nabeyama Formation that is further subdivided into the following three members in ascending order: the Yamasuge Limestone, Hanezuru Dolostone, and Karasawa Limestone Members (Fujimoto, 1961). Although the Nabeyama Formation abundantly yields various fossils, most previous researchers focused their attention on the fusulinacean biostratigraphy and descriptions (e.g., Hanzawa, 1942; Igo, 1964; Igo and Igo, 1977; Kobayashi, 1979).

Rugose corals are curiously uncommon throughout these limestones, and the occurrences of only two rugose coral species have been documented by Yabe (1951) and Yamagiwa and Tsuda (1980). Yabe (1951) proposed *Pseudoyatsengia kuzuensis* as the new genus and species from the Yamasuge Limestone Member exposed at the Aisawa quarry, Kuzu Town (Fig. 1, loc. 2). This coral is associated with *Parafusulina yabei* Hanzawa that represents a typical zone marker of the *Parafusulina* Zone in this member. Recently, Igo *et al.* (2000) discussed the validity of the genus *Pseudoyatsengia* and concluded that the genus is difficult to distinguish from the genus *Yatsengia*.

This conclusion was based on the senior author's observation of the type specimen which is now housed at the Department of Geology, National Science Museum. Igo's further observation and illustration of this specimen are here presented.

The other rugose coral hitherto described from Kuzu is *Paraipephyllum karasawense* Yamagiwa and Tsuda (1980). This coral was collected from a limestone pebble contained in the limestone conglomerate beds of the unnamed formation that unconformably overlies the Nabeyama Formation with marked discordance. The geology of this coral locality, the Nagaami quarry owned by Yoichi Suzuki (Fig. 1, loc. 1), was once investigated in detail by the senior author in collaboration with his previous colleague (Koike *et al.*, 1974; Igo and Igo, 1977). The limestone conglomerate has been interpreted as the basal conglomerate of the Triassic Adayama Formation by these previous researchers. We are now inclined to believe that the conglomerate intercalating with laminated calcareous sandstone should be separated from the chert dominated Adayama Formation. Those rubbly rocks and sandstone beds would be assigned to the unnamed formation at present. The geologic age of the formation is also uncertain, but it is apparently post-Triassic. Further discussion on this stratigraphic problem will be presented in another opportunity.

The corals described in this paper were discovered by the senior author during the previous field survey in different limestone pebbles, which were recycled both from the Yamasuge Limestone and Karasawa Limestone Members of the Nabeyama Formation. *Yatsengia suzukii* Igo and Adachi, sp. nov. contained in several dark gray dolomitic limestone pebbles, which were probably came from the upper part of the Yamasuge Limestone Member. *Yatsengia* sp. indet. is preserved in a light gray limestone pebble showing lithic characters common in the Karasawa Limestone Member, but its precise stratigraphic position is unsettled. *Waagenophyllum* (*W.*) *akasakense* occurred in a light gray limestone pebble, which was derived from the upper part of the Karasawa Limestone Member. Associated fusulinaceans in these pebbles provide confirmatory evidence for the assignment of this limestone pebbles to the Kubergandian and Midian, respectively. The specimens described are housed at the Institute of Geoscience, University of Tsukuba with prefix IGUT. The specimens discussed with prefix NSM and NSM PA are the type specimens stored at National Science Museum.

Description of Species

Family Yatsengiidae Hill, 1956

Genus *Yatsengia* Huang, 1932

Yatsengia suzukii Igo and Adachi, sp. nov.

(Fig. 2-1-3; Fig. 3-1-2)

Material: Five coralla, about 20 to 30 cm in diagonal; preserved in limestone

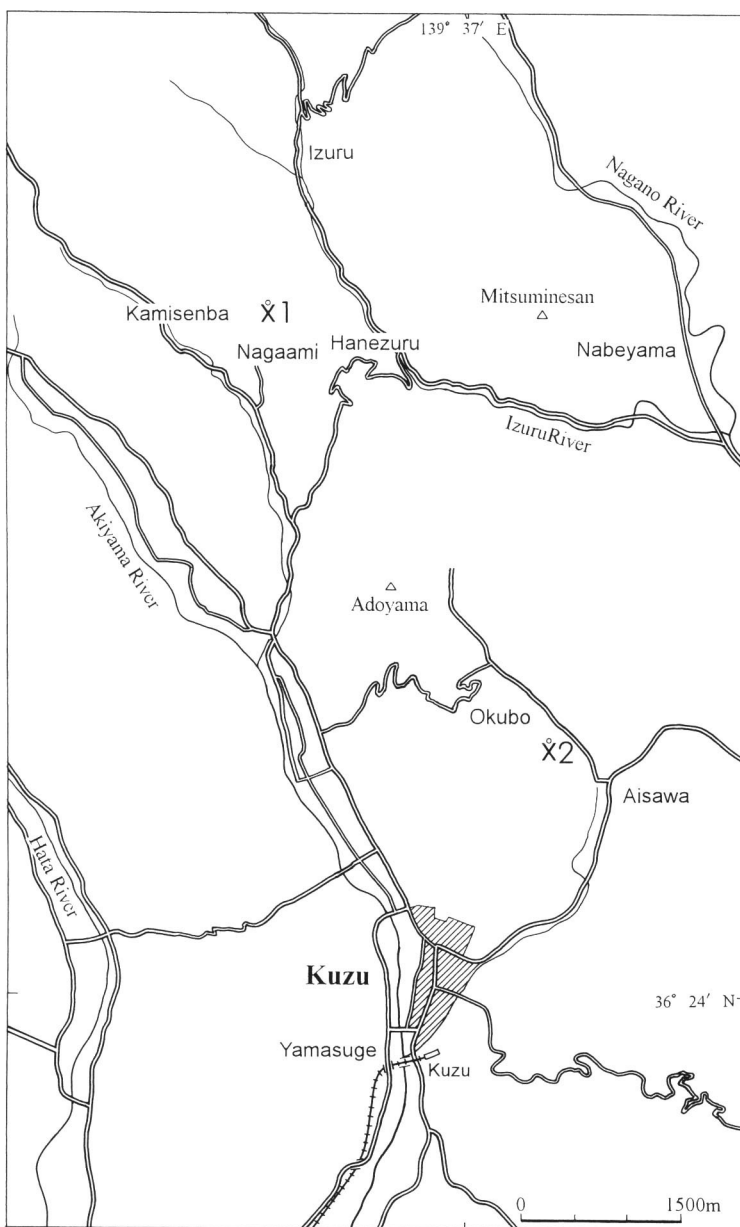


Fig. 1. Map showing localities of rugosans treated in this paper.

pebbles of conglomerate of the unnamed formation exposed at the Nagaami quarry, Kamisenba in Kuzu.

Diagnosis: A *Yatsengia* species with crowded corallites of about 7.0 mm in diameter; dilated wall and septa, 14 to 15 major septa, short rudimentary minor septa; rather large meshwork columella in transverse section; commonly horizontal to concave periaxial tabellae.

Description: Corallum compound, fasciculate, phaceloid, attaining large colony, 20 to 30 cm in diagonal; external shape unknown. Corallites cylindrical, tall, closely spaced, touching to as much as several millimeters apart; increase lateral and branching.

Transverse section: Corallites rounded, generally more or less compressed and subcircular to elliptical. Diameter of corallite 6.5 to 7.5 mm at maturity; 2.5 to 4.0 mm in immature stages. Wall thick, variable in places, ranges about 0.10 to 0.20 mm; with faint septal grooves and interseptal ridges.

Septa radially disposed, dilated and rather thick throughout growth. Major septa long, thickened in peripheral to medial area, become thin at distal; commonly connect with periphery of axial structure, a few of them directly joint with septal lamellae; number 14 or 15 in mature corallites. Minor septa appear sporadically in mature corallites, very short and rudimentary, thorn-like in immature stages.

Axial structure comparatively large, equal to about 1/3 corallite diameter; variously constructed with several septal lamellae and axial tabellae. Medial plate not distinct, but rarely appears as elongation of major septum (counter septum?) in some sections. These longitudinal axial elements dilated in various degrees and generally show meshwork to spider web pattern. Dissepimentarium narrow, dominantly composed of one to two tires of concentric dissepiments and less commonly herringbone ones. Dissepiments lack in places of immature corallites. Tabularium rather widely spaced, cut edges of tabellae variously across between two major septa.

Longitudinal section: Variation evident in axial structure, tabularium, and dissepimentarium. Axial structure consists of septal lamellae, crowded dome to tent-shaped axial tabellae, and sinuous medial plate-like edges appear in some corallites.

Tabularium occupied by axially inclined periaxial tabellae, both complete and incomplete, horizontal and concave wide tabellae (=tabulae). About 8 to 10 horizontal tabellae occur per 5 mm vertically. Dissepimentarium restricted to narrow peripheral zone; commonly one and less commonly two tires of small globose dissepiments regularly arranged.

Remarks: The present new species is readily distinguished from *Yatsengia kuzuensis* (Yabe) by its thick septa and the complicated configuration of its axial structure. It is also similar to *Yatsengia ibukiensis* Minato described from the Ibuki Mountains in Shiga and Gifu Prefectures (Minato, 1955). The former has less number of major septa, which connect with septal lamellae of columella, shorter minor septa, mostly one rank of dissepiments, and commonly horizontal tabellae in longitu-

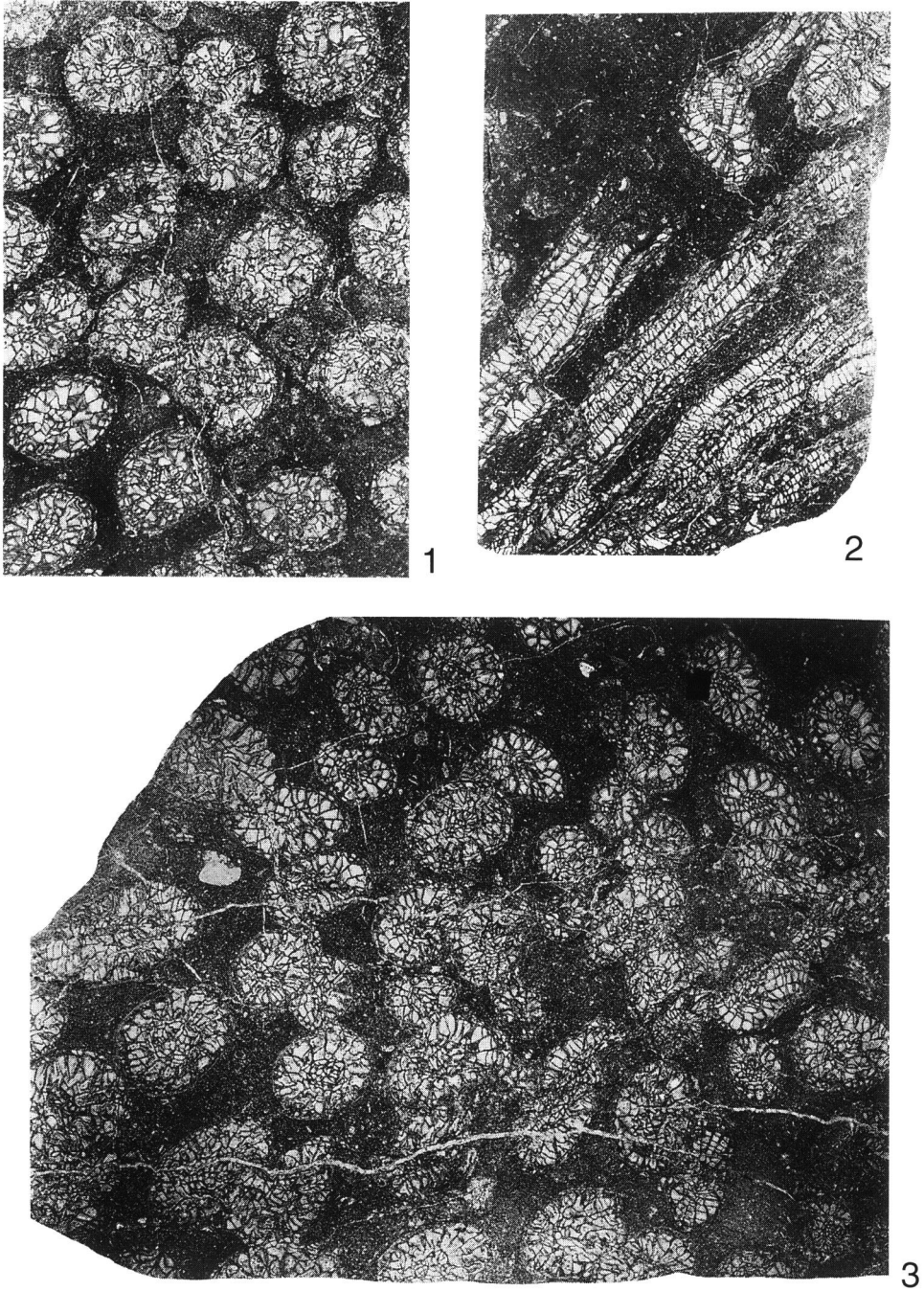


Fig. 2. *Yatsengia suzukii* Igo and Adachi, sp. nov. 1, 2, Transverse and longitudinal sections of the holotype, IGUTU 8080, $\times 2$; 3, transverse section of the paratype, IGUTU 8081, $\times 2$.

dinal section. *Y. ibukiensis* was also described by Yamagiwa, Imai and Yamamuro (1965) from the Akasaka Limestone of Gifu Prefecture. Our present species differs from this Akasaka specimen in the above mentioned differences observed in the Ibuki specimen. Yamagiwa (1962) once proposed a new subspecies, *Yatsengia kiangsuensis atetsuensis*, from the Atetsu Limestone, Okayama Prefecture. Yamagiwa's subspecies is similar to our new species, but the former has smaller diameter of columella and well developed minor septa compared with our new species. *Yatsengia hangchowensis* Huang (1932), one of the most common *Yatsengia* species in southern China, is similar to our new species in many points, but *Y. suzukii* is characterized by dominantly horizontal tabellae and thick septa. Collectively, these differences seem to constitute significant differences among the present form and the mentioned similar species.

The specific name denotes Mr. Yoichi Suzuki who owned the Nagaami Quarry, Miyata Lime Industry Ltd. and gave us various facilities for our field survey.

Geologic age: The *Parafusulina* Zone (Kubergandian).

Reg. no. IGUT 8080 (Holotype), IGUT 8081, IGUT 8082 (Paratypes)

Yatsengia sp. indet.

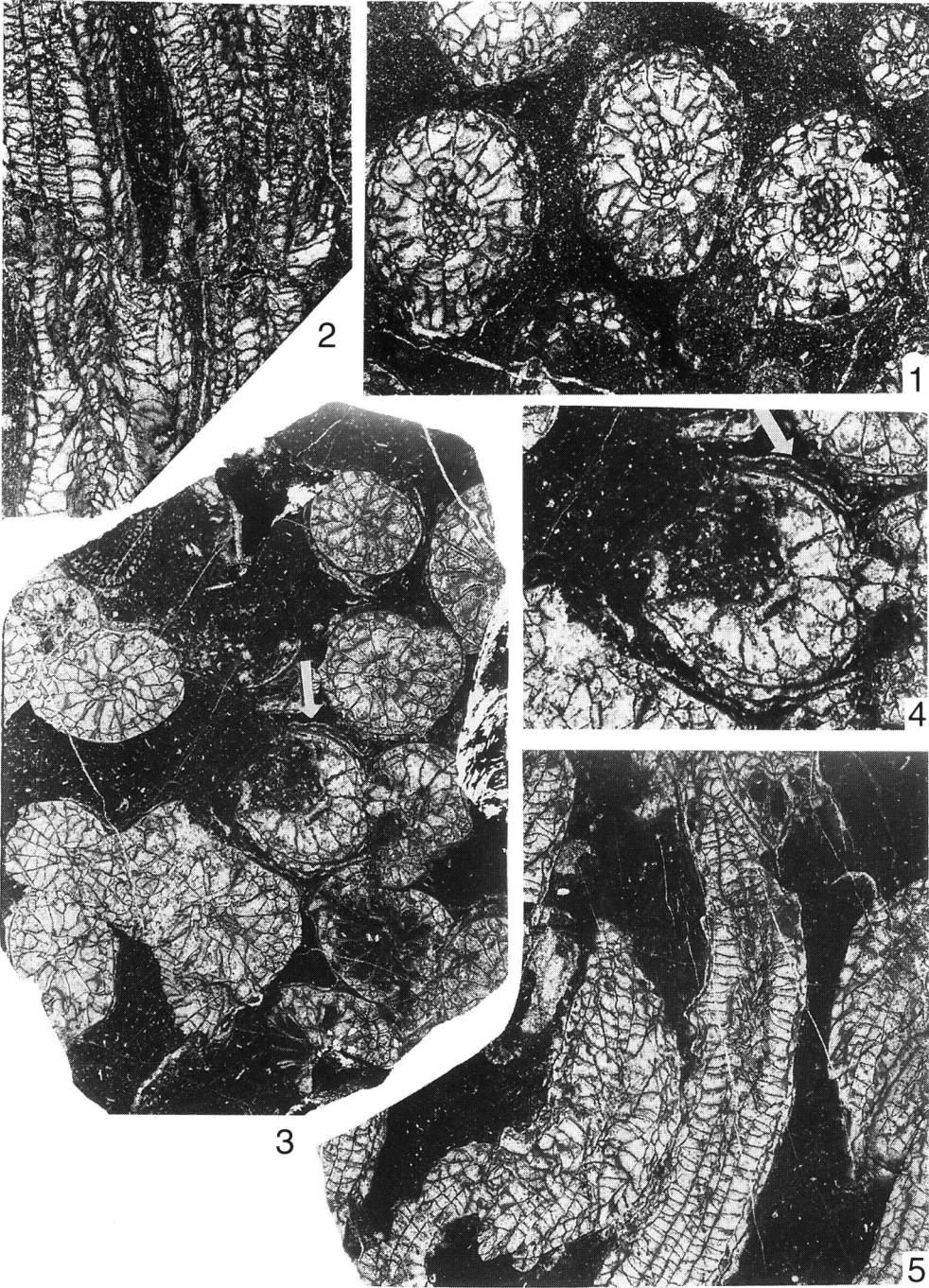
(Fig. 4-1-2)

Material: A single small fragmentary corallum in a limestone pebble of the conglomerate of the unnamed formation exposed at the Nagaami quarry, Kamisenba in Kuzu.

Description: Corallum fasciculate and phaceloid. Corallites cylindrical, closely disposed; rounded and subcircular in transverse section. Corallite diameter 7.0 to 8.5 mm. Septa thin, two orders of major and minor in regular alternation. Major septa slightly dilated in tabularium; number 15 to 16, long, reach periphery of axial column; most of them directly connect with septal lamellae. Minor septa well developed, about 1/3 length of major, commonly penetrate into tabularium. Axial structure large, diameter about 2.5 to 3.0 mm; complicated, spider web-like, consists of more or less twisted several septal lamellae, axial tabellae, and sinuous medial plate. Medial plate indistinct in some corallites. Dissepimentarium narrow, generally occupied with a single rank of augloconcentric dissepiments. Tabularium crossed with straight to curved edges of periaxial tabellae. No suitable longitudinal section obtained.

Remarks: The present unidentified *Yatsengia* is similar to *Y. suzukii* in many points, however, the latter has slightly smaller corallites, thicker septa, and shorter

→Fig. 3. *Yatsengia suzukii* Igo and Adachi, sp. nov. **1, 2**, Transverse and longitudinal sections of the holotype, IGUT 8080, ×5. *Yatsengia kuzuensis* (Yabe, 1951), **3, 4**, transverse sections of the Yabe's type specimen, ×3, ×5, respectively; **5**, longitudinal section of the same specimen, ×3, NSM 4151.



minor septa compared with those of the present unidentified species. Furthermore, the axial structure of the present one is slightly larger and more regularly constructed than those of *Y. suzukii*. We could not prepare any suitable longitudinal section from the present material at hand, it is insufficient for specific assignment, but it suggests that a new species is represented.

Geologic age: The *Parafusulina* Zone (Kubergandian) ?

Reg. no. IGUT8083.

Family Waagenophyllidae Wang, 1950

Subfamily Waagenophyllinae Wang, 1950

Genus *Waagenophyllum* Hayasaka, 1924

Subgenus *Waagenophyllum* Hayasaka, 1924

Waagenophyllum (Waagenophyllum) akasakense (Yabe, 1902)

(Fig. 4-3-6)

Lonsdaleia akasakensis Yabe, 1902, p. 4-5, fig. 3.

Lonsdaleia (Waagenella) akasakensis, Yabe and Hayasaka, 1915, p. 100-104.

Waagenophyllum akasakensis Minato, 1955, p. 104, pl. 37, fig. 7.

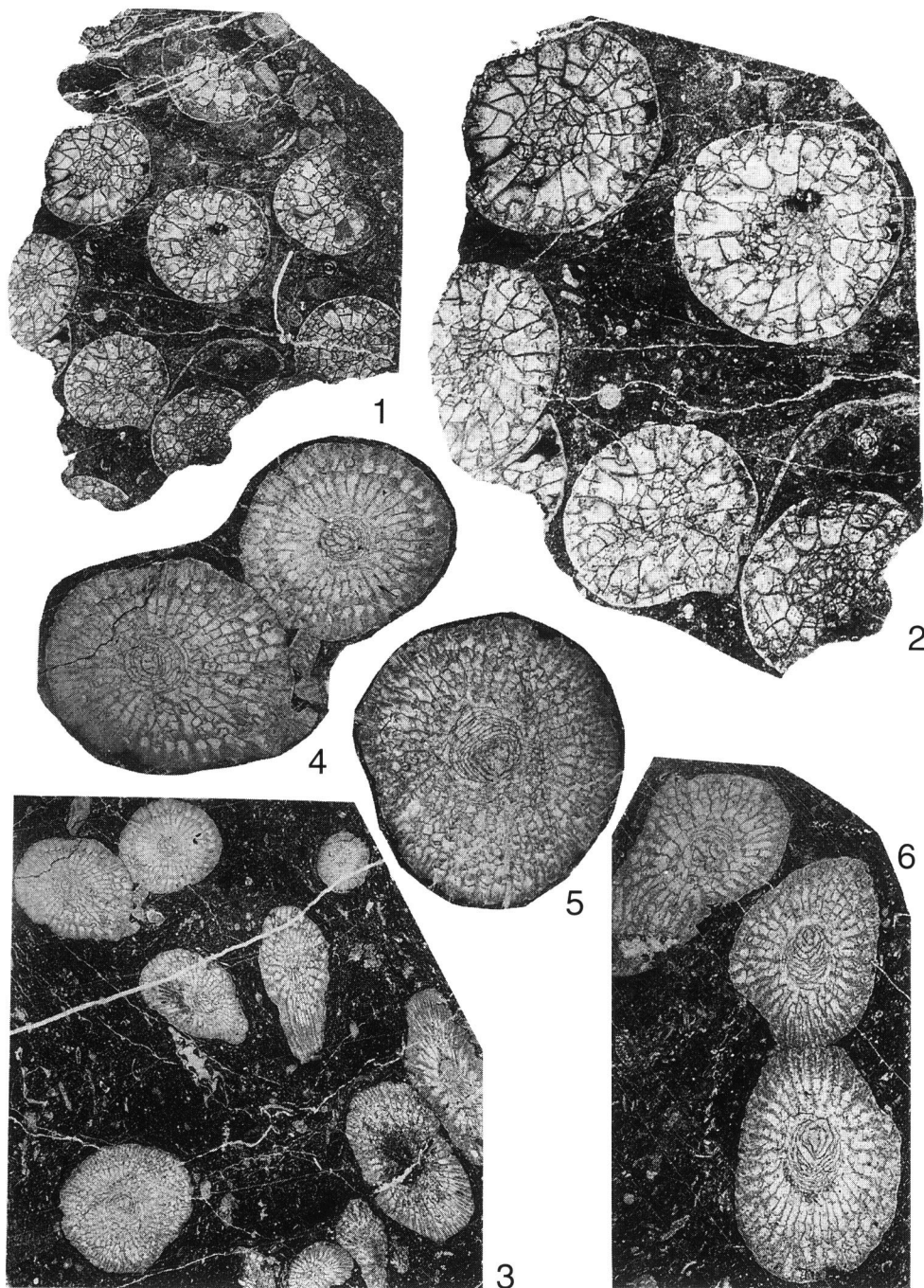
Waagenophyllum (Waagenophyllum) akasakense, Minato and Kato, 1965, p. 114-116, pl. 6, figs. 1-8.

Material: A single fragmentary corallum in a limestone pebble of the basal conglomerate of the unnamed formation exposed at the Nagaami quarry, Kamisenba in Kuzu.

Description: Corallum fasciculate and phaceloid. Corallites small, cylindrical, closely disposed. In transverse section, corallites rounded, not entirely circular with thin wall. Diameter of corallites 7.0 to 9.0 mm in mature stage. Septa two orders, major and minor in regular alternation, more or less zigzag, thickened in proximal portion. Major septa count 18 to 22; reach near periphery of axial structure, generally not connected directly with septal lamellae. Minor septa long, 4/5 to 2/3 length of major septa. Axial column variable in diameter, equal to 1/3 to 1/4 corallite diameter; rather loosely constructed, medial plate not distinct particularly in mature stages, many ranks of encircling edges of axial tabellae, and several discontinuous radiating septal lamellae. Dissepimentarium narrow, dilated by septa, one or two ranks of concentric dissepiments sporadically appear. Distinct inner wall constructs boundary between tabularium and dissepimentarium in some corallites. Tabularium rather wide, filled with cut edges of tabulae.

In longitudinal section, axial structure consists of dome-like axial tabellae and

→Fig. 4. *Yatsengia* sp., indet. **1, 2**, Transverse sections, IGUT 8083, $\times 2$, $\times 5$, respectively. *Waagenophyllum (Waagenophyllum) akasakense* (Yabe, 1902), **3**, transverse section of coralla, $\times 2$; **4-6**, transverse section of corallites, $\times 5$, IGUT 8084.



edges of septal lamellae; clinotabulae developed in rather wide tabularium. Both elongate and globose dissepiments appear in periphery of corallite.

Remarks: The present specimen is compared with the topotype specimens of *Waagenophyllum (W.) akasakense* collected by the senior author. The Kuzu specimen differs from the topotype in slightly weaker dilation of septa, fewer number of major septa, and longer minor septa than those of the latter. *Waagenophyllum (W.) pulchrum* Hamada is also similar species with the present form, but the former has smaller corallites and more simple axial structure, in particular weakly developed axial tabellae than those of the latter.

Geologic age: The *Yabeina* Zone (Midian).

Reg. no. IGUT 8084.

Note on the type specimen of *Pseudoyatsengia kuzuensis* Yabe housed at the Department of Geology, National Science Museum

Yabe's (1951) illustration of *Pseudoyatsengia kuzuensis* in his paper was poorly printed, hence the senior author took another photograph of the type specimen (transverse and longitudinal sections), and reillustrates here (Fig. 3-3-5). The thin sections, however, are rather thick to prepare a clear photograph. According to Yabe (1951), the original specimen was a large corallum as large as man's head and the corallum was separated into three pieces being kept at the Institute of Geology and Paleontology, Tohoku University (Reg. no. 66343), the Institute of Geology and Mineralogy, Tokyo University of Education, and the Department of Geology, National Science Museum, respectively. His illustrated thin sections were prepared from the material now kept at the National Science Museum (NSM 4151). Igo examined these thin sections and confirmed that the species is clearly assignable to the genus *Yatsengia* (Igo *et al.*, 2000). According to the label, this specimen was collected at the Aisawa quarry (Fig. 1, loc. 2). As shown in Fig. 3-3-4, the transverse sections of the corallites in this specimen do not have any discontinuous major septa in dissepimentarium. Some of these corallites are covered with microbial mats and sparry calcite layers (the same figure with white arrows). Yabe (1951) probably misunderstood that these layers represent the outer walls. Igo found the other specimen in the same sample storage of National Science Museum. The specimen is also labeled as *Pseudoyatsengia kuzuensis* collected by Eguchi from Kamisenba (Reg. no. NSM PA11733). The senior author assesses that the specimen came from the same locality with the present rugose corals. *Yatsengia kuzuensis* (Yabe) and our *Y. suzukii* are seemed to be main representatives of rugose coral fauna in the *Parafusulina* Zone of the Nabeyama Formation.

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