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Abstract

A float block of Mesozoic conglomerate, probably derived from the Lower Jurassic Kuruma Group, containing Devonian tabulate corals was collected in the Kotaki area, Itoigawa, Niigata Prefecture, central Japan. As the first fascicle of our study concerning this material, the present paper focuses on taxa of the suborder Favositina. They consist of *Favosites?* sp. indet., *Pachyfavosites* sp. indet. 1, *P.* sp. indet. 2, *Plicatomurus?* sp. indet., *Thamnopora itoae* Niko, Ibaraki and Tazawa sp. nov. and *Thamnoptychia mana* Niko and Senzai, 2010 from milky white to gray limestone pebbles and *Hillaepora* sp. indet., from black shale pebble. A Givetian (late Middle Devonian) species, *Thamnopora nicholsoni* (Frech, 1885), shows close resemblance with the new species, but differs by having larger mean diameters of the distal corallites and the fewer tabulae. *Thamnoptychia mana* indicates a Givetian age. Reliable stratigraphic distribution of the genus *Hillaepora* is restricted within the Lower Devonian.

Key words: Devonian, favositine tabulae corals, Kotaki area, Mesozoic conglomerate, *Thamnopora itoae* sp. nov.

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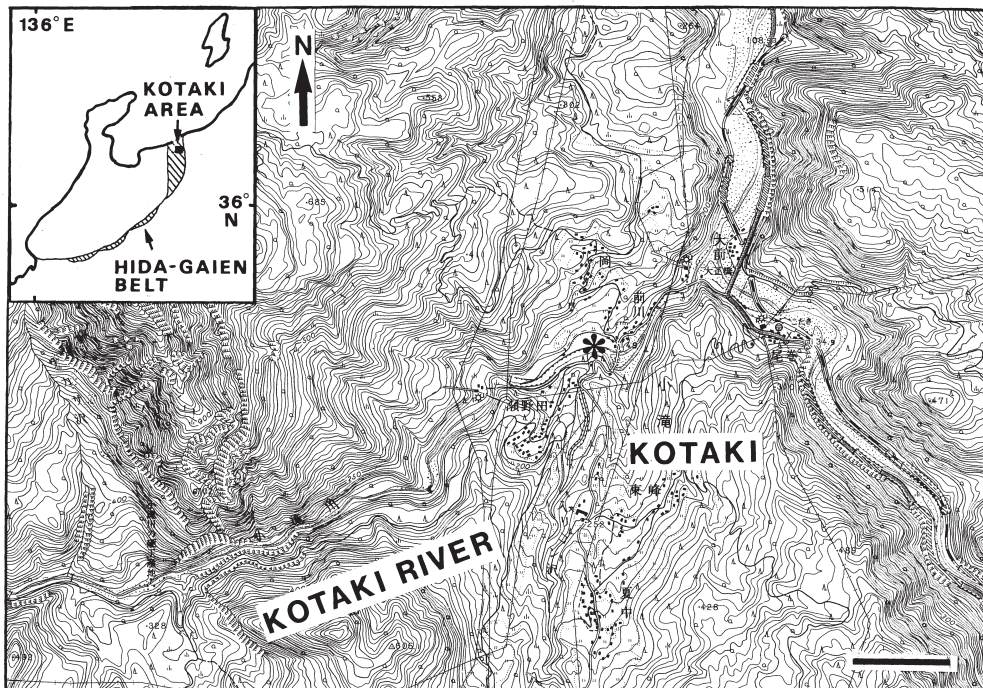


Fig. 1. Index map showing the fossil locality (asterisk) in the Kotaki area, Niigata Prefecture. Used topographic map is "Kotaki" scale 1:25,000 published by the Geospatial Information Authority of Japan. Scale bar = 500 m.

Introduction

A diverse fauna of Devonian tabulate corals was recovered from limestone and shale pebbles in a float block of conglomerate that was collected at the riverbed of the Kotaki River in the Kotaki area, Itoigawa, Niigata Prefecture, central Japan (Fig. 1). This discovery made by Mrs. Kanako Ito is noteworthy because the Middle Palaeozoic strata in the eastern part of the Hida-Gaien Belt including the Kotaki area had been subjected to erosion and disappeared at the present time. This paper represents the first fascicle of our long term project concerning the new material, the objectives of which works are: to clear the whole aspect of this tabulate coral fauna; to determine the precise age for each species; and to discuss faunal implications. Herewith, seven species of favositines are described or documented on the basis of 43 specimens. Their repository is the Fossa Magna Museum (abbreviation: FMM).

The conglomerate has sandy matrix (Fig. 2) and consists of subrounded to rounded pebbles, whose constituents are basic to intermediate volcanic rocks (abundant), chert (abundant), limestone (common), shale (common) and sandstone (relatively rare). There can be no doubt that the conglomerate was derived from the Mesozoic strata. Judging from its

sedimentary facies and geology of the upriver district of the collecting site, furthermore, the most probable origin is the Lower Jurassic Kuruma Group (Kobayashi et al., 1957; Nagamori et al., 2010).

Systematic Paleontology

Subclass Tabulata Milne-Edwards and Haime, 1850

Order Favositida Wedekind, 1937

Suborder Favositina Wedekind, 1937

Superfamily Favositoidea Dana, 1846

Family Favositidae Dana, 1846

Subfamily Favositinae Dana, 1846

Genus *Favosites* Lamarck, 1816

Type species.—*Favosites gothlandicus* Lamarck, 1816.

Favosites? sp. indet.

Fig. 3-1

Material.—FMM2108.

Description.—Corallum cerioid consists of prismatic corallites that have transverse sections of 3–8 sides in immature portions and indistinct 8–11 sides in mature ones; corallite diameters range from 0.4 to 2.1 mm; transverse sections of tabularia (lumina) are polygonal. Intercorallite walls thin, approximately 0.19 mm; mural pores occur on corallite faces; septal spines long, needle-like; tabulae probably complete.

Occurrence.—Milky white limestone pebble.

Discussion.—A single fragmentary specimen is present. Although information of longitudinal sections of its corallites is lacking, this species is assigned questionably to *Favosites* because the thin intercorallite walls with the mid-wall pores and the long septal spines were found. These characters would distinguish it from the comparable genera, such as *Mesofavosites* Sokolov, 1951, *Pachyfavosites* Sokolov, 1952, and *Squameofavosites* Chernyshev, 1941.

Subfamily Pachyfavitinae Mironova, 1965

Genus *Pachyfavosites* Sokolov, 1952

Type species.—*Calamopora polymorpha* var. *tuberosa* Goldfuss, 1826.

Pachyfavosites sp. indet. 1

Figs. 3-4, 5

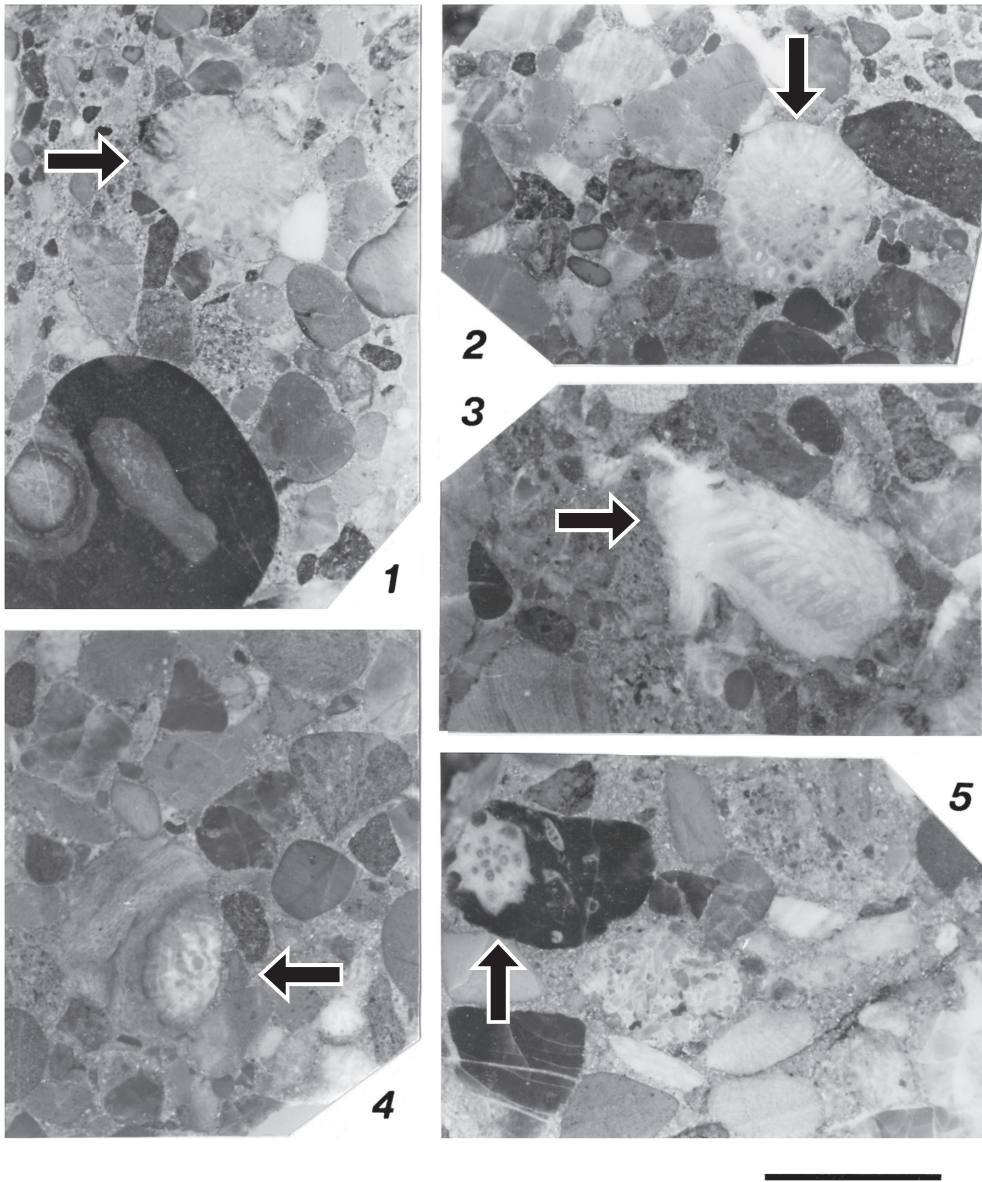


Fig. 2. Polished sections of conglomerate slabs showing mode of occurrence of Devonian fossils. **1:** Isolated branch of *Thamnopora itoae* Niko, Ibaraki and Tazawa sp. nov. (holotype, FMM2072, arrow) from limestone pebble and black shale pebble containing stromatoporoids. **2:** Isolated branch of *T. itoae* (paratype, FMM 2068, arrow) from limestone pebble. **3:** *Thamnopora itoae* (paratype, FMM2073, arrow) in milky white limestone pebble. **4:** *Thamnoptychia mana* Niko and Senzai (2010; FMM2097, arrow) in gray limestone pebble. **5:** *Hillaepora* sp. indet. (FMM2100, arrow) in black shale pebble. Scale bar = 10 mm for Figs. 2-1, 2; = 9 mm for Fig. 2-3; = 7 mm for Figs. 2-4, 5.

Material.—FMM2104, 2105.

Description.—Coralla massive with approximately 9 mm in maximum observable diameter, cerioid. Corallites prismatic, 5–8 sided in transverse section; their diameters 0.4–1.0 mm. Intercorallite walls thickened by stereoplasm, attaining 0.48 mm; transverse sections of tabularia (lumina) are rounded polygonal; mural pores common, occur on corallite faces; diameters of pores are large in comparing with corallite size, 0.15 mm in typical one; apparent septal spine is not detected; tabulae rare, complete.

Occurrence.—Gray limestone pebbles.

Discussion.—The thickened intercorallite walls, rounded polygonal profiles of the lumina, the relatively large diameters of the mural pores of this species are consistent with the morphology of *Pachyfavosites*.

Pachyfavosites sp. indet. 2

Fig. 3-6

Material.—FMM2106, 2107.

Description.—Coralla probably massive, cerioid. Corallites prismatic, 4–8 sided in transverse section; diameters of corallites 0.3–1.2 mm. Intercorallite walls thickened by stereoplasm, attaining 0.42 mm; transverse sections of tabularia (lumina) are rounded polygonal; no apparent mural pore and septal spine are detected; tabulae well-developed, complete or dissepiment-like in rare cases.

Occurrence.—Gray limestone pebbles.

Discussion.—The second species also has comparable morphology with *Pachyfavosites*. However, information of its mural pores is lacking, so the generic assignment is tentative. *Pachyfavosites* sp. indet. 2 differs from *P.* sp. indet. 1 by the well-developed tabulae.

Genus *Plicatomurus* Chang, 1959

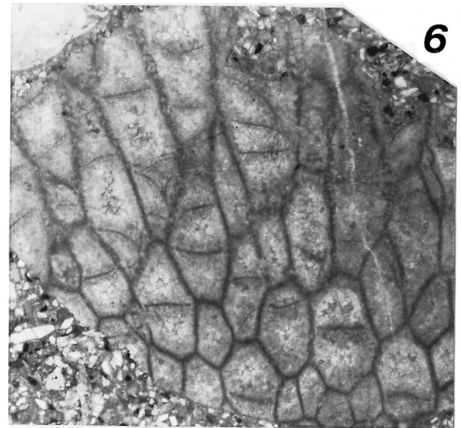
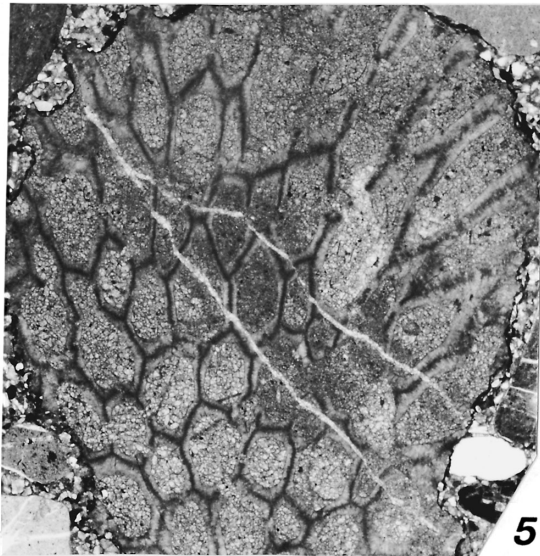
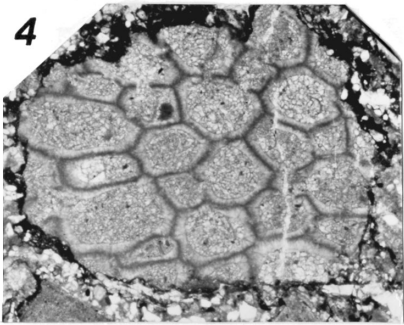
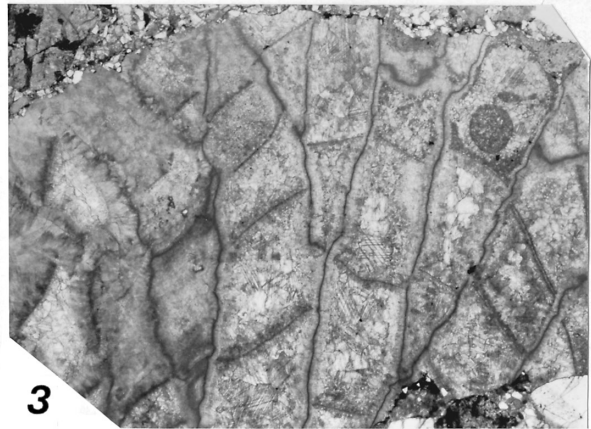
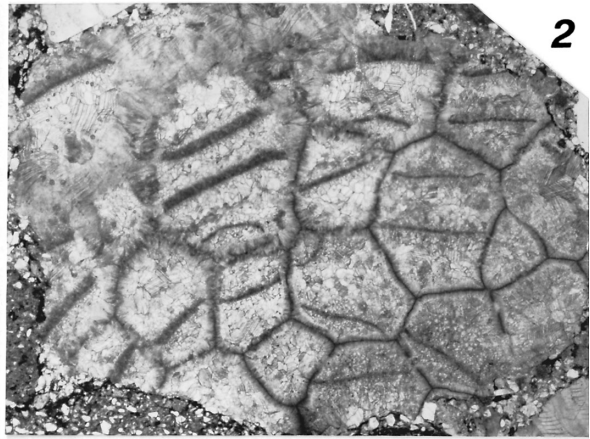
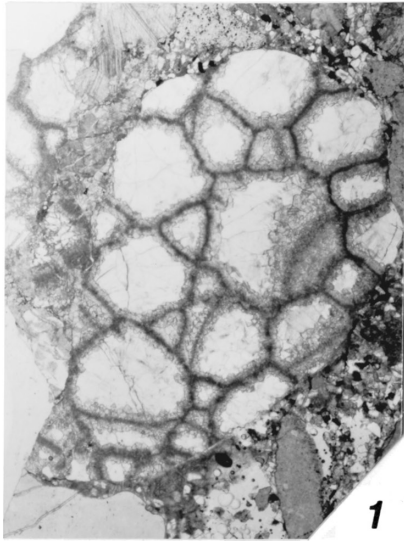
Type species.—*Plicatomurus solidus* Chang, 1959.

Plicatomurus? sp. indet.

Figs. 3-2, 3

Material.—FMM2101–2103.

Description.—Coralla, massive, cerioid composed by prismatic corallites; transverse section of corallites possesses 3–8 sides and has approximately 0.8–2.5 mm in diameter. Intercorallite walls wavy and thickened to form distinct peripheral stereozone; mural pores well-developed, occur on corallite faces; apparent septal spine is not detected; tabulae well-developed, complete; distal tabulae thickened.



Occurrence.—Milky white to gray limestone pebbles.

Discussion.—The presence of the stereozone in the peripheral corallum and wavy nature of the intercorallite walls are features of *Plicatomurus*. However, the examined specimens are too poor in preservation to confident generic assignment.

Superfamily Pachyporoidea Gerth, 1921

Family Pachyporidae Gerth, 1921

Genus *Hillaepora* Mironova, 1960

Type species.—*Hillaepora spica* Mironova, 1960.

Hillaepora sp. indet.

Figs. 2-5; 5-5

Material.—FMM2100.

Description.—Examined specimen is represented by a fragmentary branch that has 3.3–4.5 mm in diameter. Except for free and cylindrical calical rims, corallites are prismatic having indistinct triangular transverse sections in axial zone or sub-prismatic having sub-trapezoidal to fan-shaped sections in peripheral zone of branch; diameters of corallites 0.3–1.3 mm. Intercorallite walls thickened by stereoplasm, attaining approximately 0.63 mm; mural pores well-developed, occur on corallite faces, and have 0.13–0.63 mm in diameter; apparent septal spine is not detected; tabulae probably rare, complete.

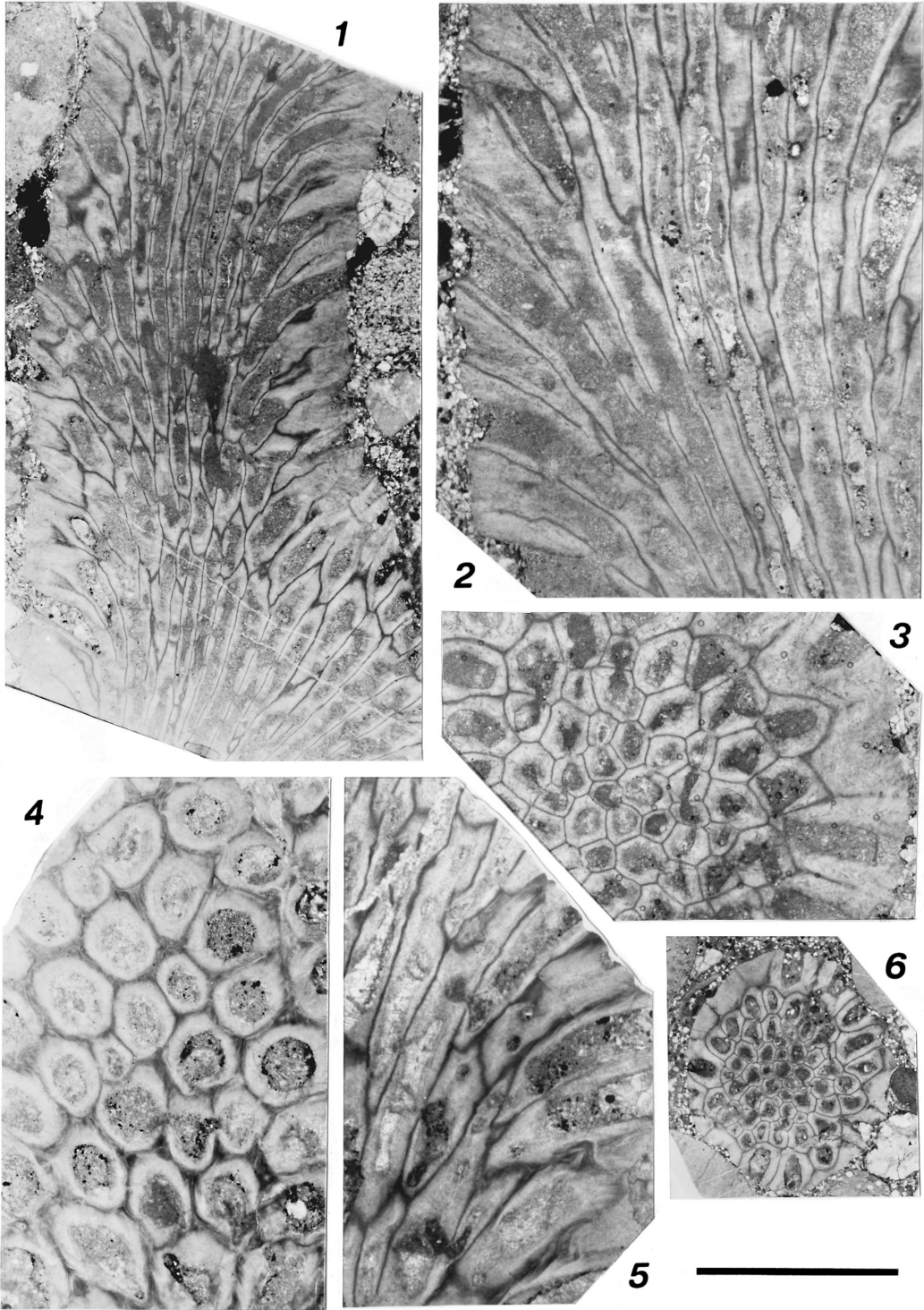
Occurrence.—Black shale pebble.

Discussion.—The observable features of this distinctive specimen seem to conform to the diagnosis of *Hillaepora*. Its reliable stratigraphic distribution is restricted within the Lower Devonian (Hill, 1981). Previously, *Hillaepora* sp. cf. *H. altaica* Dubatolov *in* Dubatolov and Spasskiy (1964) from the Takaharagawa Member of the Fukuji Formation in Gifu Prefecture (Niko, 2005, p. 13, 14, 16, figs. 2-1-7) was an only representative of the genus in Japan. The present specimen differs from the Fukuji species by having triangular transverse sections of the corallites in the axial zone of the branches, but information about longitudinal section of the corallites is necessary to advocate a new species.

Genus *Thamnopora* Steininger, 1831

Type species.—*Thamnopora madreporacea* Steininger, 1831.

←**Fig. 3. 1:** *Favosites?* sp. indet., FMM2108, transverse thin section of corallum. **2, 3:** *Plicatomurus?* sp. indet., thin sections. **2,** FMM2101, transvers section of corallum; **3,** FMM2103, longitudinal section of corallum. **4, 5:** *Pachyfavosites* sp. indet. 1, FMM2104, thin oblique sections of corallum. **6:** *Pachyfavosites* sp. indet. 2, FMM2106, thin oblique section of corallum. Scale bar = 3 mm.



Thamnopora itoae sp. nov.

Figs. 2-1-3; 4-1-6

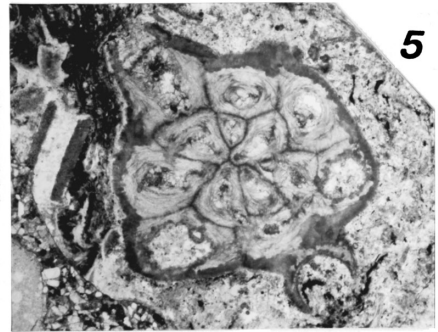
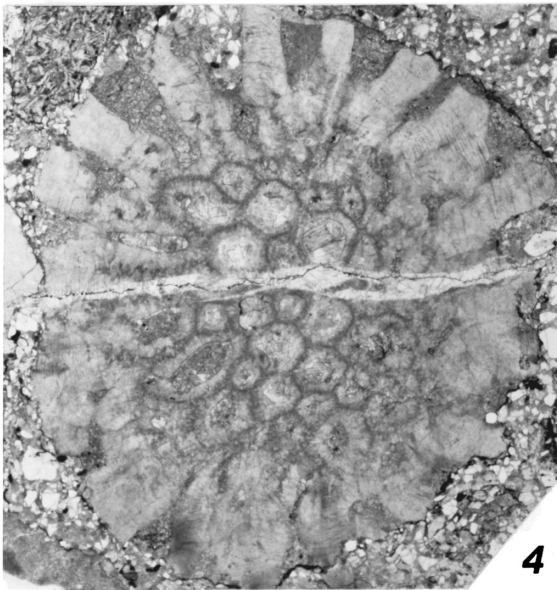
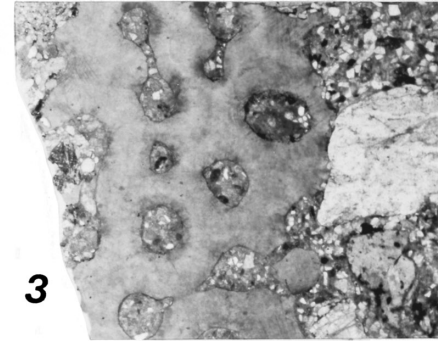
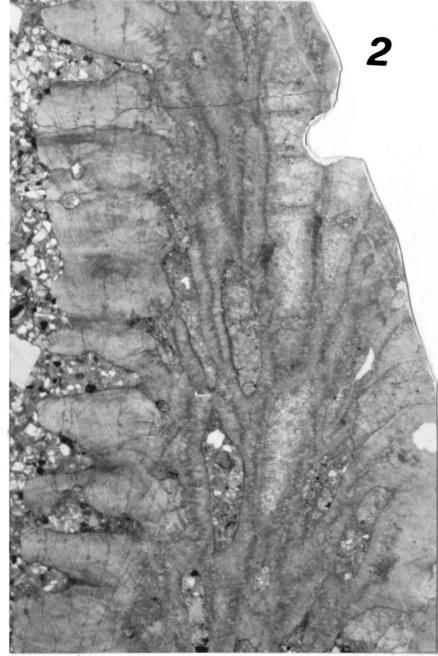
Etymology.—The specific name honors Mrs. Kanako Ito, who collected the examined block of conglomerate including all specimens of this new species.

Material.—Holotype, FMM2072, from which five thin and one polished sections were prepared. Thirteen thin and five polished sections were studied from the seven paratypes, FMM2066, 2068, 2069, 2071, 2073, 2077, 2078. In addition, eight fragmentary specimens, FMM2067, 2074–2076, 2079–2082, were also examined.

Diagnosis.—Species of *Thamnopora* with 6.6–10.8 mm in usual diameter of branches, 73–97 in number of corallites in transverse section of branches, and approximately 1.4 mm in distal corallite diameter; thickness of intercorallite walls attains 0.86 mm in peripheral zone of branches; mural pore abundant, elliptical; robust septal spines well developed in peripheral zone; tabulae relatively rare.

Description.—Coralla ramose with cylindrical branches, cerioid; branching probably common, bifurcate; usual diameters of branches are 6.6–10.8 mm; total corallum diameter and growth form unknown. Corallites prismatic, 4–7 sided; there are 73–97 corallites in transverse section of branches; each corallite consists of narrowly divergent proximal portion and outwardly curved distal one; these proximal and distal portions respectively form axial and peripheral zones of branches; ratios of axial zone width per branch diameter are approximately 0.5–0.7; diameters of corallites range from 0.4 to 1.7 mm, with 1.4 mm mean in distal corallites; tabularia (lumina) indicate rounded polygonal transverse sections, and shift to very deep calical pits; calices have obliquely upwards to nearly perpendicular direction with 44°–83° in angle to branch axis; lateral increases of new corallites commonly occur in axial zone. Intercorallite walls uniformly thickened in axial zone, 0.15–0.59 mm, then their thickness gradually increases attaining 0.86 mm in peripheral zone and form distinct stereozone; constituents of walls are median dark line and stereoplasm; microstructure of the latter layer is rect-radiate fibers; in addition, lamellar wall structure is developed in peripheral stereozone; mural pores abundant forming a single row on each corallite face, and longitudinally elongated elliptical profiles with somewhat variable in size; typical pores have 0.15 × 0.21, 0.17 × 0.36, 0.23 × 0.38 mm in diameter; septal spines common in axial zone and well developed in peripheral one, robust and low to high conical having 0.06–0.19 mm in length of protrude portions into tabularia; tabulae relatively rare, complete, concave proximally, nearly flat, or slightly oblique.

← **Fig. 4.** *Thamnopora itoae* Niko, Ibaraki and Tazawa sp. nov., thin sections. **1–3:** Holotype, FMM2072. **1,** longitudinal section of branch; **2,** longitudinal sections of distal corallites; **3,** transverse section of branch. **4, 5:** Paratype, FMM2071. **4,** transvers sections of distal corallites; **5,** oblique sections of distal corallites. **6:** Paratype, FMM2069, transverse section of branch. Scale bar = 1.5 mm for Figs. 4-1, 6, = 3 mm for Figs. 4-2-5.



Occurrence.—Milky white to gray limestone pebbles.

Discussion.—Due to its morphologies of the branches and the intercorallite walls, *Thamnoptora itoae* sp. nov. most closely resembles a Givetian (late Middle Devonian) species, *T. nicholsoni* (Frech, 1885, p. 104, 105), known from Germany, Novaya Zemlya, Ukraine, Morocco, Siberia, South China, and the Kuzuryu Lake–Ise River area, Fukui Prefecture (Niko and Senzai, 2011, p. 31, 33, 34, figs. 2-1-8). However, *T. nicholsoni* differs from this new species by larger mean diameters of the distal corallites (1.9 mm) and the fewer tabulae.

Thamnoptora itoae is also similar to *T. siavis* Dubatolov *in* Dubatolov et al. (1959, p. 22, 23, pl. 7, figs. 2a–e) from the Middle Devonian of Da Xinggan Ling (the Greater Khingan), Northeast China and *T. incerta* Regnéll (1941, p. 36–40, pl. 8, figs. 4a, b, 5, 6; pl. 9, figs. 1a, b, 2a, b, 3a–e, 4, 5) from the lower Devonian of Tarim, but the former species has larger diameters of the usual branches (15 mm) than the new species and the latter one is diagnosed by the lacking of the septal spine. Previously known other species of the genus from Japan, such as *T. hayasakai* Niko (2005, p. 22, 24, 26, figs. 6-1-9; Niko and Senzai, 2010, p. 49, 50, figs. 8-3, 4; Ibaraki and Niko, 2012, p. 107, 109, figs. 3-6-8), *T. senzaii* Niko (2003, p. 10, 12, figs. 2-1-9; 4-6-8; Niko and Adachi, 2004, p. 48, figs. 1-4, 7), *T. suberidaniensis* Niko (2003, p. 12, 15, 17, figs. 3-1-8), are readily differentiated from *T. itoae* by their smaller diameters of the branches.

Genus *Thamnoptychia* Hall, 1876

Type species.—*Striatopora* (*Thamnoptychia*) *limbata* Eaton, 1832.

Thamnoptychia mana Niko and Senzai, 2010

Figs. 2-4; 5-1-4

Thamnoptychia mana Niko and Senzai, 2010, p. 50, 52, figs. 10-1-8.

Material.—FMM2070, 2083–2099.

Occurrence.—Milky white to gray limestone pebbles.

Discussion.—The present material is conspecific with *Thamnoptychia mana*, whose types were recovered from float block of tuffaceous shale in the Kuzuryu Lake–Ise River area, Fukui Prefecture. Niko and Senzai (2011) regarded its age as the Givetian. *Thamnoptychia mana* differs from another species from Japan, *T. yanagidai* Niko (2010, p. 13, 14, pl. 2, figs. 1-6), by having the narrower peripheral stereozone in the branches.

←**Fig. 5. 1-4:** *Thamnoptychia mana* Niko and Senzai, 2010, thin sections. **1**, FMM2090, longitudinal section of branch; **2, 3**, FMM2088, **2**, longitudinal section of branch, **3**, transverse sections of distal corallites; **4**, FMM2096, transverse section of branch. **5:** *Hillaepora* sp. indet., FMM2100, thin transverse section of branch. Scale bar = 3 mm.

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