

Silurian Multisoleniids (Coelenterata: Tabulata) from the Gionyama Formation, Miyazaki Prefecture

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Abstract Four species of multisoleniid tabulate corals, *Multisolenia tortuosa* Fritz, 1937, *Multisolenia tessellata* sp. nov., *Mesosolenia decorasa* (Lin, 1975), and *Priscosolenia?* sp. indet., are described from the upper Wenlock (Lower Silurian) G2 Member of the Gionyama Formation, Miyazaki Prefecture. A new species of *Multisolenia tessellata* differs from all other species of the genus in having the large, almost 4 sided corallites and the fewer but very large connecting protuberances with the elliptical cross sections. *Mesosolenia* was not previously known in Japan. Besides a cosmopolitan species *Multisolenia tortuosa*, this assemblage includes a rare species *Mesosolenia decorasa* which is common only in the Ta–Pa Mountains in South China.

Key words: Early Silurian, tabulate corals, Multisoleniidae, Gionyama Formation, Miyazaki

Introduction

Silurian tabulate corals are far away to well-known in the Kurosegawa Terrane, only halysitids have been monographed by Hamada (1958) and Nakai (1981). The purpose of our project is to supply this gap. Following a serial papers of Niko (1998) and Niko and Adachi (1999a, 1999b), herein the authors provide additional materials of tabulate corals, ascribed to the family Multisoleniidae, from the Gionyama Formation in the Kuraoka area, Miyazaki Prefecture, southern Japan. Taxonomic analysis on the materials leads to the conclusion that a new species *Multisolenia tessellata* is associated with *Multisolenia tortuosa* Fritz, 1937, *Mesosolenia decorasa* (Lin, 1975), and *Priscosolenia?* sp. indet. The tabulate coral specimens studied are deposited in the National Science Museum, Tokyo.

Systematic Paleontology

Order Favositida Wedekind, 1937

Suborder Favositina Wedekind, 1937

Superfamily Favositicae Dana, 1846

Family Multisoleniidae Fritz, 1950

Subfamily Multisoleniinae Fritz, 1950

Genus *Multisolenia* Fritz, 1937

Type species: Multisolenia tortuosa Fritz, 1937.

Multisolenia tortuosa Fritz, 1937

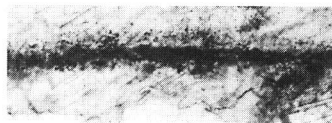
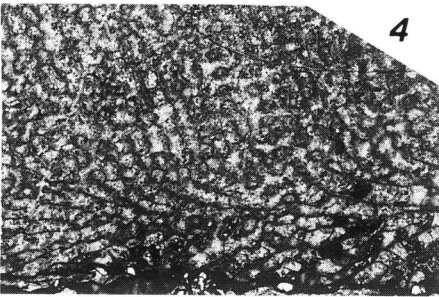
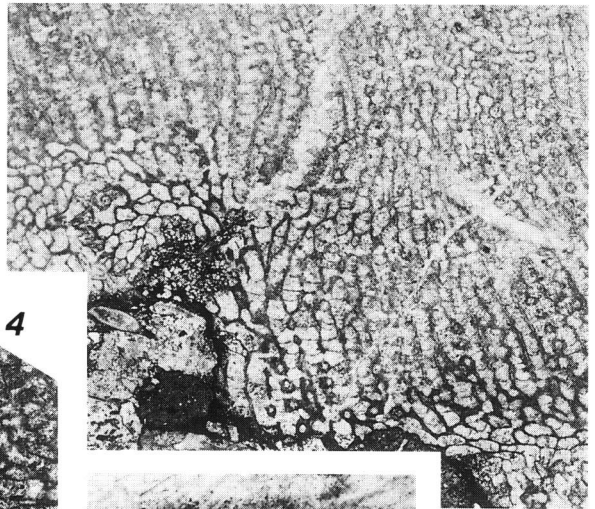
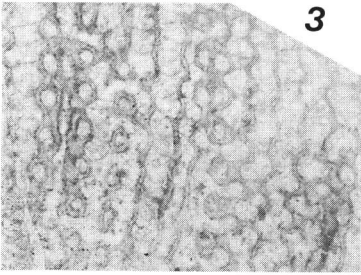
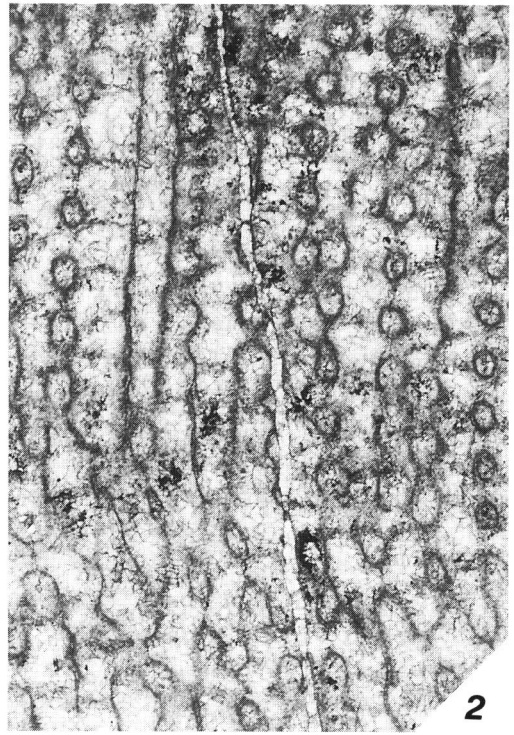
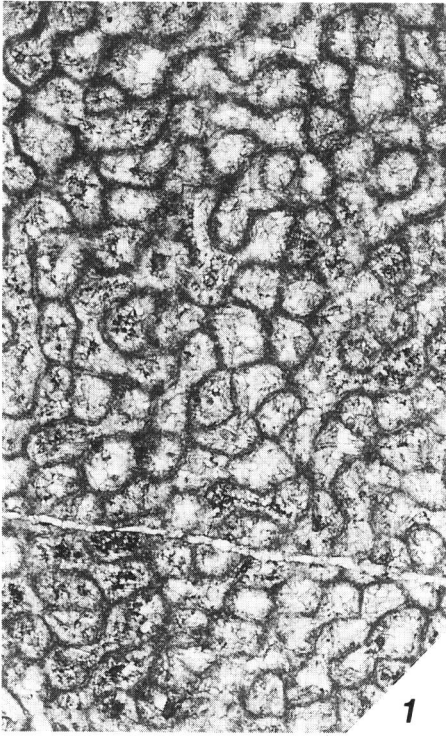
Fig. 1

- Multisolenia tortuosa* Fritz, 1937, p. 233, 234, figs. 1, 2, 2a, 3, 3a, 4, 4a, 5, 6; Fritz, 1939, p. 512, 513, pl. 59, figs. 3, 4; Sokolov, 1949, p. 82, pl. 7, figs. 7, 8; Sokolov, 1950, p. 222, 223, pl. 4, figs. 1, 2; Sokolov in Nikiforova, 1955, p. 31, pl. 52, figs. 3, 4a, b; Hill and Stumm, 1956, figs. 349-8a, b; Stearn, 1956, p. 66, pl. 5, figs. 1-4; Leleshus, 1959, p. 50, 51, pl. 1, figs. 1, 2; Zhizhina and Smirnova, 1959, p. 69, 70, pl. 5, figs. 1, 2; Dzyubo and Mironova, 1961, p. 58, pl. S9, figs. 3a, b; Strusz, 1961, p. 352, 353, pl. 44, fig. 3; Yü, 1962, p. 346, 347, pl. 1, figs. 1a-d; Barskaya and Sharkova, 1963, p. 140, pl. 18, figs. 3, 4; Leleshus, 1963, p. 163, 166, pl. 2, fig. 4; Sokolov and Tesakov, 1963, p. 127, 128, pl. 26, figs. 1, 2; Klaamann, 1964, p. 43, 44; Bolton, 1965, p. 26, 27, pl. 6, figs. 2, 3, pl. 8, figs. 1-4; Chekhovich, 1965, p. 76, pl. 14, fig. 1; Kovalevskiy, 1965, p. 118, pl. 24, figs. 1a, b; Kim, 1971, p. 133, 134, pl. 26, figs. 1a, b; Bolton and Copeland, 1972, pl. 3, figs. 5, 6; Ge and Yü, 1974, p. 172, 173, pl. 79, figs. 4, 5; Tesakov, 1979, pl. 26, figs. 3-7, 9-12, pl. 27, figs. 3-5, 7-10, pl. 28, figs. 1-4, pl. 31, figs. 1, 2, pl. 32, figs. 1, 2, 7, 8, pl. 33, figs. 1-4, 7-10 [non pl. 26, figs. 1, 2, 8, pl. 27, figs. 1, 2, 6, pl. 28, figs. 5-8, pl. 29, figs. 1-9, pl. 30, figs. 1-9, pl. 31, figs. 3-8, pl. 32, figs. 3-6, 9, 10, pl. 33, figs. 5, 6]; Hill, 1981, figs. 370-1a, b; Lin *et al.*, 1988, figs. 146a, b.
- Palaeofavosites mirabilis* Chernyshev, 1937a, p. 13, 14, 29, pl. 2, figs. 1a-c; Chernyshev, 1937b, p. 86, pl. 7, figs. 4a-c; Chernyshev, 1938, p. 149, figs. 1a, b; Chernyshev, 1941, p. 68, 69, figs. 1a, b; Chernyshev, 1951, p. 40-42, pl. 3, figs. 5, 6.
- Multisolenia* sp., Adachi and Niko, 1996, p. 69, 70, figs. 3-1, 2.

Material examined: Twenty-six coralla, NSM PA14569-14594.

Description: Coralla tabular with nearly flat to low domed surface in growth form, pile of tabular coralla to form large colony, maximum observed size approximately 135 mm in diameter and 78 mm in height, usually cerioid frequently indicating pseudomeandroid appearance in transverse section; dark growth bands of approximately 2-5 mm in height commonly recognized in longitudinal section of corallum.

→Fig. 1. *Multisolenia tortuosa* Fritz, thin sections. 1, 2, 6, NSM PA14569. 1, transverse section, ×14. 2, longitudinal section, ×14. 6, partial enlargement to show corallite wall structure, ×100. 3, 5, NSM PA14579. 3, longitudinal section, showing thickened corallite walls, ×10. 5, longitudinal section, note prostrate and alveolitoid-like proximal corallites, ×5. 4, NSM PA14574, longitudinal section, note prostrate and alveolitoid-like proximal corallites, ×5.



Corallites slender, almost cylindropismatic; each corallite perpendicular to corallum surface for the most part, but proximal portion prostrate and alveolitoid-like; excepting prostrate portion, cross sections of corallites and tabularia are polygonal with indistinct 4–6 sided or subcircular; corallite diameters range from 0.31 to 0.73 mm with 0.45 mm mean in cerioid portion, and maximum 0.77×0.29 mm in prostrate portion; calices shallow, calical opening perpendicular to corallum surface; increase of new corallites lateral. Intercorallite walls usually very thin, 0.02–0.03 mm in thickness, composed of median dark line and stereoplasm of rect-radiate fibers on each side; some coralla partially possess thickened intercorallite walls attaining 0.10 mm; in longitudinal section, corallite walls zigzag or rarely straight; connecting protuberances numerous, radially arranged with regularity and closed by pore-diaphragms; cross sections of connecting protuberances are elliptical with lateral compression to subcircular, large in comparing to corallite, 0.23×0.31 mm in minimum diameter of usual one; short spine-like projections recognized in transverse section; tabulae complete, located at nearly same level with connecting protuberance, rectangular to corallite, convex both proximally and distally, or flat; number of tabulae 4–7 in 2.5 mm of corallite length.

Discussion: The present species agrees closely with the type, known from the middle Silurian of Ontario, in diagnostic features such as the corallum growth form, the corallite size and shape, characters of the connecting protuberances, and arrangement of the tabulae. *Multisolenia tortuosa* is a cosmopolitan species which has been identified in North and South China, Kazakhstan, Siberia, Baltica, Laurentia, and Gondwana. Undoubted stratigraphic range of this species is the middle Llandovery to upper Wenlock (Lower Silurian).

Occurrence: Abundant in limestone pebbles to boulders of the upper Wenlock G2 Member at locality 1 (see Niko, 1998 for information of collecting site).

***Multisolenia tessellata* sp. nov.**

Figs. 2; 3-1

Holotype: NSM PA14596, from which two thin sections were made.

Other specimens: Eleven thin sections were studied from the six paratypes, NSM PA14595, 14597–14599, 14602, 14603. In addition, seven specimens, NSM PA14600, 14601, 14604–14607, 14610, also examined.

Diagnosis: Species of *Multisolenia* with large, almost 4 sided corallites of approximately 0.95 mm in diameter; septal spine may absent; fewer connecting protuberances than type species of genus; diameters of connecting protuberances very large, elliptical in cross section, 0.49×0.73 mm.

Description: Coralla tabular with usually flat surface in growth form and somewhat variable height ranging from approximately 10 mm to 61 mm, large, maximum observed size 105 mm in diameter and 36 mm in height (holotype), 53 mm in diame-

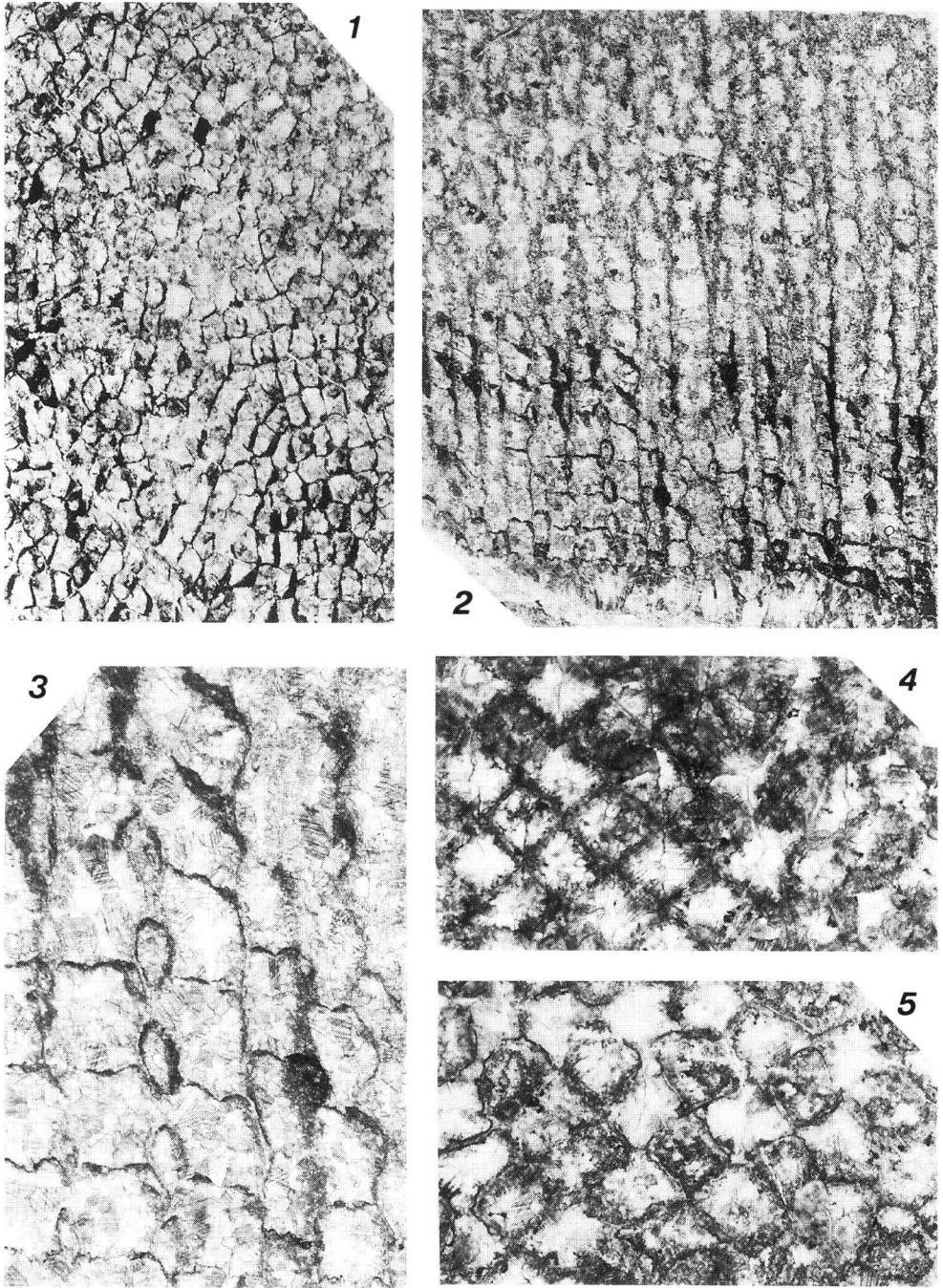


Fig. 2. *Multisolenia tessellata* sp. nov., thin sections. 1–3, holotype, NSM PA14596. 1, transverse section, $\times 5$. 2, longitudinal section, $\times 5$. 3, partial enlargement to show connecting protuberances and tabulae, $\times 14$. 4, 5, paratype, NSM PA14595, transverse sections, $\times 14$.

ter and 61 mm in height (paratype, NSM PA14597), almost cerioid rarely indicating pseudomeandroid appearance in transverse section. Corallites almost (cylindro-)prismatic with very gradual inflation; each corallite perpendicular to slightly oblique to corallum surface for the most part, but proximal portion is prostrate and alveolitoid-like; excepting prostrate portion, cross sections of corallites and tabularia are polygonal with 4–6, almost 4, sided or subcircular in rare occasions; corallite diameters large for family, range from 0.73 to 1.26 mm with 0.95 mm mean in cerioid portion, and maximum 1.10×0.53 mm in prostrate portion; calices shallow, to open perpendicular or oblique decreasing approximately 55° in angle to corallum surface, lacking calical modification; increase of new corallites lateral, common. Intercorallite walls thin, approximately 0.06 mm in thickness, composed of median dark line and stereoplasm of fibers(?) on each side; in longitudinal section, corallite walls zigzag or straight; connecting protuberances common, but not so abundant in comparing with type species of genus, situated at angles of corallites, radially arranged and closed by pore-diaphragms; cross sections of connecting protuberances are elliptical with lateral compression, very large, 0.49×0.73 mm in minimum diameter; septal element not recognized; tabulae complete, usually rectangular to corallite, weakly sinuate or convex distally, number of tabulae moderate for genus, 5–7 in 2.5 mm of corallite length.

Discussion: This new species is clearly distinguished from the associated species *Multisolenia tortuosa* in its predominance of the 4 sided corallite cross sections, larger corallite diameters (approximately 0.95 mm versus approximately 0.45 mm in *M. tortuosa*), and fewer number of the connecting protuberances resulted in the scant pseudomeandroid structure. *Multisolenia ninae* (Chernyshev, 1937, pl. 6, figs. 4a, b, text-fig. 7) from the Upper Silurian of Novaya Zemlya is comparable to *M. tessellata* sp. nov. Excepting the difference of diameters of the connecting protuberances (0.49×0.73 mm versus 0.3–0.35 mm mean in *Multisolenia ninae*), this arctic species also has the frequently 4 sided corallite cross sections with similar corallite diameters, and shares an absence of the septal spine. *Multisolenia tessellata* also has similarities with *M. confluens* Stearn (1956, pl. 5, figs. 6–8), from the middle Silurian of Manitoba, Laurentia. However, differences can be noted with respects to the corallite diameters (approximately 1.07 mm in *Multisolenia confluens*) and the cross sections of the connecting protuberances (elliptical versus circular in *M. confluens*). *Multisolenia baskuskanensis* (Chernyshev, 1951, pl. 26, figs. 3, 4) was described as *Palaeofavosites mirabilis* var. *baskuskanensis* from the Upper Silurian of the Kuznetsk Basin, Siberia, and it appears to be like this new species. Although Chernyshev's (1951) description is too insufficient to determine the specific diagnosis, the Siberian species probably has the more numerous connecting protuberances and the smaller corallite diameters (approximately 0.4–0.7 mm) than those of *Multisolenia tessellata*.

Etymology: The specific name is derived from the Latin *tessellatus* (=mosaic) in reference of its appearance in transverse section.

Occurrence: Common in limestone pebbles to cobbles of the G2 Member at lo-

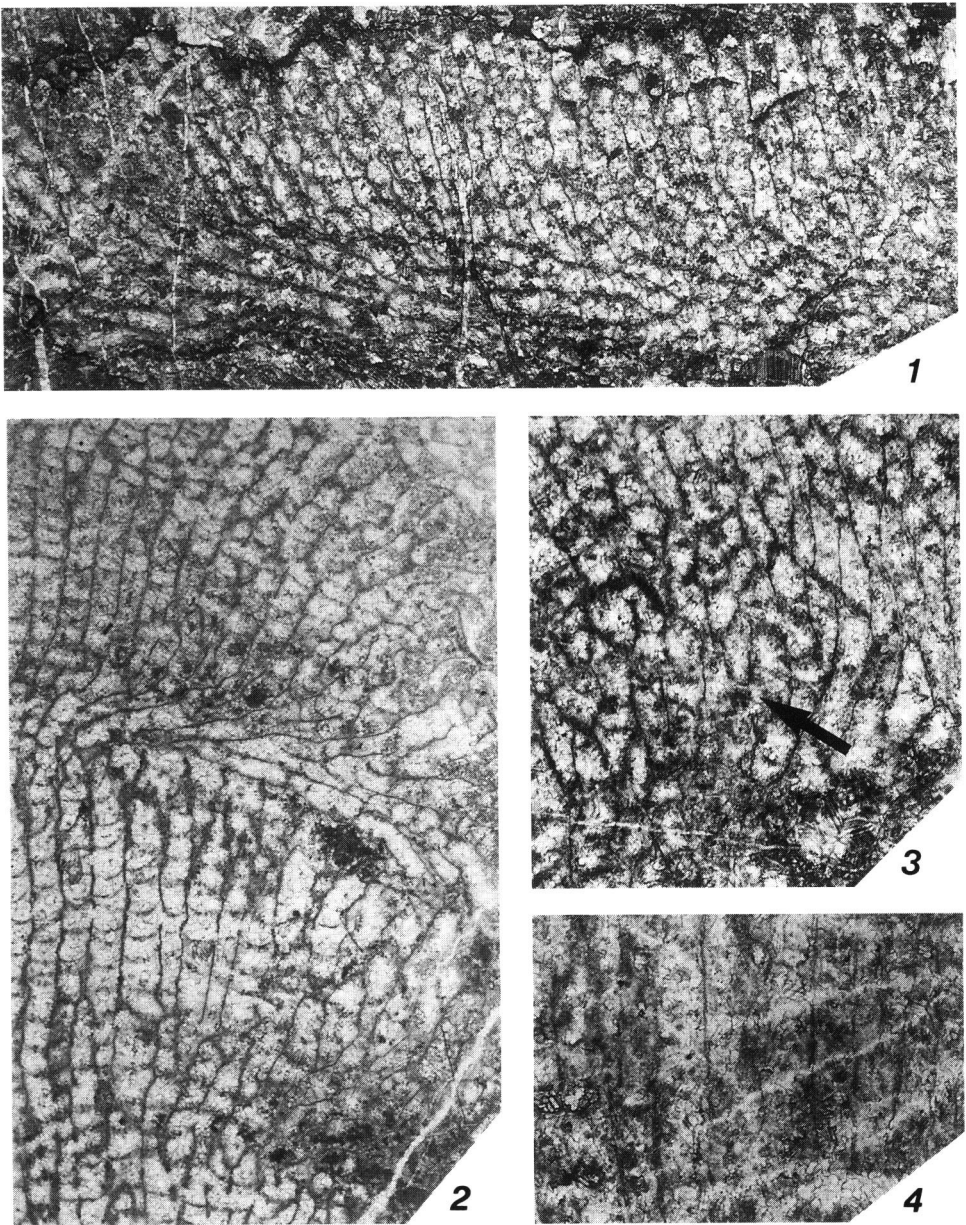


Fig. 3. 1, *Multisolenia tessellata* sp. nov., paratype, NSM PA14598, longitudinal thin section, note prostrate and alveoloid-like proximal corallites, $\times 5$. 2, *Mesosolenia decorasa* (Lin), NSM PA14608, longitudinal thin section, showing overlapped corallites, $\times 14$. 3, 4, *Priscosolenia?* sp. indet., NSM PA14609, thin sections. 3, oblique section, arrow indicates connecting protuberance, $\times 14$. 4, longitudinal section, $\times 14$.

cality 1.

Genus *Mesosolenia* Mironova, 1960

Type species: Favosites festivus Chernyshev, 1951.

***Mesosolenia decorasa* (Lin, 1975)**

Figs. 3-2; 4

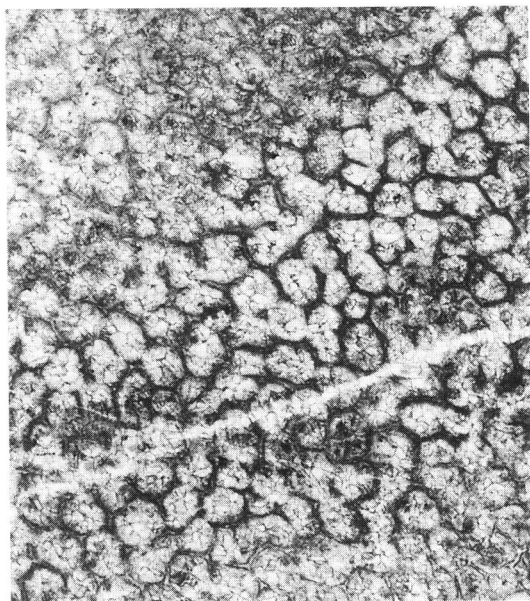
Mesosoleniella decorasa Lin, 1975, p. 208, pl. 60, figs. 1a-d; Lin *et al.*, 1988, pl. 6, figs. 2a, b, text-figs. 149a, b.

Material examined: A single corallum, NSM PA14608.

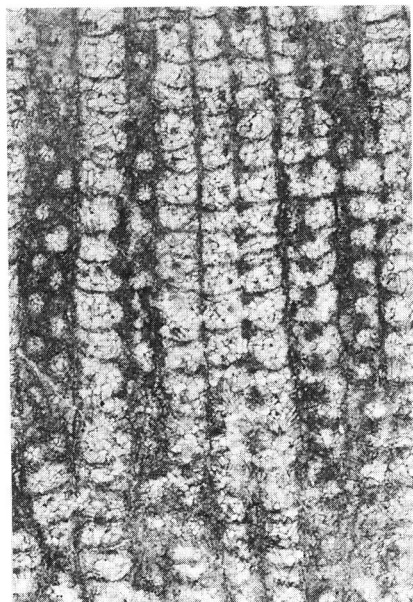
Description: Corallum domed in growth form with maximum observed size 57 mm in diameter and 29 mm in height, almost cerioid partly indicating pseudomeandroid appearance in transverse section. Corallites slender, almost prismatic; each corallites perpendicular to corallum surface for the most part, but proximal and overlapped portions are prostrate and alveolitoid-like; excepting prostrate portion, cross sections of corallites and tabularia are polygonal with 4–6, usually 6, sided; corallite diameters range from 0.21 to 0.59 mm with 0.43 mm mean in cerioid portion, and maximum 0.82×0.50 mm in prostrate portion; calice not preserved; increase of new corallites lateral. Intercorallite walls variable in thickness, ranging from 0.04 to 0.12 mm; well-preserved intercorallite walls composed of median dark line and stereoplasm of fibers(?) on each side; in longitudinal section, corallite walls straight or rarely zigzag; probable connecting protuberances rarely recognized at angles of corallites, their cross sections subcircular, large in comparing to corallite, approximately 0.31 mm in diameter; mural pores subcircular in cross section, numerous, also large, attaining 0.25 mm in diameter, regularly spaced with a single row (or 2 rows in rare occasions) in each corallite face; squamulae short, approximately 0.08 mm in length, numerous, triangular, form eaves-like structure at mural pores; tabulae usually complete, rectangular to corallite, convex proximally; number of tabulae 6–10 in 2.5 mm in length of corallite.

Discussion: Although only a single corallum was discovered from the Gionyama Formation, this specimen differs in no significant respects from the holotype of *Mesosolenia decorasa* known from the middle Wenlock of the Ta-Pa Mountains in the northern margin of South China. This is the first record of *Mesosolenia* in Japan. We consider that its somewhat smaller corallite diameters (approximately 0.43 mm versus 0.6–0.7 mm in holotype) are intracolony variations on account of the most

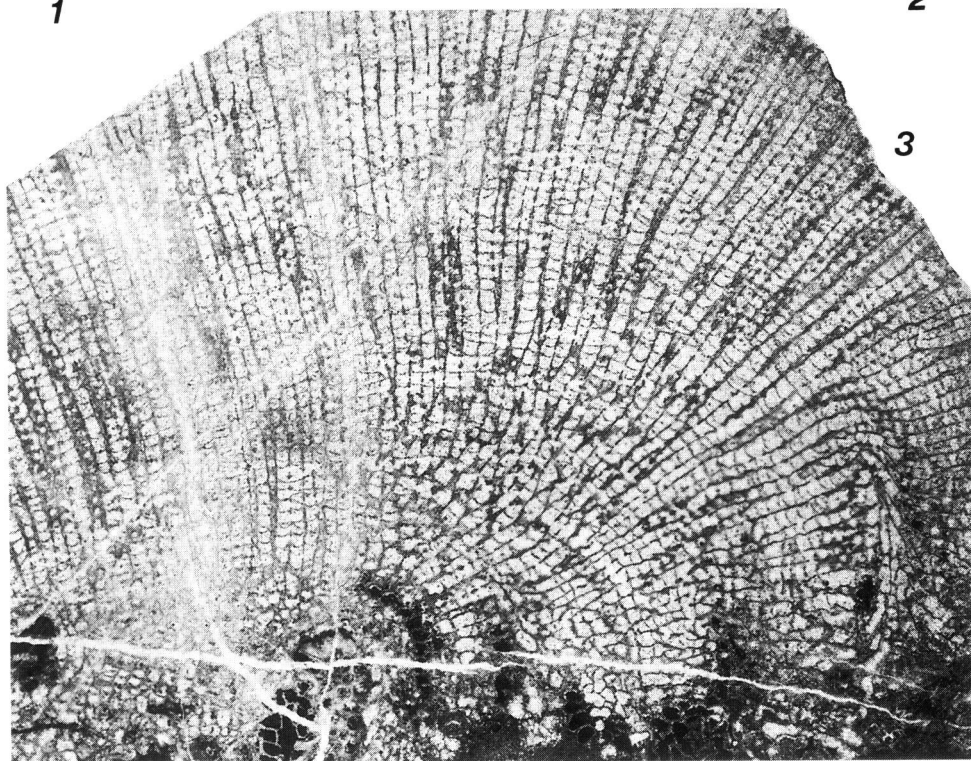
→Fig. 4. *Mesosolenia decorasa* (Lin), NSM PA14608, thin sections. 1, transverse section, $\times 14$. 2, longitudinal section, $\times 14$. 3, longitudinal section, note prostrate and alveolitoid-like proximal corallites, $\times 5$.



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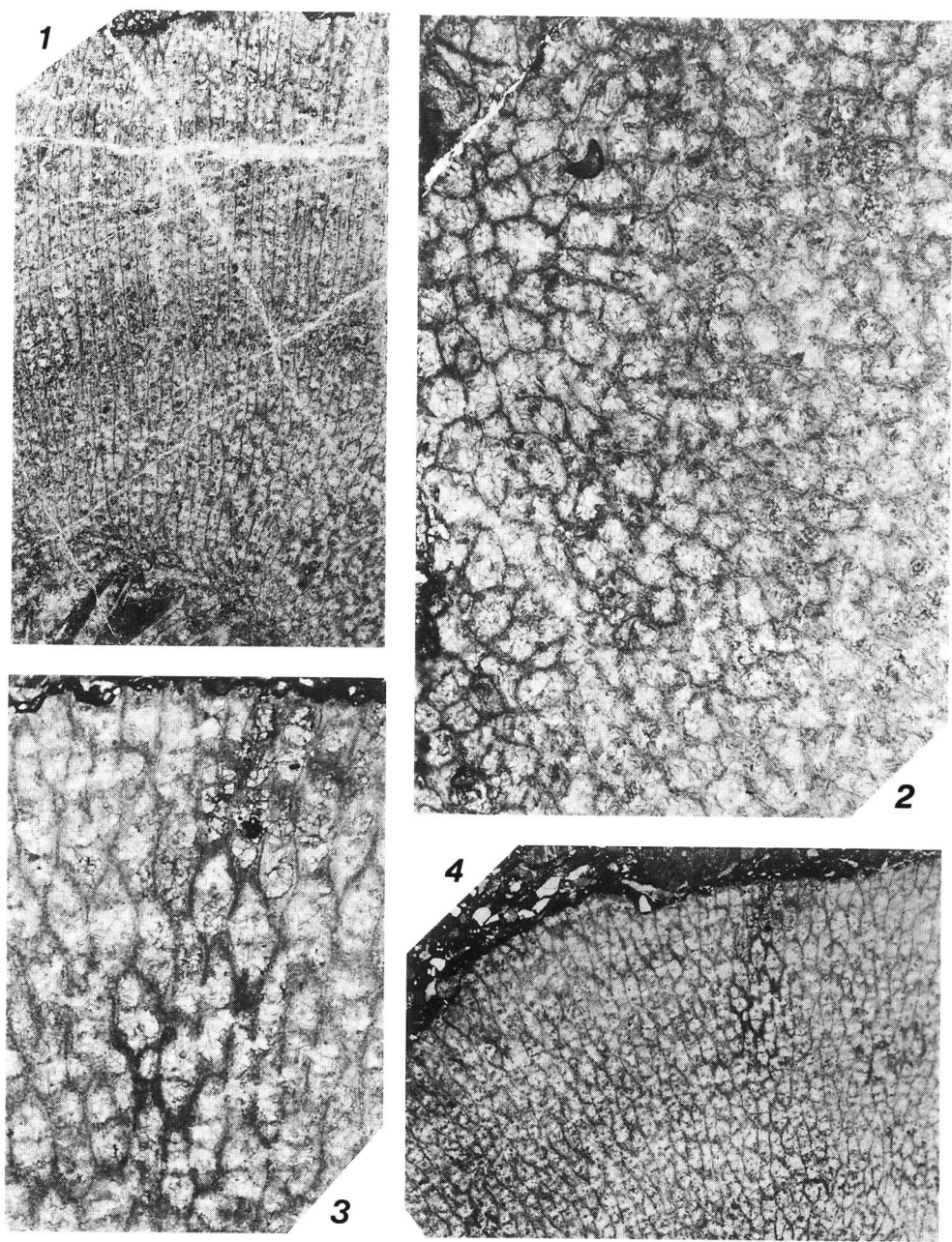


Fig. 5. *Priscosolenia?* sp. indet., NSM PA14609, thin sections. 1, longitudinal section, note prostrate and alveolitoid-like proximal corallites $\times 5$. 2, transverse section, $\times 14$. 3, 4, oblique sections, $\times 14$ and $\times 5$, respectively.

distal (thus most inflated) portion of the corallites including the calices is eroded away in the Gionyama specimen. Previous occurrence of this species has been restricted in South China.

Occurrence: Scarce in limestone pebble in the G2 Member at locality 1.

Genus *Priscosolenia* Klamann, 1964

Type species: *Multisolenia prisca* Sokolov, 1951.

***Priscosolenia?* sp. indet.**

Figs. 3-3, 4; 5

Material examined: A single corallum, NSM PA14609.

Description: Corallum domed in growth form with maximum observed size 53 mm in diameter and 41 mm in height, almost cerioid, rarely indicating pseudomeandroid appearance in transverse section. Corallites slender, (cylindro-)prismatic; each corallite perpendicular to corallum surface, but most proximal portion is prostrate and alveoloid-like; cross sections of corallites and tabularia are polygonal with indistinct 4–6 sided or rarely subcircular to fan-shaped; corallite diameters range from 0.21 to 0.75 mm; increase of new corallites lateral. Intercorallite walls relatively thick for subfamily, approximately 0.13 mm in thickness, may differentiated; mural pores well-developed on each corallite face and edge; in addition, sporadic connecting protuberances also recognized; septal spines frequent, thick and long, attaining 0.26 mm in length; tabulae complete, rectangular or oblique to corallite, convex both distally and proximally.

Discussion: This species is known from a single and somewhat recrystallized specimen. It shows thick and long septal spines and sporadic connecting protuberances that suggest a relationship with *Priscosolenia*. However, the type species (Sokolov, 1951, pl. 20, figs. 1–6), from the Upper Ordovician of Estonia, has much numerous septal spines.

Occurrence: Scarce in limestone pebble in the G2 Member at locality 1.

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