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# Devonian Pachyporoidean Tabulate Corals from the Fukuji Formation, Gifu Prefecture

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**Abstract** Five tabulate coral species of the superfamily Pachyporoidea are described from the Lower Devonian (Emsian?) of the Fukuji Formation, Gifu Prefecture, Central Japan. They include pachyporids consisting of *Hillaepora* sp. cf. *H. altaica* Dubatolov *in* Dubatolov and Spasskiy, 1964, *Isurugiopora obesa* gen. et sp. nov., *Striatopora takayamaensis* sp. nov. and *Thamnopora hayasakai* sp. nov., and a parastriatoporid of *Parastriatopora innae* Dubatolov, 1963. Among the previously known pachyporid genera, a new genus *Isurugiopora* is most similar to *Gertholites*, differing mainly in its exceptionally inflated median dark line. *Dendropora dubrovensis* Dubatolov, 1959 from the Givetian of the Kuznetsk Basin, southwestern Siberia is assigned to *Isurugiopora.* The conspecific and closely related species are reported from the Kuznetsk Basin and Altai of southwestern Siberia. The tabulate coral faunas from Salair and the Kuznetsk Basin of southwestern Siberia, Inner Mongolia, the Urals, Tarim, and Belgium also have comparable species with the Fukuji fauna. From a paleobiogeographic point of view, this fauna shows most strong affinities with those in southwestern Siberia.
**Key words:** Early Devonian, tabulate corals, Pachyporoidea, *Isurugiopora* gen. nov., Fukuji Formation, Gifu.

## Introduction

Following Niko (2001, 2003), in the present paper five tabulate coral taxa from the Lower Devonian (Emsian?) of the Fukuji Formation are described, including a new genus and species, *Isurugiopora obesa*, and two new species, *Striatopora takayamaensis* and *Thamnopora hayasakai*. These fossils occur in the Fukuji area belonging to Okuhidaonsen-gou, Takayama-shi (previously Kamitakara-mura, Yoshiki-gun) of Gifu Prefecture, Central Japan. Detailed geographic positions of fossil localities (FH-4, 6–9) are given in Fig. 1. Used specimens are kept in the National Science Museum (abbreviation NSM) or in the Hikaru Memorial Museum (abbreviation HMM).

## Systematic Paleontology

Order Favositida Wedekind, 1937

Suborder Favositina Wedekind, 1937

Superfamily Pachyporoidea Gerth, 1921

Family Pachyporidae Gerth, 1921

Genus ***Hillaepora*** Mironova, 1960

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

***Hillaepora*** sp. cf. ***H. altaica*** Dubatolov *in* Dubatolov and Spasskiy, 1964

(Figs. 2-1–7)

*Compare*:

*Hillaeopora* [sic] *altaica* Dubatolov *in* Dubatolov and Spasskiy, 1964, p. 127, 128, pl. 7, figs. 3a, b, v, 4–6.

*Hillaepora altaica* Dubatolov; Avrov and Dubatolov,

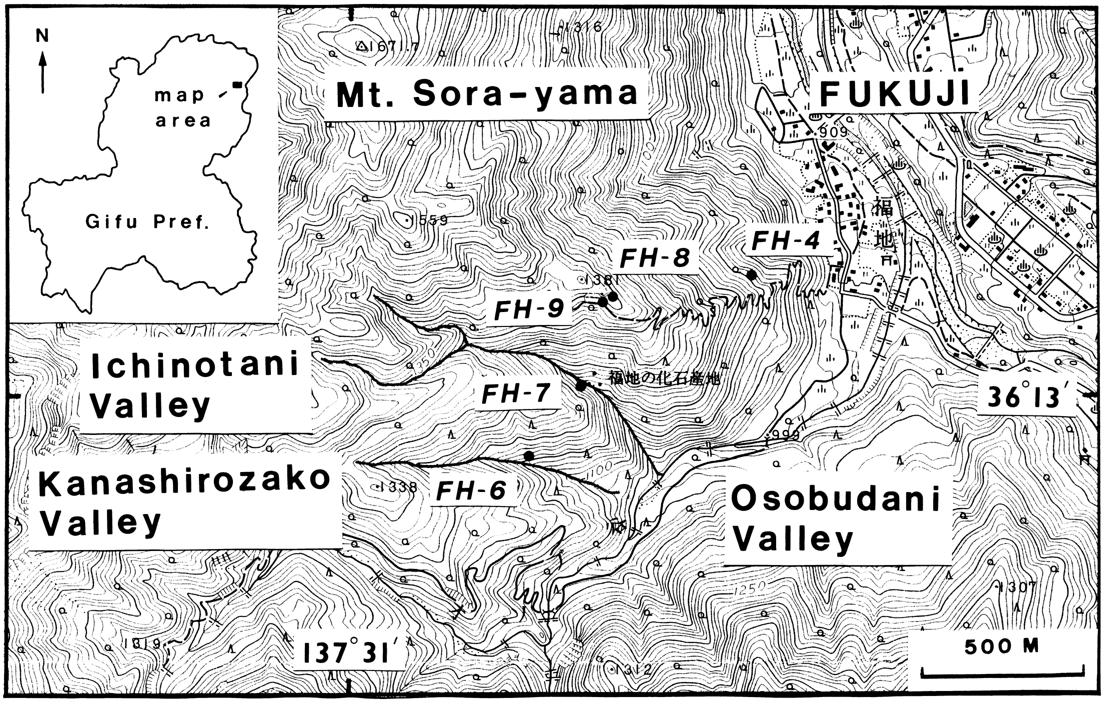


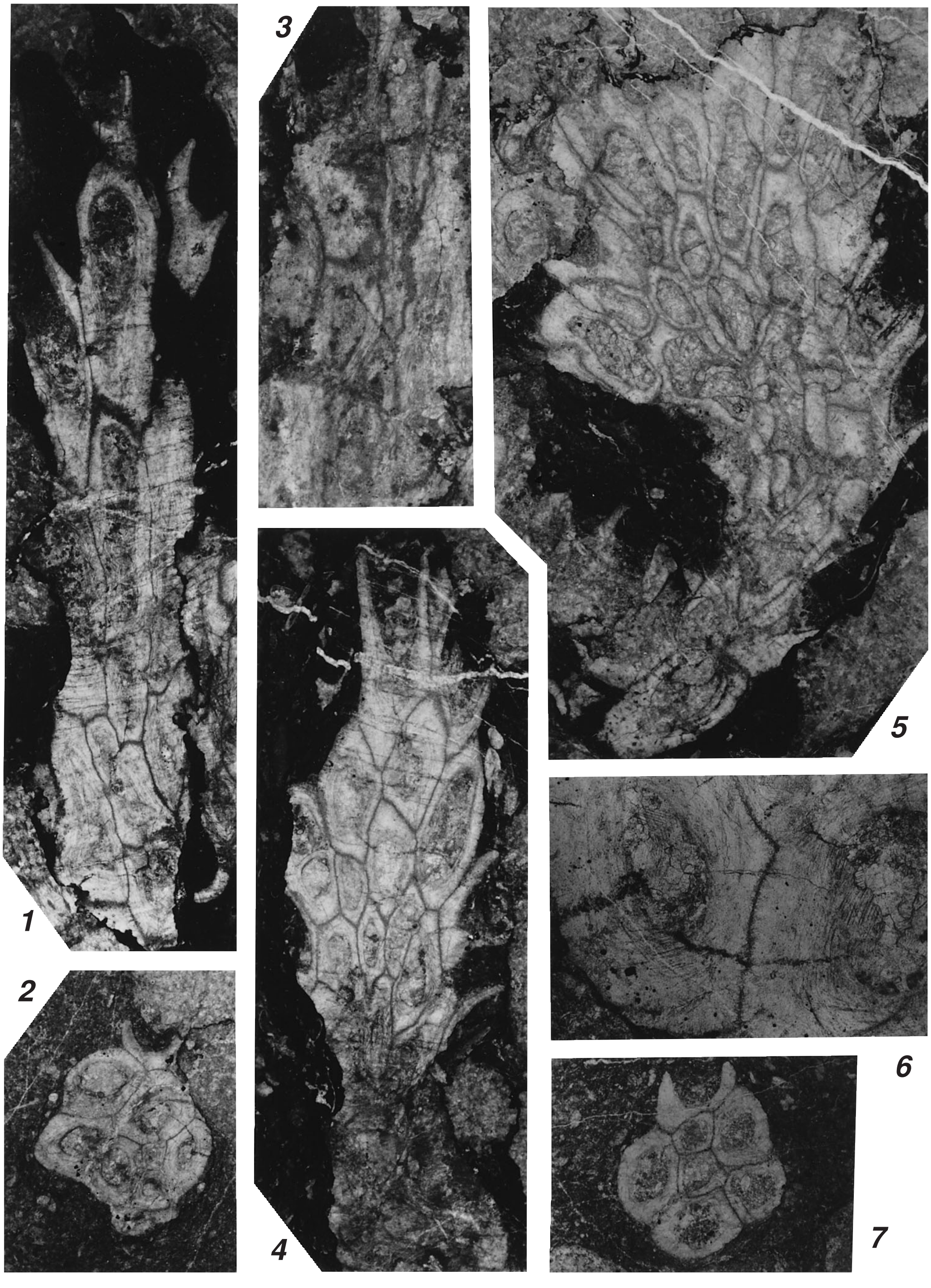

Fig. 1. Index map of the Fukuji area, Gifu Prefecture showing coral localities (FH-4, 6–9). Used base map is "Yakedake" (1 : 25,000 quadrangle) published by Geographical Survey Institution.

1969, p. 21, 22, pl. 3, figs. 1a, b, v, g, 2–6.

*Material examined*: Two coralla, NSM PA15594, 15595.

*Description*: Coralla ramose with subcylindrical to somewhat irregular shaped branches, cerioid except for free calical edges; branching rare, may be umbelliferous; diameters of branches range from 1.5 to 6.1 mm, usually 2.0–3.7 mm; total corallum diameter and growth form unknown owing to fragile nature. Observation based on longitudinal (but not through central axis of branch), oblique and transverse sections provides following corallite features; corallites mostly prismatic, have 3–6 sides in transverse section, or subprismatic with subtrapezoidal to fan-shaped transverse sections in corallites verging on branch periphery; there are 6 to at least 15 corallites in transverse section of branch; diameters of corallites range from 0.40 to 1.30 mm, with 1.19 mm mean in free calical edge; each corallite lies at small angle to branch axis in its proximal and main portions, then turns gradually outward to form long free calical edge that opens obliquely upward, with approximately 25°–45° in angle to branch surface; calical edges cylindrical, attain 1.07 mm in length; transverse sections of typical tabularia are subcircular, whose proximal and main portions are strongly narrowed; calical pits deep; increase of new corallite is not observable in sectioned parts. Intercorallite walls almost uniformly corpulent, very thick for the genus attaining 0.61 mm; microstructure of intercoral-

Fig. 2. *Hillaepora* sp. cf. *H. altaica* Dubatolov *in* Dubatolov and Spasskiy, 1964, NSM PA15594, thin sections. **1**, longitudinal (but not through central axis of branch) section of branch, ×10. **2**, **7**, transverse sections of branches, ×10. **3**, oblique sections of corallites, partial enlargement to show mural pores, ×14. **4**, oblique section of branch, ×10. **5**, oblique section of branch, note complete tabulae, ×10. **6**, transverse sections of corallites, partial enlargement to show intercorallite wall structure, ×50.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lite walls differentiated into median dark line and stereoplasm, the latter of which composed of microlamellae; mural pores rare, subcircular in profile, forming a single row on each corallite face; typical mural pore have 0.20 mm in diameter; distinct septal spine not observable; tabulae very rare, complete, usually rectangular to corallite.

*Occurrence*: This species was collected from the float blocks of black limestone (bioclastic wackestone) in talus on the eastern slope of Mt. Sora-yama near locality FH-4 (NSM PA15595) and in talus at the Kanashirozako Valley near locality FH-6 (NSM PA15594).

*Discussion*: The described coralla are tentatively assigned to *Hillaepora altaica* with which they share to the usual diameters of the branches and the corallites, the very thick intercorallite walls for the genus attaining approximately 0.6 mm, and a rareness of the mural pores. Although I identified two specimens in my collections, none of them makes well-oriented longitudinal section. Thus, the Fukuji species being left under open nomenclature. *Hillaepora altaica* is known from the Eifelian (lower Middle Devonian) of Altai, southwestern Siberia.

The present species is also similar to *Hillaepora spica* Mironova (1960, p. 98, pl. 11, fig. 2) from the Lower Devonian of Salair, southwestern Siberia and *H.* ? sp. (Tchi, 1976, p. 116, pl. 47, fig. 7) from the Upper Silurian of Inner Mongolia, but the latter two species have the much thinner (less than 0.25 mm in *H. spica* and approximately 0.2 mm in *H.*? sp.) intercorallite walls.

### Genus ***Isurugiopora*** nov.

*Type species*: *Isurugiopora obesa* sp. nov.

*Other included species*: *Isurugiopora dubrovoensis* [sic] (Dubatolov *in* Sokolov, 1955, pl. 25, figs. 2, 3) [nomen nudum]; *I. dubrovensis* Dubatolov, 1959, p. 135, 136, pl. 45, figs. 2a, b, v, g) from the Givetian (upper Middle Devonian) of the Kuznetsk Basin, southwestern Siberia.

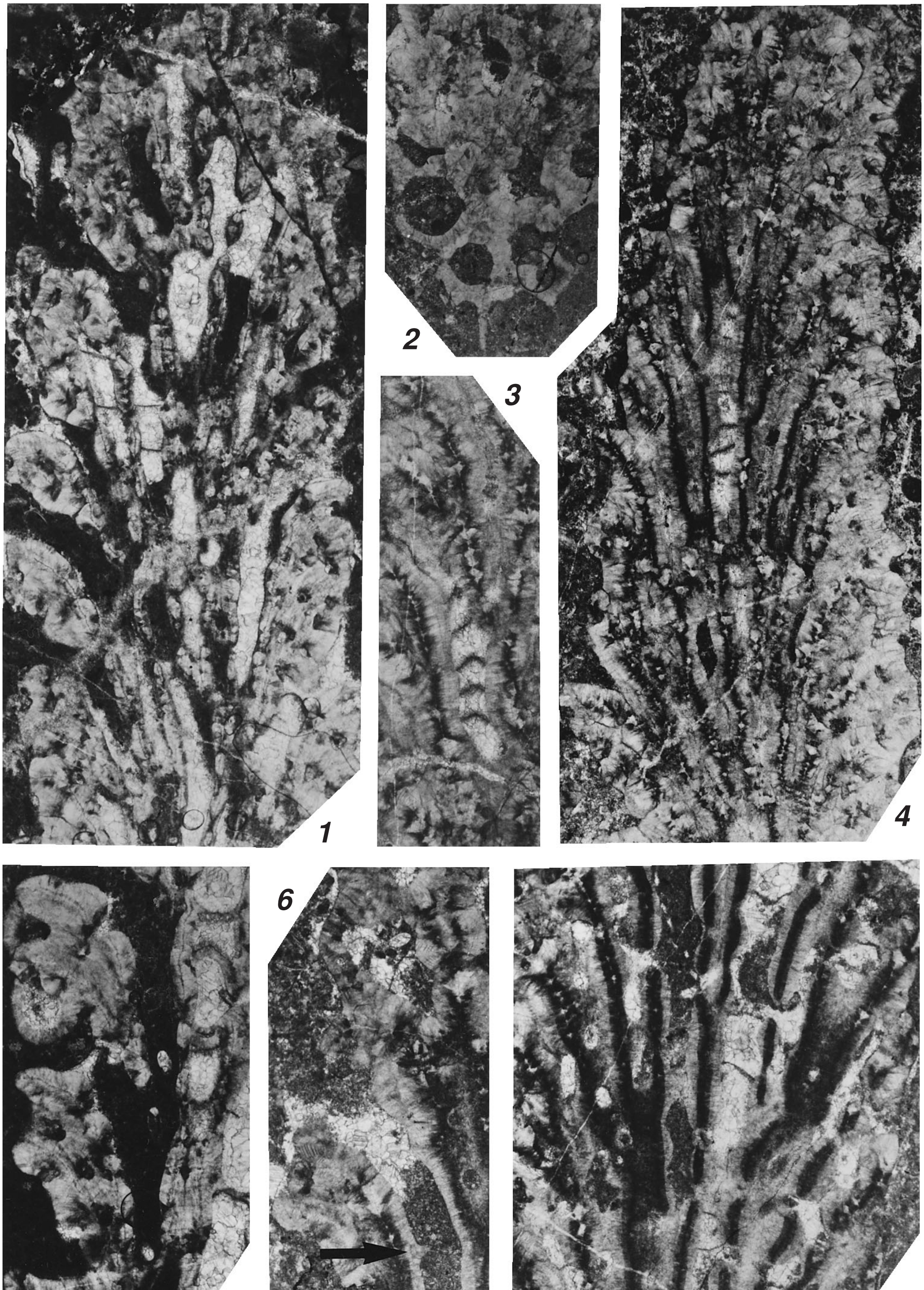
*Diagnosis*: Cylindrical to subcylindrical, usually bifurcate branches forming ramose coralla; corallites indistinctly differentiated into gradually diverging proximal portion in axial zone of branches and outwardly curved distal portion in peripheral zone of branches; calices open obliquely upward; intercorallite walls strongly thickened; median dark line of intercorallite walls exceptionally inflated; microstructure of stereoplasm is rect-radiate fibers; mural pores to vermiform mural tunnels well-developed on corallite face; septal spines rare; tabulae mostly complete, rare to common.

*Etymology*: The generic name is derived from the Isurugi Shrine located in the Fukuji area.

*Discussion*: Among the pachyporid genera, only the Late Permian genus *Gertholites* Sokolov (1955; type species, *Pachypora curvata* Waagen and Wentzel, 1886, p. 846, 847, pl. 97, figs. 1a–c, 2a, b, 3a–c) shares the possession of the vermiform mural tunnels in *Isurugiopora* n. gen. Except for chronological gap, there is an important structural difference in the intercorallite walls between these taxa, namely the exceptionally inflated median dark line of *Isurugiopora* separates the new genus from *Gertholites*.

*Isurugiopora* also includes a previously known species, *dubrovensis*, originally assigned to *Dendropora* Michelin (1846; type species, *D. explicita* Michelin, 1846, p. 187, pl. 48, fig. 6). Lafuste (1981) and Lafuste and Tourneur (1988) clarified the generic concept of *Dendropora* by a re-exam-

Fig. 3. *Isurugiopora obesa* gen. et sp. nov., thin sections. **1**, **5**, paratype, NSM PA15606. **1**, longitudinal section of branch, ×10. **5**, longitudinal sections of corallites, partial enlargement to show morphology of calices and distal corallites, ×14. **2**, paratype, NSM PA15610, transverse sections of distal corallites, ×10. **3**, **4**, holotype, NSM PA15600. **3**, longitudinal sections of corallites, partial enlargement to show crowded tabulae, ×14. **4**, longitudinal section of branch, ×10. **6**, **7**, paratype, NSM PA15605. **6**, longitudinal sections of corallites, partial enlargement to show morphology of calices and distal corallites, arrow indicates septal spine, ×14. **7**, longitudinal sections of corallites, partial enlargement to show morphology of proximal corallites, ×14.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ination of *D. explicita* and excluded *dubrovensis* from this genus. The strongly thickened intercorallite walls even in the proximal corallites with the inflated median dark line and the well-developed mural tunnels permit its assignment to the new genus rather than *Dendropora*. Sokolov (1955, pl. 25, fig. 1) reported "*Dendropora*" sp. from the Givetian of Armenia. This species may belong to *Isurugiopora*. However, no information about the internal structure precludes a confident identification.

### ***Isurugiopora obesa*** sp. nov.

(Figs. 3-1–7; 4-1–8)

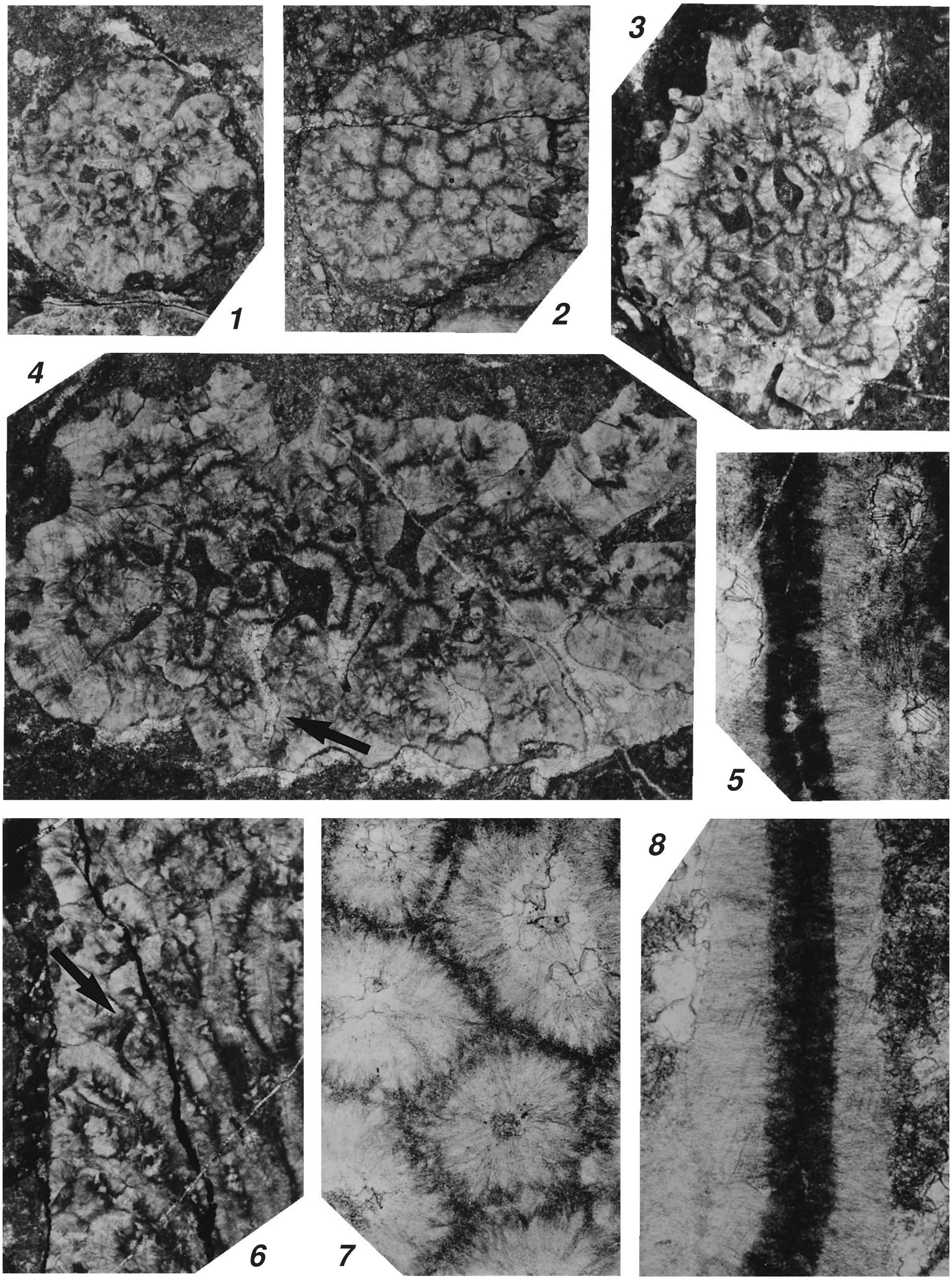
*Holotype*: NSM PA15600, from which 12 thin sections were made.

*Other specimens*: Seventy-seven thin sections were studied from the seven paratypes, NSM PA15596, 15597, 15602, 15605–15607, 15610. In addition, seven specimens, NSM PA15598, 15599, 15601, 15603, 15604, 15608, 15609, were also examined.

*Diagnosis*: Species of *Isurugiopora* with branch diameter of usually 3.6–5.7 mm, 20–49 in number of corallites in transverse section of branch, approximately 1.10 mm in corallite diameter near calical rim; usual calical opening 40°–70° in angle to branch surface; intercorallite walls attain 0.73 mm in thickness; mural tunnels relatively narrow, having 0.06–0.14 mm in diameter; tabulae common.

*Description*: Coralla ramose with cylindrical to subcylindrical branches having 2.2–6.2 mm, usually 3.6–5.7 mm, in diameter, cerioid; branching very rare, may be bifurcate; adjoining two branches uncommonly anastomosed to form gourd-shaped profiles; total corallum diameter and growth form unknown owing to fragile nature. Corallites prismatic to subprismatic, 4–6 sided in immature corallites, then ontogenetically shift to 6–8 sided or somewhat rounded subpolygonal in adult ones; depressed corallite face commonly occurs; there are 20–49 corallites in transverse section of branch; diameters of corallites range from 0.31 to 1.36 mm, with 1.10 mm mean near calical rim; each corallite differentiated into gradually divergent proximal portion forming axial zone of branch and outwardly curved distal portion forming peripheral zone of branch, but this differentiation is not always clear; corallite inflation is gradual in proximal portion and relatively rapid in distal portion; ratios of axial zone width per branch diameter are approximately 0.4 in holotype; calices obliquely upwards with usually 40°–70° in opening angle to branch surface; tabularia narrow to very narrow indicating subcircular, subelliptical to sub-stellate profiles, or almost closed, then they shift to deep calices; calical pits subcylindrical to funnel-shaped; increase of new corallite is lateral, frequently occurs in axial zone. Intercorallite walls strongly thickened even in axial zone; in immature branches, they are moderately thick to very thick, 0.15–0.46 mm, in axial zone, furthermore gradually thickened attaining 0.73 mm in peripheral zone to form peripheral stereozone; in gerontic branches, stereozone spreads over axial zone; structural differentiation of intercorallite walls in axial and inner peripheral zones is distinct, exceptionally inflated median dark line and stereoplasm of rect-radiate fibers; thickness of median dark line attains 0.17 mm; microstructure of median dark line may be gran-

Fig. 4. *Isurugiopora obesa* gen. et sp. nov., thin sections. **1**, paratype, NSM PA15602, transverse section of branch, ×10. **2**, **6**, **7**, holotype, NSM PA15600. **2**, transverse section of branch, ×10. **6**, longitudinal sections of corallites, partial enlargement to show morphology of calices and distal corallites, arrow indicates mural tunnel, ×14. **7**, transverse sections of corallites, partial enlargement to show morphology of proximal corallites, ×50. **3**, **4**, paratype, NSM PA15607. **3**, transverse section of branch, ×10. **4**, oblique section of branch, arrow indicates mural tunnel, ×14. **5**, **8**, paratype, NSM PA15605. **5**, partial enlargement to show intercorallite wall structure and mural pores, transverse section, ×50. **8**, partial enlargement to show intercorallite wall structure, transverse section, ×75.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ular; in outer peripheral zone, this differentiation becomes obscure; mural pores to tunnels well-developed, forming a single row on each corallite face; in less corpulent intercorallite walls, mural pores indicate elliptical profiles and relatively large, 0.16×0.27 mm in typical one; in stereozone, they shift vermiform and weakly curved mural tunnels with subcircular profiles, relatively narrow 0.06–0.14 mm in diameter; mural tunnels usually occur at same level, thus they indicate radiate structure in transverse section; anastomosis of mural tunnels not detected; septal spines rare, robust, approximately 0.17 mm in length of protrude portions into tabularia; squamula absent; tabulae common, partly crowded, complete or incomplete in very rare cases, mostly thin; profiles of tabulae are flat, strongly oblique, uparched or weakly sagging; there are 0–5 tabulae in 2.5 mm of corallite length.

*Etymology*: The specific name is derived from the Latin *obesus*, meaning swollen, in reference to its intercorallite wall nature.

*Occurrence*: *Isurugiopora obesa* gen. et sp. nov. was collected from the float blocks of buff, gray to light brown limestone (bioclastic wackestone) at locality FH-8 (NSM PA15596, 15600–15606, 15608–15610), and an outcrop of reddish light brown to gray limestone (bioclastic wackestone) at locality FH-9 (NSM PA 15597–15599, 15607).

*Discussion*: *Isurugiopora obesa* sp. nov. differs from *I. dubrovensis* in having the narrower branches, usually 3.6–5.7 mm versus approximately 10 mm in *I. dubrovensis*, the smaller adult corallite diameters, usually 1.10 mm versus attaining 2 mm in *I. dubrovensis*, narrower diameter of the mural tunnels, 0.06–0.14 mm versus attaining 0.3 mm in *I. dubrovensis*, and the commonly developed tabulae, whereas the tabulae of *I. dubrovensis* are rare. In addition, the intercorallite walls of *I. dubrovensis* are strongly wavy.

### Genus ***Striatopora*** Hall, 1851

*Type species*: *Striatopora flexuosa* Hall, 1851.

### ***Striatopora takayamaensis*** sp. nov.

(Figs. 5-1–10)

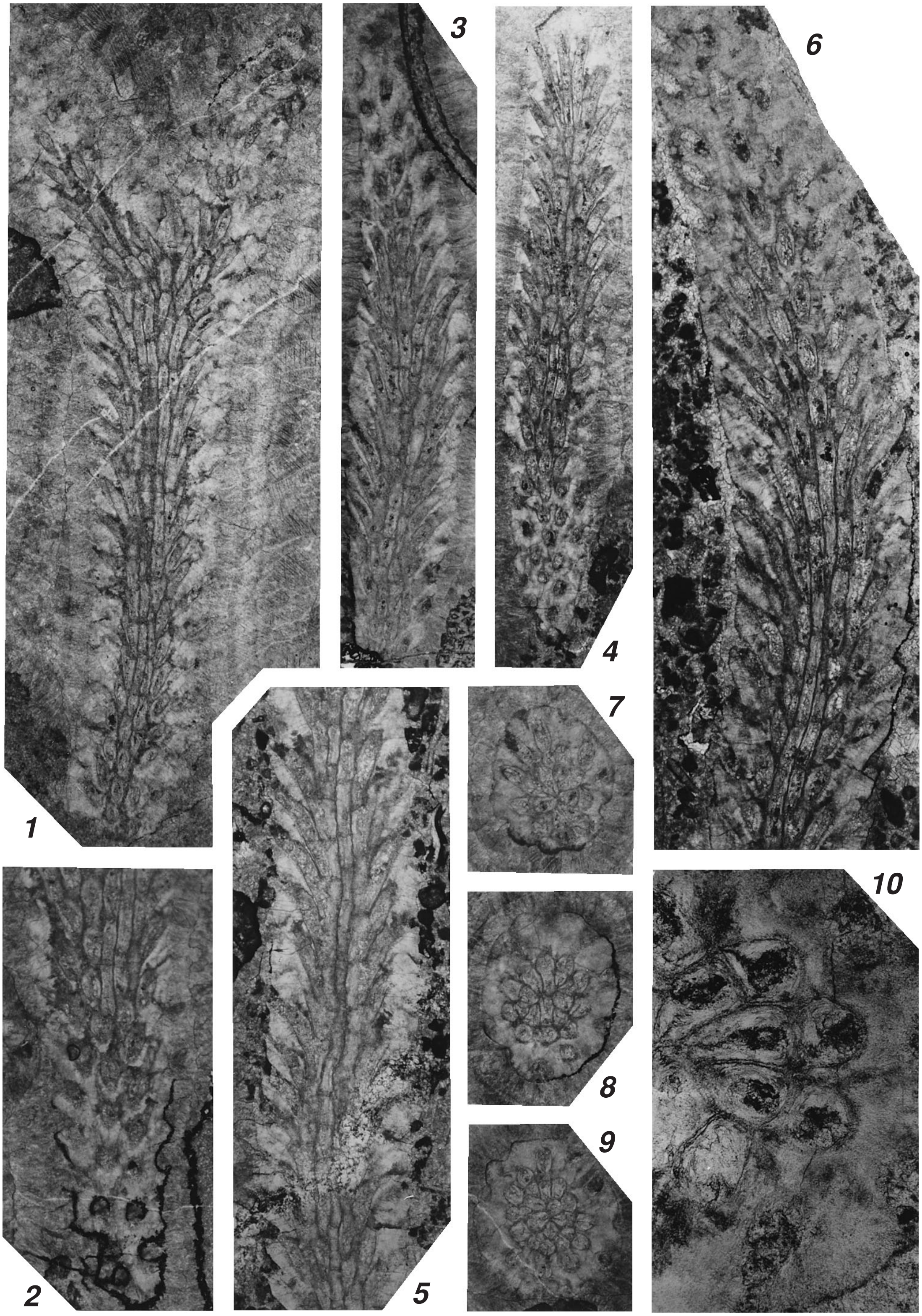
*Holotype*: NSM PA15611, from which 21 thin sections were made.

*Other specimens*: Fifty-three thin sections were studied from the six paratypes, NSM PA15612, 15617, 15619, 15621–15623. In addition, six specimens, NSM PA15613–15616, 15618, 15620, were also examined.

*Diagnosis*: Species of *Striatopora* with very slender, mostly 1.3–2.2 mm, branches, and 23–32 in number of corallites in transverse section of branch; distal corallites rapidly inflate; approximately 0.6 mm in corallite diameter near calical rim; calical opening obliquely upward with approximately 35°–60° in angle to branch surface; intercorallite walls attain to 0.36 mm in thickness; mural pores abundant in axial and inner peripheral zones of branches, small, typically 0.05 mm in diameter; tabulae spacing relatively close, 3–8 tabulae in 2.5 mm of corallite length.

*Description*: Coralla ramose with very slender, roughly cylindrical branches of 1.3–2.2 mm, exceptionally attaining 3.0 mm near branching point, in diameter, cerioid; branching rare, bifurcate; total corallum diameter and growth form unknown owing to fragile nature. Corallites prismatic with usually 3–7 sided profiles in proximal

Fig. 5. *Striatopora takayamaensis* sp. nov., thin sections. **1**–**3**, **7**, holotype, NSM PA15611. **1**, **3**, longitudinal sections of branches, ×10. **2**, longitudinal (but not through central axis of branch) section of branch, showing transverse sections of distal corallites, ×14. **7**, transverse section of branch, ×14. **4**, **10**, paratype, NSM PA15623. **4**, longitudinal section of branch, ×10. **10**, transverse section of branch, partial enlargement to show intercorallite wall structure, ×50. **5**, paratype, NSM PA15612, longitudinal section of branch, ×14. **6**, paratype, NSM PA15622, longitudinal section of branch, ×14. **8**, paratype, NSM PA15619, transverse section of branch, ×14. **9**, paratype, NSM PA15621, transverse section of branch, ×14.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portion, where depressed corallite face commonly occurs; distal corallites may have polygonal profiles, but their outlines not clear because of intercorallite wall thickening and partial disappearance of median dark line; there are 23–32 corallites in transverse section of branch; diameters of corallites range from 0.17 to approximately 0.8 mm, with approximately 0.6 mm mean near calical rim; each corallite consists of proximal portion, that lies nearly parallel to central axis of branch to narrowly divergent, and outwardly curved distal portion; inflation of corallites is very gradual in proximal portion and rapid in distal portion; proximal and distal corallites form axial and peripheral zones of branch, respectively; ratios of axial zone width per branch diameter are approximately 0.4; tabularia have subcircular to subpolygonal profiles; calices deep, to open obliquely upward with approximately 35°–60° in angle to branch surface; calical pits cylindrical; increase of new corallite is lateral, very frequently occurs near boundary between of axial and peripheral zones. Intercorallite walls in axial and inner peripheral zones are usually thin, 0.06–0.10 mm, rarely attaining 0.17 mm in gerontic branches, then abruptly thickened in outer peripheral zone to form peripheral stereozone, where thickness reaches 0.36 mm; ratios of stereozone width per peripheral zone width are approximately 0.6; structure of intercorallite walls differentiated into median dark line and stereoplasm, the latter of which consists of microlamellae; in each calice, thickness of stereoplasm is much thicker in upper rim than lower rim; mural pores abundant in axial and inner peripheral zones, small, circular in profiles with 0.05 mm in diameter in typical one; arrangement of mural pores is a single row on each corallite face; in peripheral stereozone, mural pore not developed; septal spine absent; tabulae complete, nearly rectangular to corallite; spacing of tabulae relatively close for the genus; there are 3–8 tabulae in 2.5 mm of corallite length.

*Etymology*: The specific name is derived from Takayama-shi.

*Occurrence*: *Striatopora takayamaensis* sp. nov. was collected from the float blocks of buff, gray to light brown limestone (bioclastic wackestone) at locality FH-8.

*Discussion*: The only species that shows resemblance to *Striatopora takayamaensis* sp. nov. is *S. alba* (Yanet *in* Dubatolov *et al.*, 1968, p. 98, 99, pl. 45, figs. 3a, b, v, g, d) from the Lower Devonian of the Urals. *Striatopora alba*, however, differs from the new species in having the slightly larger branch diameters, 2.6–2.8 mm versus mostly 1.3–2.2 mm in *S. takayamaensis*, the fewer mural pores in the axial and inner peripheral zones of the branches, and the much fewer tabulae.

### Genus ***Thamnopora*** Steininger, 1831

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

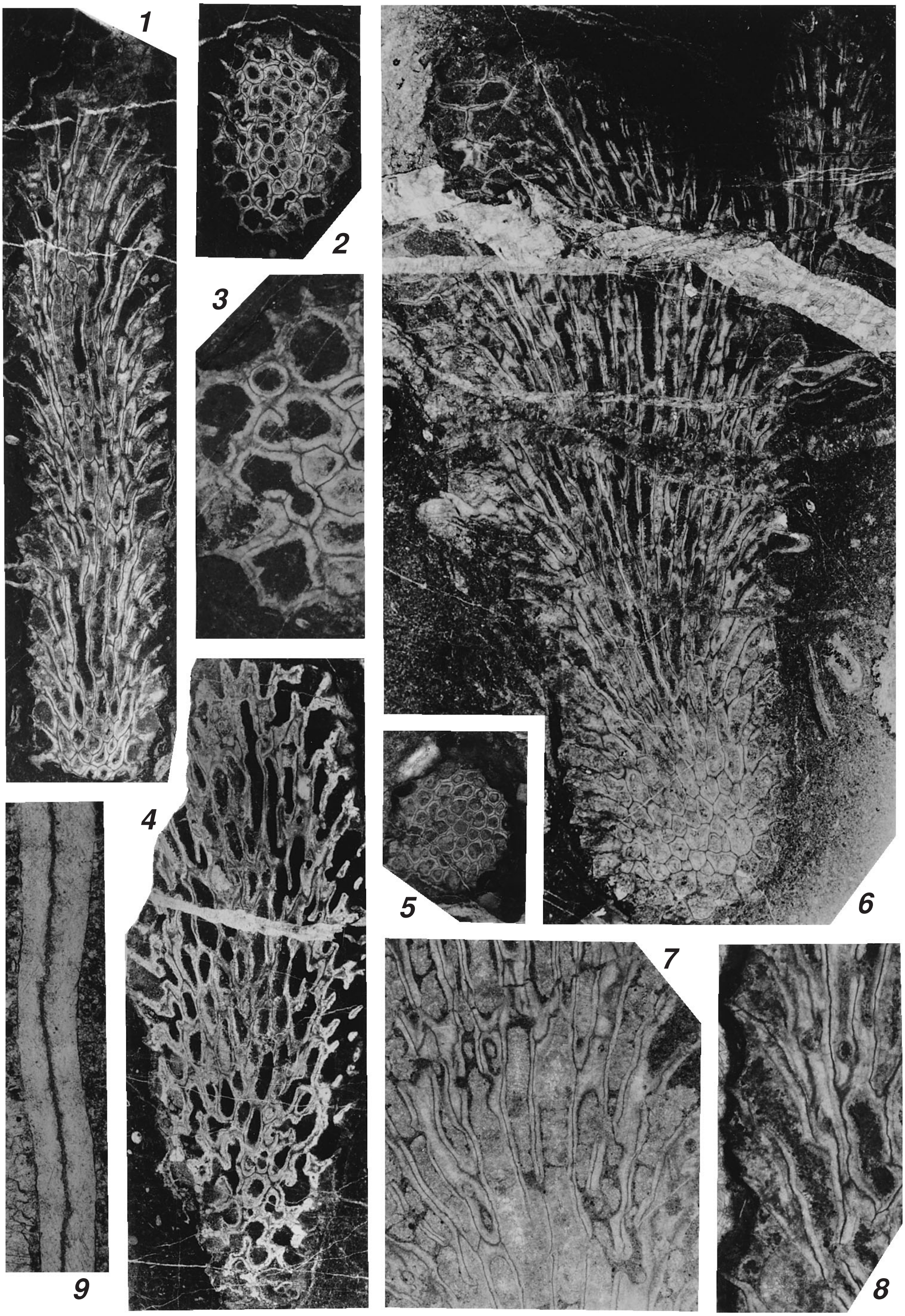
### ***Thamnopora hayasakai*** sp. nov.

(Figs. 6-1–9)

[?] *Thamnopora* sp. b, Kamei, 1961, p. 4.
*Coenites* sp., Wakata, 1974, p. 6; Hamada and Itoigawa, 1983, p. 11, fig. 3.
*Thamnopora* sp., Obata (ed.), 1994, p. 38.

*Holotype*: NSM PA15644, from which 11

Fig. 6. *Thamnopora hayasakai* sp. nov., thin sections. **1**–**3**, **8**, holotype, NSM PA15644. **1**, longitudinal section of branch, ×5. **2**, transverse section of branch, ×5. **3**, transverse section of branch, partial enlargement to show septal spines and mural pores, ×14. **8**, longitudinal sections of corallites, partial enlargement to show morphology of calices and distal corallites, ×14. **4**, paratype, NSM PA15637, oblique section of branch, ×5. **5**, paratype, NSM PA 15625, transverse section of branch, ×5. **6**, paratype, HMM 03062, longitudinal to transverse sections of branches, ×5. **7**, **9**, paratype, NSM PA15648. **7**, longitudinal sections of corallites, partial enlargement to show morphology of proximal corallites, ×14. **9**, partial enlargement to show intercorallite wall structure, longitudinal section, ×75.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thin sections were made.

*Other specimens*: Seventy thin sections were studied from the 10 paratypes, NSM PA15624, 15625, 15628, 15633, 15634, 15636, 15637, 15642, 15648, HMM 03062. In addition, 22 specimens, NSM PA15626, 15627, 15629–15632, 15635, 15638–15641, 15643, 15645–15647, 15649–15655, were also examined.

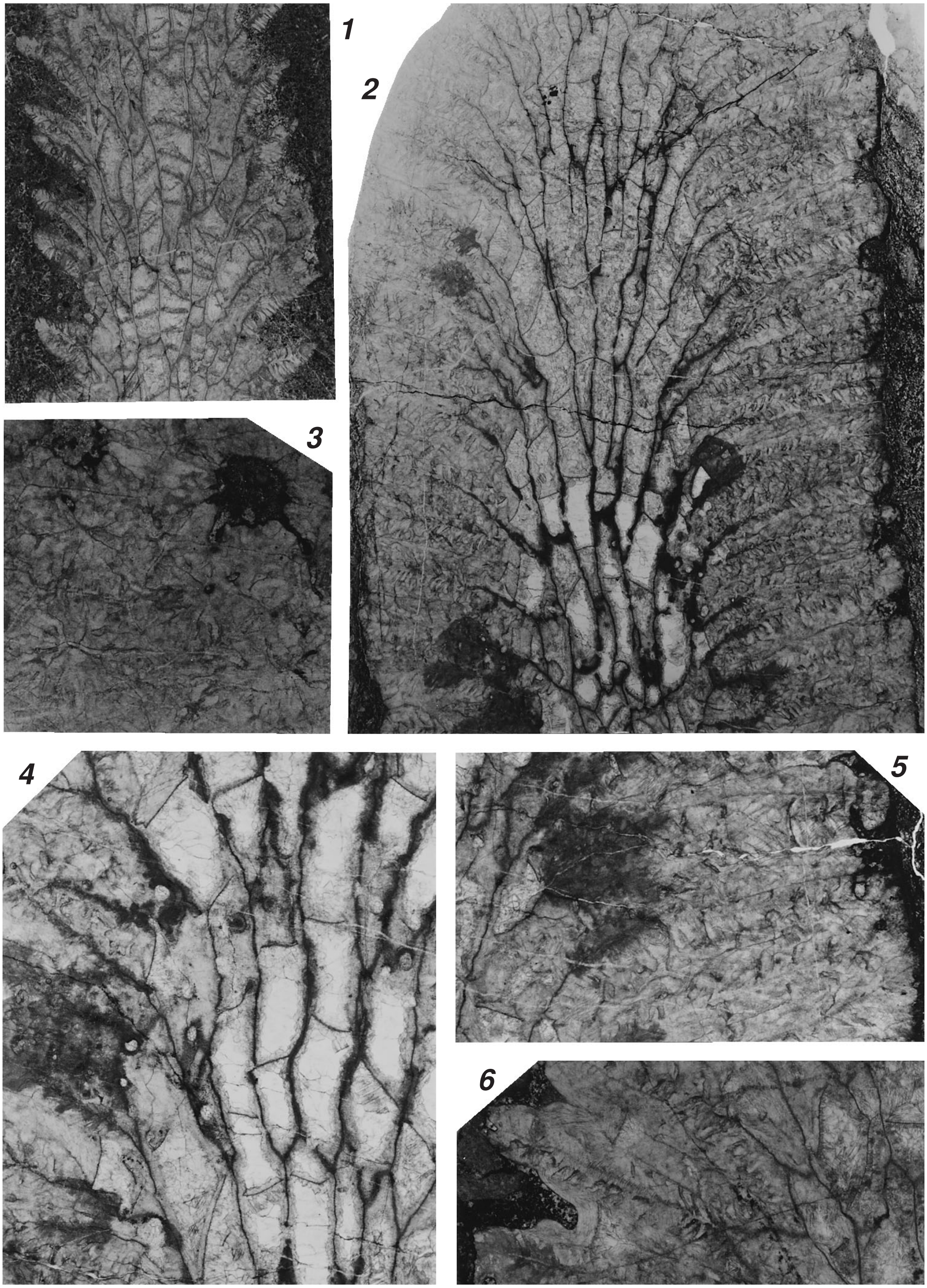
*Diagnosis*: Species of *Thamnopora* with relatively slender, usually 3.4–9.5 mm, branches with common bifurcation, 37–121 in number of corallites in transverse section of branch, approximately 1.06 mm in corallite diameter near calical rim; peripheral zone of branches narrow; calical opening oblique upward to nearly perpendicular to branch surface; thickness of intercorallite walls usually 0.06–0.23 mm; mural pores abundant, elliptical; robust septal spines commonly occur in peripheral zone; tabulae very rare.

*Description*: Coralla ramose with cylindrical to subcylindrical branches, cerioid; branching frequent, commonly bifurcate, rarely umbelliferous; diameters of branches are relatively slender for the genus, somewhat variable, usually 3.4–9.5 mm, but attain 12.4 mm near branching point: total corallum diameter and growth form unknown owing to fragile nature. Corallites prismatic, mostly 4–6 sided; depressed corallite face and/or corner frequently occur, furthermore *Antherolites*-like sub-stellate profiles rarely developed; there are 37–121 corallites in transverse section of branch; inflation of corallites relatively gradual throughout all growth stages; diameters of corallites range from 0.27 to 1.55 mm, with 1.06 mm mean near calical rim; each corallite usually consists of narrowly divergent proximal portion and outwardly curved distal potion; proximal and distal corallites respectively form axial and peripheral zones of branches, but this differentiation is obscure in some branches; peripheral zone narrow, ratios of axial zone width per branch diameter at least approximately 0.7; calices open obliquely upward to nearly perpendicular, approximately 25°–85° in angle to branch surface; profiles of tabularia and calical pits subpolygonal to subcircular in immature branches, then shift subcircular to circular in gerontic ones; calical pits very deep, subcylindrical; lateral increase of new corallite frequently occurs in axial zone. Intercorallite walls uniformly thickened, usually 0.06–0.23 mm, but attain to 0.48 mm in gerontic branch, differentiated into median dark line and stereoplasm; microstructure of stereoplasm may be rect-radiate fibers; no peripheral stereozone developed; mural pores abundant forming a single row on each corallite face, longitudinally elongated elliptical profiles with 0.21×0.16 mm in diameter in typical one; septal spines relatively rare in axial zone, common in peripheral zone, robust, 0.09–0.17 mm in length of protruded portions into tabularia; tabulae very rare, complete, slightly sagging, nearly flat, or slightly uparched.

*Etymology*: The specific name honors the late Dr. Ichiro Hayasaka, in recognition of his contribution to the study of Paleozoic fossils.

*Occurrence*: *Thamnopora hayasakai* sp. nov. was collected from the float blocks of black limestone (peloidal wackestone; NSM PA15642) and argillaceous limestone (NSM PA15643) in talus on the eastern slope of Mt. Sora-yama near locality FH-4, the float blocks of black limestone (bioclastic to peloidal wackestone; NSM PA15624–15633, 15635, 15646–15649, 15651) and argillaceous limestone (NSM PA15634, 15645, 15650) in talus at the Kanashirozako Valley near locality FH-6, an outcrop of black limestone (peloidal wackestone) at locality FH-7 (NSM PA15639,

Fig. 7. *Parastriatopora innae* Dubatolov, 1963, thin sections. **1**, HMM 03156, longitudinal section of immature branch, ×5. **2**–**5**, HMM 06710. **2**, longitudinal section of branch, ×5. **3**, transverse sections of corallites, partial enlargement to show morphology of distal corallites, ×10. **4**, longitudinal sections of corallites, partial enlargement to show morphology of proximal corallites, ×10. **5**, longitudinal sections of corallites, partial enlargement to show morphology of calices and distal corallites, ×10. **6**, NSM PA15657, oblique sections of corallites, partial enlargement to show morphology of calices and mural tunnels, ×10.



15640, 15644, 15652–15655), the float blocks of black limestone (bioclastic to peloidal wackestone) in the Ichinotani Valley (NSM PA15636–15638, HMM 03062), and a float block of argillaceous limestone in the Osobudani Valley (NSM PA15641). This species is the most abundant pachyporoidean tabulate coral in the Fukuji Formation.

*Discussion*: Based on dimensions of the branches, characters of the corallites especially their distal morphology including the calices, and thickness and nature of the intercorallite walls, *Thamnopora hayasakai* sp. nov. appears to have affinities with *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 the Chöltagh Range in the eastern T'ien-shan, Tarim. *Thamnopora incerta* can be distinguished from *T. hayasakai* by its lacking of the septal spine, in contrast with the new species has the robust ones. In addition, Regnéll (1941) stated that "tabulae and mural pores not distinguishable" in *T. incerta*, whereas in *T. hayasakai*, these elements are very rarely and abundantly developed, respectively.

*Thamnopora hayasakai* is also similar to *T. angusta* Lecompte (1939, p. 115, pl. 16, figs. 17, 17a, 18, 18a, 19, 20) from Givetian of Belgium and *T. solida* Dubatolov (1963, p. 67, pl. 25, figs. 5a, b; Tchi, 1976, p. 112, 113, pl. 54, figs. 4a, b, 5a, b) from the Lower Devonian of the Kuznetsk Basin, southwestern Siberia and the Middle Devonian of Inner Mongolia. However, *T. hayasakai* differs from the latter two species by being a narrower peripheral zone of the branches and the fewer tabulae.

Family Parastriatoporidae Chudinova, 1959

Genus ***Parastriatopora*** Sokolov, 1949

*Type species*: *Parastriatopora rhizoides* Sokolov, 1949.

### ***Parastriatopora innae*** Dubatolov, 1963

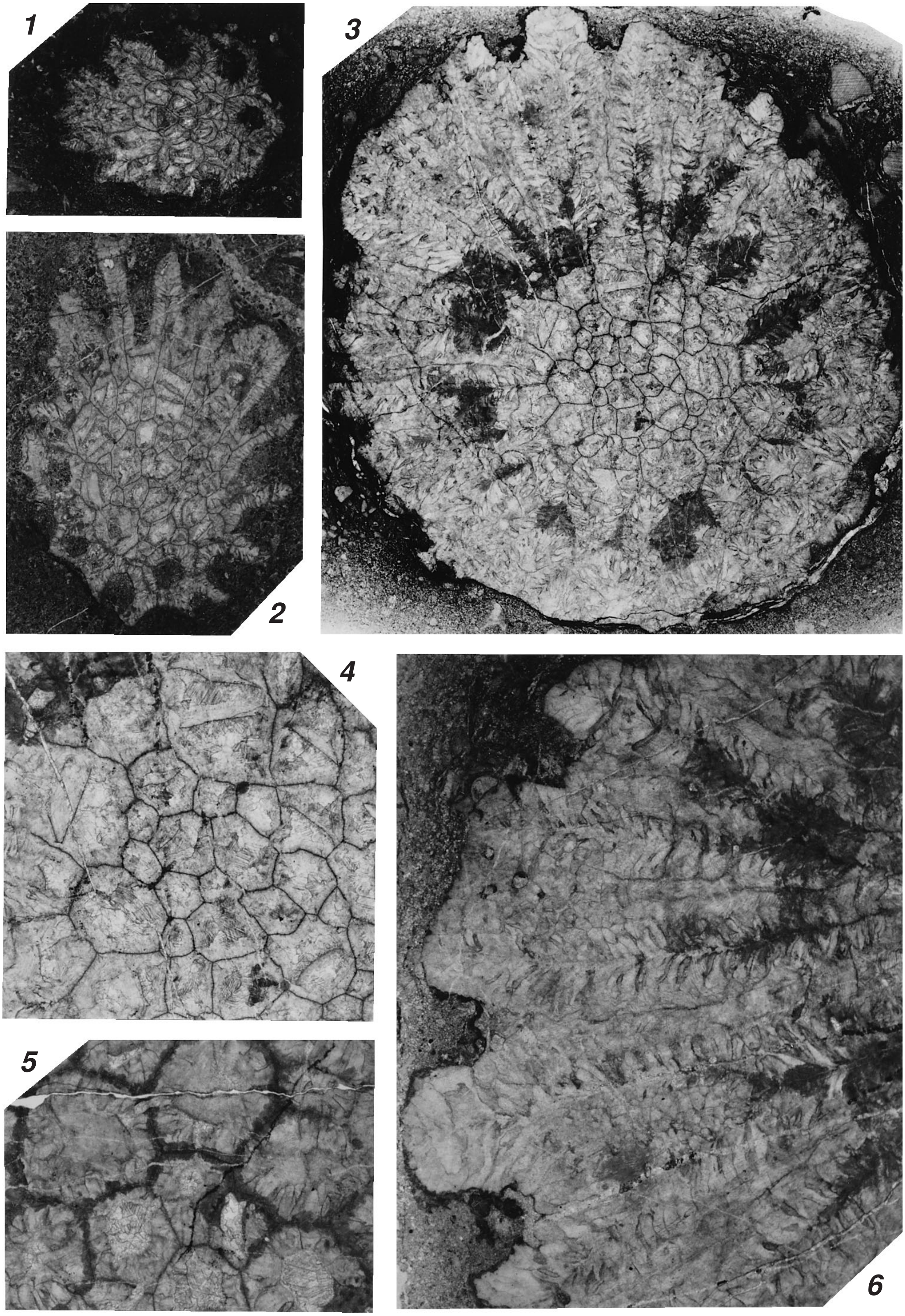
(Figs. 7-1–6; 8-1–6)

*Parastriatopora innae* Dubatolov, 1963, p. 64–66, pl. 24, figs. 1a, b, 2a, b, v, g; Chudinova, 1964, p. 26, 27, pl. 9, figs. 1a, b, 2a, b.

*Material examined*: Seven coralla, NSM PA15656–15659, HMM 03156, 03582, 06710. In addition, a single corallum, HMM 05019, was questionably assigned to this species.

*Description*: Coralla large for genus, ramose, consisting cylindrical to subcylindrical, thick branches, cerioid; diameters of branches range from 3.9 to 18.3 mm with 16.3 mm mean in gerontic branches; branching rare, bifurcate; adjoining two branches anatomized in very rare cases; branch of the largest specimen (HMM 06710) attains to 130 mm in length, but total corallum diameter and growth form unknown owing to fragile nature. Corallites prismatic; their profiles indicate 3–5 sided in most proximal (just after offset) portions, then shift 5–9 sided distally; depressed corallite face and/or corner frequently occur; there are 20–66 corallites in transverse section of branch; diameters of corallites are large for the genus, range from 0.56 to 2.98 mm, with 2.40 mm mean near calical rim; each corallite consists of narrowly divergent to fanwise (up to 35° to central axis of branch) proximal portion, and distal portion indicating outward curvature to nearly straight with outward direction; they form axial and wide peripheral zones of branch, respectively; ratios of axial zone

Fig. 8. *Parastriatopora innae* Dubatolov, 1963, thin sections. **1**, NSM PA15656, transverse section of immature branch, ×5. **2**, HMM 03156, transverse section of immature branch, ×5. **3**–**6**, HMM 06710. **3**, transverse section of branch, ×5. **4**, transverse sections of corallites, partial enlargement to show morphology of proximal corallites, ×10. **5**, transverse sections of corallites, partial enlargement to show morphology of distal corallites, ×10. **6**, longitudinal sections of corallites, partial enlargement to show morphology of calices, distal corallites and intercorallite wall structure, ×10.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width per branch diameter are 0.39–0.54; inflation of corallite is gradual in proximal and very gradual in distal portions; calices moderately deep in immature branches, very shallow in gerontic ones, directed upward with at least approximately 50° in angle to nearly perpendicular to branch surface; tabularia have subpolygonal to subcircular profiles in proximal corallites, but they are almost closed in distal ones; increase of new corallite is lateral, frequently occurs in axial zone. Intercorallite walls moderately thick to very thick even in axial zone, 0.15–0.37 mm, and abruptly thickened attaining 2.05 mm in peripheral zone by continuation of septal spines; thickened intercorallite walls form peripheral stereozone, whose width is almost equal with that of peripheral zone; in axial zone, intercorallite walls consist of median dark line and stereoplasm, then the latter layer mostly replaced by septal spines; microstructure of stereoplasm may be lamellar; mural pores abundant in axial zone, longitudinally elongated elliptical to circular in profiles, 0.16×0.23 mm, 0.17 mm in diameter in typical ones, occur on corallite faces as mid-wall pores and at corallite corners as corner pores; occurrence of corner pores restricted to most proximal portions of corallites; arrangement of mid-wall pores in axial zone is a single row; in peripheral zone, mural pores shifting to weakly curved mural tunnels; they have circular profiles, differentiated two types in their diameter, small mural tunnels of 0.05–0.06 mm and large ones of 0.15–0.23 mm, form 2–3 rows on each corallite face; septal spines absent in axial zone, very numerous in peripheral zone, large with wide basis, attaining 1.09 mm in length; tabulae thick, mostly complete, but incomplete ones rarely developed near turning points between axial to peripheral zones; shape of tabulae variable, usually flat and slightly sagging, but strongly oblique, slightly uparched, in addition vesicular tabulae rarely recognized; there are 2–6 tabulae in 5 mm of corallite length; tabulae thickening caused by outwardly growth of microlamellar layer; approximate thickness of tabulae 0.08 mm in axial zone and 0.32 mm in peripheral zone.

*Occurrence*: This species was collected from the float blocks of black to dark gray limestone (bioclastic to peloidal wackestone; NSM PA15656–15659, HMM 03156, 03582, 05019) and argillaceous limestone (HMM 06710) in talus at the Kanashirozako Valley near locality FH-6.

*Discussion*: The morphologic characters and dimensions of the Fukuji specimens agree well with diagnostic respects of the type specimens described by Dubatolov (1963) from the Upper Silurian of the Kuznetsk Basin, southwestern Siberia. It is known that the stratigraphic range of *Parastriatopora innae* extents into the Lower Devonian (Chudinova, 1964). *Parastriatopora innae* is distinguished from all other species of the genus by the possession of the thick gerontic branches, usually 12–20 mm, with the wide peripheral zone, and the large septal spines in the peripheral zone.

In addition to *Hillaepora* sp. cf. *H. altaica*, the occurrence of *Parastriatopora innae* in the Fukuji fauna indicates most strong affinities with those in southwestern Siberia.

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