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Late Silurian Auloporids (Coelenterata: Tabulata) from the Hitoegane Formation, Gifu Prefecture

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Abstract Two new species of auloporid tabulate corals, *Aulocystis hitoeganensis* and *Syringoporella yamakoshii*, are described from the Late Silurian of the Hitoegane Formation, Gifu Prefecture. *Aulocystis hitoeganensis* closely resembles a Ludlow species *A. okitsui* from the Suberidani Group, Tokushima Prefecture and Gionyama Formation, Miyazaki Prefecture. The discrimination of these species is based on the smaller corallite diameters, the shorter free portion of the corallites, and the fewer tabulae of *Aulocystis hitoeganensis*. Furthermore, this new *Aulocystis* species probably absents in septal spine. The most similar species with *Syringoporella yamakoshii* was reported from Guizhou, South China as *S. paramoravica*, but differs in its less irregular corallite distribution. *Syringoporella* was not previously known in Japan. The age of Hitoegane coral fauna is Ludlow (to Pridoli?).
Key words: Late Silurian, tabulate corals, Aulocystidae, *Aulocystis*, Multitheco-poridae, *Syringoporella*, Hitoegane Formation, Gifu.

Introduction

Our knowledge of the Late Silurian coral fauna in the Hitoegane area, Yoshiki-gun, Gifu Prefecture, Central Japan is very limited with the exception of some preliminary reports including Wakata (1974; *Auloporella* sp. and *Parastriatopora hidensis*, nomen nudum), Kato *et al.* (1980; *Rhizophyllum*), Hamada (1983; auloporid), Kato (1990; "*Parastriatopora*" like favositids), and Kamiya and Niko (1998; *Planocoenites* sp.). Thus, its paleobiogeographic evaluation is still uncertain. The purpose of this paper is to describe two auloporid species, *Aulocystis hitoeganensis* sp. nov. and *Syringoporella yamakoshii* sp. nov., as the first attempt to a project that will document and describe the whole aspect of the Hitoegane tabulate coral fauna.

The Hitoegane Formation (Nakai, 1984; redefined by Tsukada, 1997) is chiefly composed of acidic tuff and tuffaceous sediments with minor amounts of impure limestone to calcareous shale in its uppermost part. The formation attains total thickness of more than 800 m, and ranges in age from Middle or Late Ordovician (Tsukada and Koike, 1997) to Late Silurian. Igo (1990) named the uppermost calcareous

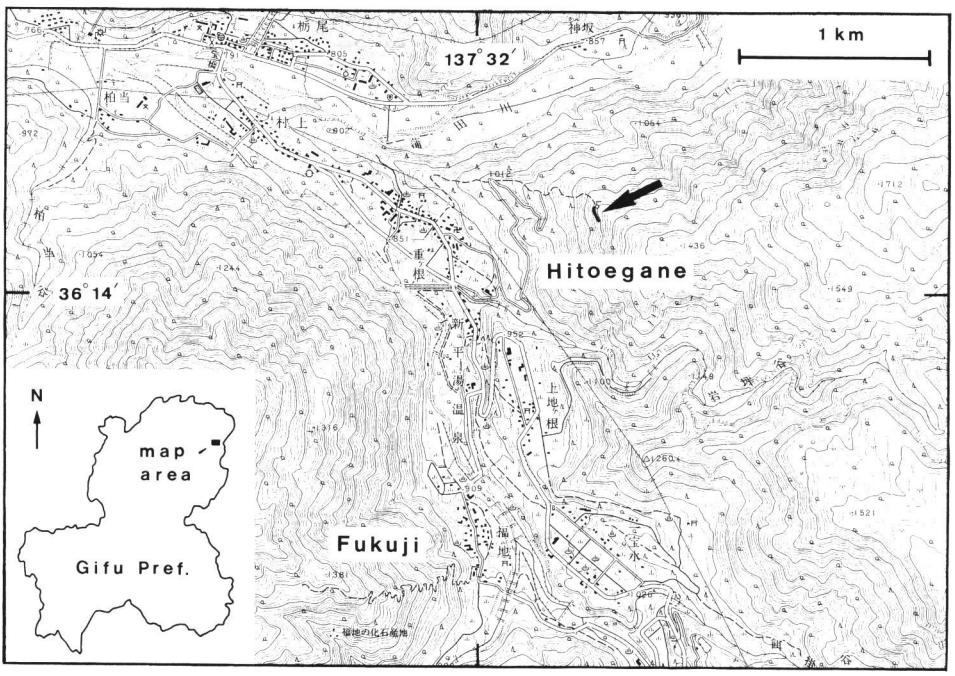


Fig. 1. Index map of the present coral locality in the Hitoegane area, Gifu Prefecture using 1:25,000 map of "Yakedake" published by the Geographical Survey Institution.

strata as the Hitoegane Limestone Member, from which the most macro-fossils, such as trilobites (Kobayashi and Hamada, 1974, 1987), machaerid (Kobayashi and Hamada, 1976), and corals, were collected. The tabulate corals described below came from talus on a ridge sandwiched between Takahara-gawa and Gamata-gawa Rivers (Fig. 1). They comprise the main framework of biolithite to form dark gray limestone intercalated with shale films, or occur in greenish gray calcareous shale both belonging to the Hitoegane Limestone Member. Based on trilobites from the same locality with corals, Kobayashi and Hamada (1987) stated that the limestone is judged to be middle or late Ludlow and the shale is interpreted as being late Ludlow (or Pridoli) in age.

The tabulate coral specimens described herein are deposited in the National Science Museum (prefix NSM), Tokyo or the Hikaru Memorial Museum (prefix HMM), Takayama.

Systematic Paleontology

Order Auloporida Sokolov, 1947

Superfamily Auloporicae Milne-Edwards and Haime, 1851

Family Aulocystidae Sokolov, 1950

Genus *Aulocystis* Schlüter, 1885

Type species: *Aulocystis cornigera* Schlüter, 1885.

Aulocystis hitoeganensis sp. nov.

Figs. 2-1–2; 3-1–6

Auloporella sp.; Wakata, 1974, fig. 5.
auloporid; Hamada, 1983.

Holotype: NSM PA14664, from which 43 thin sections were made.

Other specimens: Fifty thin sections were studied from the seven paratypes, NSM PA14665–14667, 14669, 14671–14673. In addition, the three specimens, NSM PA14668, 14670, 14674, were also examined.

Diagnosis: Species of *Aulocystis* with very small corallite diameter, usually 1.0–1.6 mm, and short distal free portion of corallites, 1.3–2.9 mm, for genus; corallite walls thick, approximately 0.30 mm; septal spine probably absents; tabulae incomplete or complete, sporadic with irregular spacing, thus partial corallites free from tabula.

Description: Coralla mat- to overlapped shrub-like in growth form comprise closely spaced corallites; total corallum diameter unknown owing to fragile nature. Corallites cylindrical, lack attachment scar; corallite diameters very small for genus, ranging from 0.6 to 1.9 mm, usually 1.0–1.6 mm; each corallite composed of proximal prostrate portion, 2.6–9.2+ mm in length, and distal free portion that is short for genus, 1.3–2.9 mm in length, and forms cylindrical calice without calical modification; calices relatively deep to shallow with cylindrical or funnel-shaped calical pits; calical opening upward with mostly 30° to 53° in angle to prostrate corallites; tabularia circular in cross section, approximately 1.1 mm in mean diameter; increase of corallites unilateral; daughter corallite of offset arises in basal part of preceding free portion. Corallite walls thick, usually rang from 0.23 to 0.42 mm with 0.30 mm mean; apparent epitheca not detected; stereoplasm consists of microllamellae which are weakly undulated in transverse section and oblique to corallite surface in longitudinal section. Septal spine probably absents. Tabulae incomplete or complete in rare cases with irregular spacing, sporadic but uncommonly crowded; there are 0–5 in 2.5 mm of corallite length; thus partial corallites free from tabula; incomplete tabulae elongated vesicular and infundibuliform; complete tabulae concave both proximally and

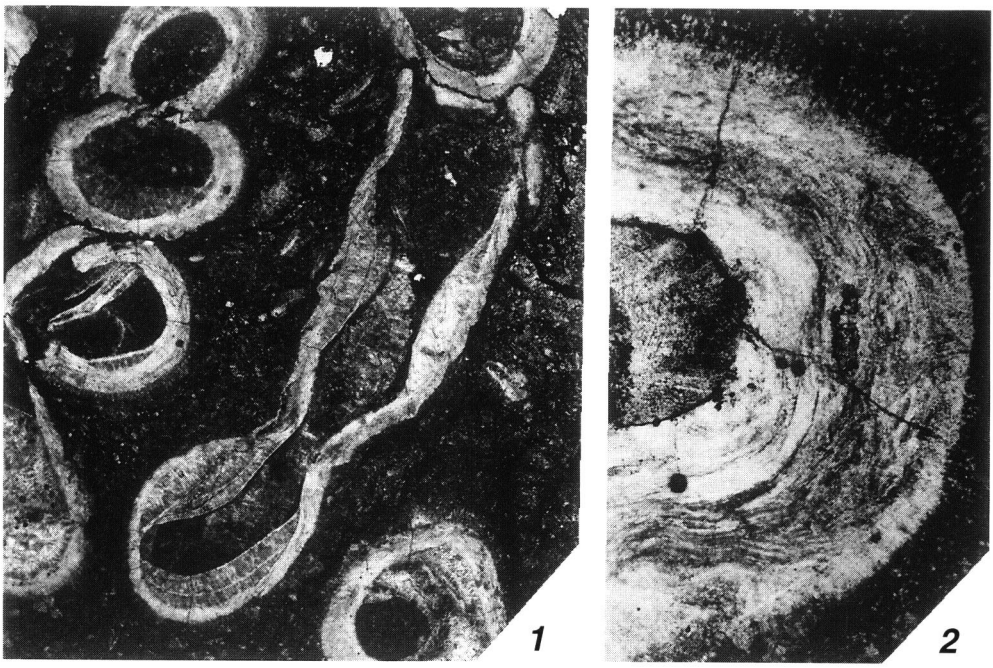


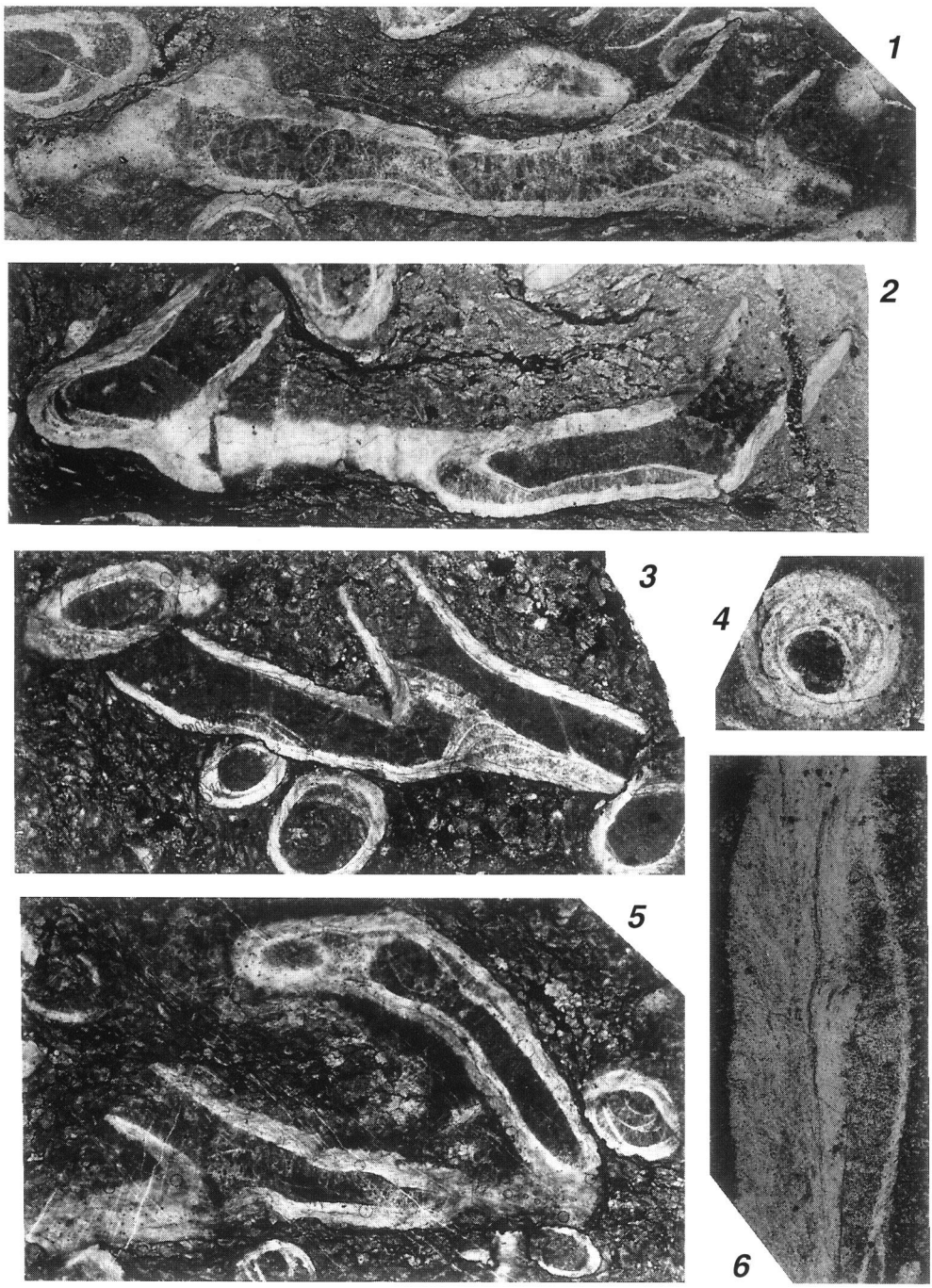
Fig. 2. *Aulocystis hitoeganensis* sp. nov., thin sections. **1**, **2**, holotype, NSM PA14664. **1**, longitudinal to oblique (center) and transverse sections of corallites, ×14. **2**, partial enlargement of transverse section of corallite to show corallite wall structure, ×75.

distally; septal spine-like projection on tabula may absent; crowded tabulae form indistinct axial syrinx, where corallite walls decrease in thickness to 0.10–0.19 mm; axial tabella absents.

Discussion: *Aulocystis hitoeganensis* sp. nov. occurs through all faunal association in the Hitoegane Limestone Member, and is exceptionally abundant in calcareous shale. Thus, Hamada (1983) was considered this coral to be a representative of the Hitoegane coral fauna as auloporid. The author names this pending species, based on well-oriented thin sections.

Aulocystis okitsui Niko (2001, figs. 2-1–4; 3-1–6) from the early Ludlow of the

→ Fig. 3. *Aulocystis hitoeganensis* sp. nov., thin sections. **1**, **3**, paratype, NSM PA14672. **1**, longitudinal section of corallite, ×10. **3**, longitudinal (center) and transverse to oblique sections of corallites, ×10. **2**, paratype, NSM PA14666, longitudinal to oblique sections of corallites, ×10. **4**–**6**, holotype, NSM PA14664. **4**, transverse section of corallite, note axial syrinx, x14. **5**, longitudinal to oblique (center) and transverse sections of corallites, ×10. **6**, partial enlargement of longitudinal section of corallite to show corallite wall structure and vesicular tabula, ×75.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Suberidani Group, Tokushima Prefecture and the G3 Member of the Gionyama Formation, Miyazaki Prefecture is closely similar to this new species. The two species apart from slight differences in corallum diameters (usually 1.6–2.2 mm in *A. okitsui* versus 1.0–1.6 mm in *A. hitoeganensis*), length of distal free portion of corallites (5.0–9.8 mm in *A. okitsui* versus 1.3–2.9 mm in *A. hitoeganensis*), and degrees of tabula and septal spine occurrence. The tabulae of *Aulocystis okitsui* are usually abundant for the genus (3–6 tabulae in 2.5 mm of corallite length), on the other hand there are 0–5 tabulae in the same corallite length in *A. hitoeganensis*. The septal spines, which are sporadically developed in *Aulocystis okitsui*, may be absent in *A. hitoeganensis*.

Etymology: The specific name is derived from the Hitoegane Formation, from which this species occurs.

Occurrence: Limestone (NSM PA14664, 14667, 14668, 14670–14672, 14674) and calcareous shale (NSM PA14665, 14666, 14669, 14673).

Superfamily Sylingoporicae Fromentel, 1861

Family Multithecoporidae Sokolov, 1950

Genus *Syringoporella* Kettner, 1934

Type species: *Syrigopora moravica* Roemer, 1883.

Syringoporella yamakoshii sp. nov.

Figs. 4-1–4

Holotype: NSM PA14675, from which nine thin sections were made.

Other specimens: Twenty-two thin sections were studied from the three paratypes, NSM PA14676, 14677, HMM 03681.

Diagnosis: Species of *Syringoporella* with more or less uniformly distributed and very narrow corallites having 0.4–0.6 mm in diameter, and rare connecting tubuli; corallite walls relatively thin for genus with 0.04–0.08 mm in thickness; septal spine absents; tabulae well-developed.

Description: Coralla always occur inside stromatoporoids as hemispherical to somewhat irregular in growth form; maximum observed diameter attains approximately 148 mm (paratype, HMM 03681), phaceloid. Corallites cylindrical with circular cross section, and very narrow; diameters of corallites range from 0.4 to 0.6 mm; corallite spacing more or less uniform, moderate for genus, usually 0.5–1.2 mm in distance (center-to-center) between corallites; there are 56–124 corallites per cm^2 in transverse section of holotype; increases of new corallites lateral, frequent; each new corallite forms upwardly oblique branch in most proximal portion with 50°–80° in angle to parent corallite, 0.6–1.9 mm in length in this oblique portion; then it indi-

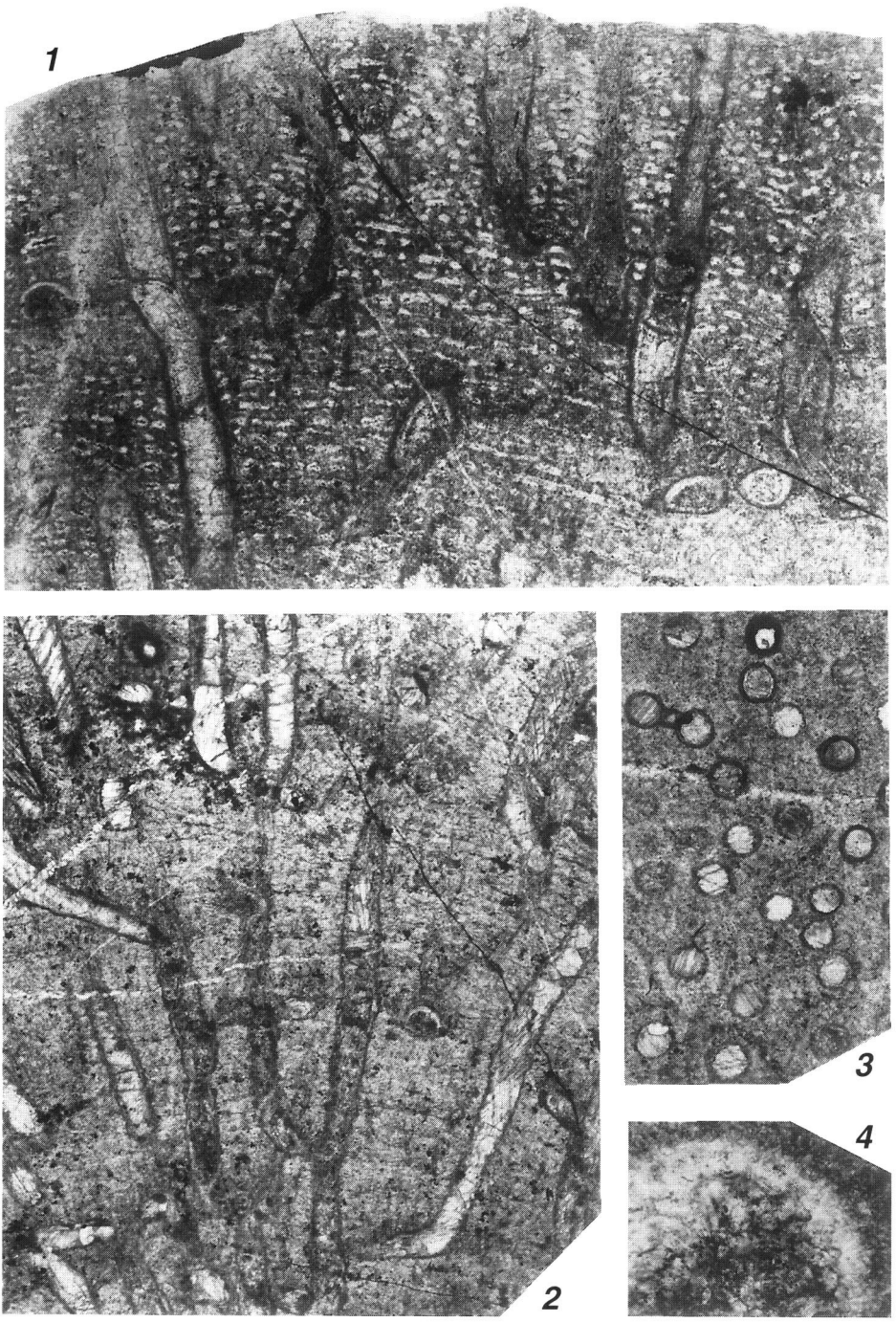

Fig. 4. *Syringoporella yamakoshii* sp. nov., thin sections, holotype, NSM PA14675. **1**, longitudinal section, ×14. **2**, longitudinal section, ×10. **3**, transverse section, ×10. **4**, partial enlargement of transverse section of corallite to show corallite wall structure, ×100.

cates parallel orientation with parent corallite; connecting tubuli rare, occur nearly same level, short with 0.19–0.38 mm in length; tabularia circular in cross section with approximately 0.4 mm in diameter; calice not preserved. Corallite walls relatively thin for genus, range from 0.04 to 0.08 mm, probably consist of epitheca and stereoplasm; microstructure of stereoplasm not well preserved, but seems rect-radiate fibers in composition. Septal spine absents. Tabulae complete, well-developed and rectangular to corallite; profiles of usual tabulae are weakly concave proximally (sagging); somewhat irregular in tabula spacing; there are 1–10 tabulae in 2.5 mm length of corallite.

Discussion: The cylindrical corallites that have the connecting tubuli and the complete tabulae are the basis for placement of the present specimens in *Syringoporella*. This species represents the first record of the genus *Syringoporella* in Japan.

The type species, *Syringoporella moravica* (Roemer, 1883; Kettner, 1934, figs. 1–5; Kettner, 1937) from the Givetian (Middle Devonian) of Moravia, Czecho, differs from *S. yamakoshii* sp. nov. by the thicker corallite walls (0.04–0.08 mm versus 0.1–0.25 mm in *S. moravica*), the fewer tabulae and the more well-developed connecting tubuli. The two Middle Devonian Chinese species, *Syringoporella paramoravica* Yang (1978, pl. 81, figs. 1a, b *in* Yang *et al.*, 1978) and *S. spinosa* (Yang, 1978, pl. 81, figs. 2a, b *in* Yang *et al.*, 1978) both from Guizhou in South China, have the similar corallite diameters with this new species. Among them, *Syringoporella paramoravica* is most similar to *S. yamakoshii* in many respects. With the exception of an age gap, the both species may be distinguished by the corallite spacing; i.e., *Syringoporella paramoravica* indicates variable distances between corallites. *Syringoporella yamakoshii* lacks the septal spine which is the most diagnostic feature of *S. spinosa*.

At a first glance, *Syringoporella yamakoshii* is comparable to an insufficiently diagnosed species described as *Syringopora* cf. *tonkinensis* Mansuy, 1914, by Sugiyama (1940, pl. 22, fig. 11) from the Silurian Kawauchi Formation, Iwate Prefecture. However, he stated that "funnel shaped tabulae probably present" in the Kawauchi species.

Etymology: The specific name honors the late Mr. Satoru Yamakoshi, who was a distinguished collector of Paleozoic fossils occur in the Fukuji and Hitoegane areas.

Occurrence: All specimens were recovered from calcareous shale.

Acknowledgments

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