

Middle Devonian auloporid corals from the Naidaijin Formation, Kumamoto Prefecture, Southwest Japan

Shuji Niko*

Department of Environmental Studies, Faculty of Integrated Arts and Sciences, Hiroshima University,
Higashihiroshima 739–8521, Japan

*Author for correspondence: niko@hiroshima-u.ac.jp

Abstract As the first record of the Devonian auloporid corals from the Kurosegawa Belt, the present study describes three Givetian (late Middle Devonian) species from the Naidaijin Formation in Kumamoto Prefecture, Kyushu Island, Southwest Japan. They are two auloporoids, *Aulopora* sp. indet. and *Kumamotolites patulus* gen. et sp. nov. and a single syringoporoid, *Syringopora* sp. indet. Because *Kumamotolites* closely resembles the genus *Bajgolia*, this new genus is tentatively assigned to the family Bajgoliidae that was monotypic and restricted in the Ordovician.

Key words: Givetian, Kurosegawa Belt, *Kumamotolites* gen. nov., Bajgoliidae, Tabulata

ZooBank registration:

<https://www.zoobank.org/urn:lsid:zoobank.org:pub:8093CF1E-C613-491D-AD2A-8BF6DF06CB53>

Introduction

In a serial paper concerning Givetian (late Middle Devonian) tabulate coral assemblages of the Naidaijin Formation in Kumamoto Prefecture, Kyushu Island, Southwest Japan, the present study deals three species of the order Auloporida. This is the first record of the Devonian auloporid corals from the Kurosegawa Belt. Geologic and geographic settings of the material examined herein are referable in preceding Niko (2022).

Repository: Department of Geology and Paleontology, National Museum of Nature and Science (prefixed NMNS), Tsukuba, Ibaraki Prefecture, Japan.

Systematic paleontology

Order Auloporida Sokolov, 1947

Superfamily Auloporoidea

Milne-Edwards and Haime, 1851

Family Auloporidae

Milne-Edwards and Haime, 1851

Genus *Aulopora* Goldfuss, 1829

Type species: *Aulopora serpens* Goldfuss, 1829.

Aulopora sp. indet.

Fig. 1A–C

Material examined: NMNS PA20538, 20539, 20542.

Occurrence: Black calcareous mudstones at localities NAD-1 (NMNS PA20538, 20539) and gray limestone at NAD-4 (NMNS PA20542).

Discussion: Examined three fragmentary specimens indicate following characteristics: coralla encrusting, mat-like in growth form; corallites short, approximately 3 mm; each corallite differentiates into proximal adherent and distal free portions; proximal portions reptant, indicating semicircular to fan-shaped transverse sections; distal cylindrical portions turn upward and 0.5–1.0 mm in calical diameter; corallite walls thickened, attaining 0.38 mm; septal spines sporadic, high conical; tabulae very rare, complete. The overall morphology of *Aulopora sorayamaensis* Niko (2001, p. 74, 76, 77, figs. 1-1–7, 2-1–4; Niko and Senzai, 2006, p. 33, fig. 2-1–3), that occurs from the Lower Devonian Fukuji and Kamianama formations in Central Japan, well agrees with the Naidaijin specimens, however *A. sorayamaensis* is separated from by its slightly larger calical diameters, approximately 1.1 mm. Although the material probably represents a new species, it is too insufficient to a specific identification.

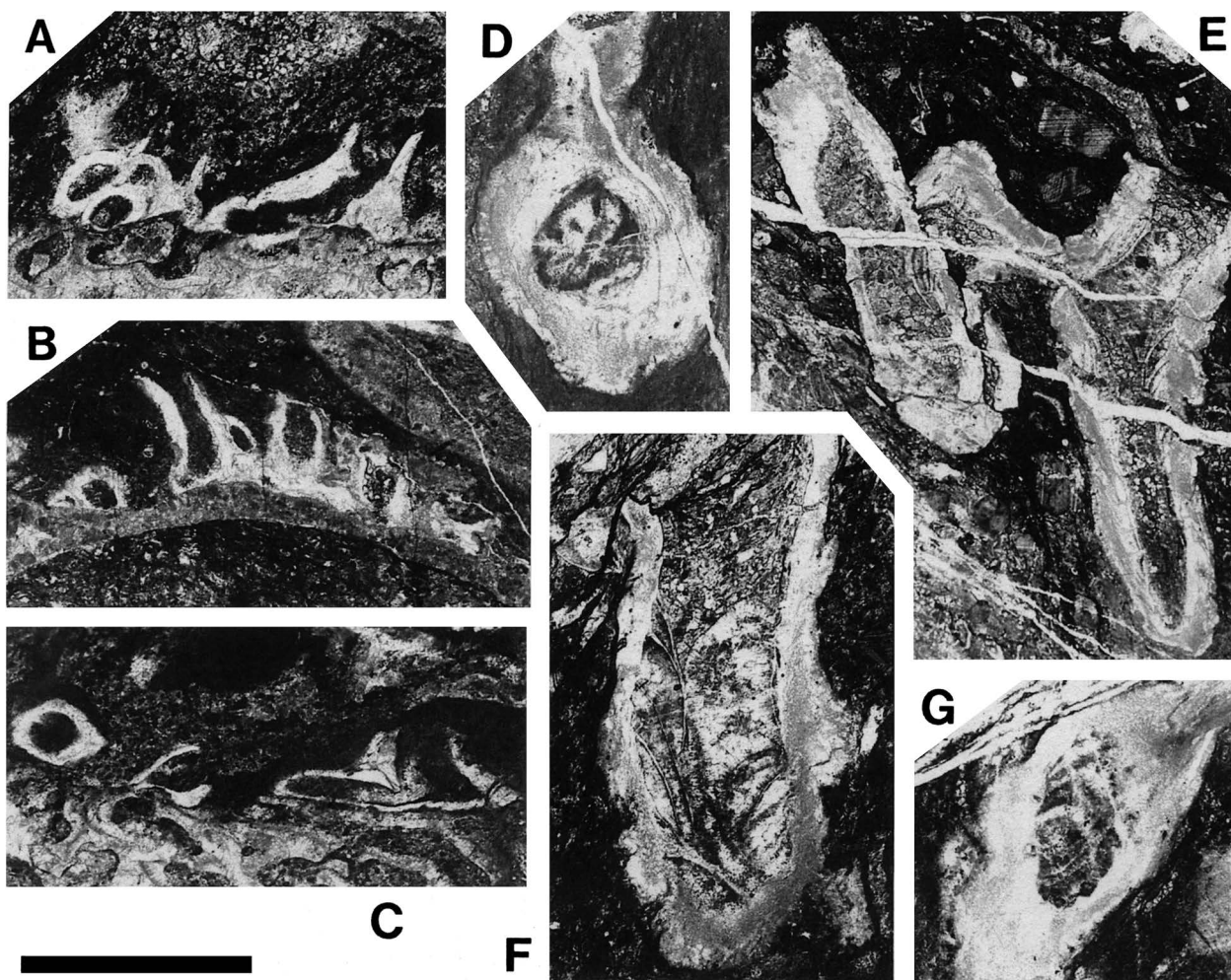


Fig. 1. A–C, *Aulopora* sp. indet., thin longitudinal sections of coralla; A, C, NMNS PA20539, B, NMNS PA20538. D–G, *Syringopora* sp. indet., NMNS PA20543, thin sections; D, transverse section of corallite, note well-developed septal spines, E, longitudinal section of corallum, F, longitudinal section of corallite, note infundibuliform tabulae and axial syrinx, G, transverse section (slightly oblique) section of corallite, note infundibuliform tabulae. Scale bar: 3 mm in A–D, F, G; 6 mm in E.

Family Bajgoliidae Hill, 1981

Genus *Kumamotolites* gen. nov.

urn:lsid:zoobank.org:act:67F2B51B-71A9-45E8-9300-B6EC7186F890

Type species: *Kumamotolites patulus* sp. nov. by monotypy.

Diagnosis: Coralla ramose; branches made by loosely aggregated bundles of corallites and probably bifurcated; corallites mostly cylindrical, subcylindrical to subprismatic; early juvenile parts of corallites adhere to parent or adjoining corallites and very narrow; distal ends of corallites form free and fanwise calices; connecting tubule absent; intercorallite walls thickened, differentiated, and possess distinct median line; mural pore absent; no septal spine developed; tabulae rare, complete.

Etymology: The generic name is derived from Kumamoto Prefecture, in which the type locality of *Kumamotolites patulus* gen. et sp. nov. situates.

Discussion: The diagnostic characters of *Kumamotolites* gen. nov. clearly correspond to those of the Ordovician genus *Bajgolia* Dzyubo (1962; type species, *B. altaica* Dzyubo, 1962, from the Altai Mountains, Siberia; emended by Webby, 1977) that also known to occur from Tasmania Island (Hill, 1955) and New South Wales (Hill, 1957) in Australia. Especially the characteristics of their gross branch shapes, calices and tabulae and the lacking of septal spine, mural pore and connecting tubule are quite identical between the two genera. On the basis of these similarities, the present Middle Devonian new genus, *Kumamotolites*, is tentatively assigned to the family Bajgoliidae that was previ-

ously monotypic. The difference between the two genera only in corallite arrangement, i.e., the cerioid parts in the branches of *Bajgolia* are not developed in *Kumamolites*.

The new genus resembles the aulocystid genus, *Pseudoromingeria* Yabe and Sugiyama (1941; type species, *Romingeria? kotoi* Yabe and Hayasaka, 1915, from the Permian of Central Japan; emended by Niko, 2009), in its coralla composed by a lax mass of the corallites. However, the absence of infundibuliform tabulae excludes it from *Pseudoromingeria*.

Shapes of the early juvenile corallites of *Kumamolites* are similar to those of the Devonian genus, *Spiranopora* Plusquellec and Gourvenec (2000; type species, *S. persica* Plusquellec and Gourvenec, 2000, from Central Iran). I think this similarity is superficial. The undifferentiated walls of the family Trypanoporidae (Li, 1981; including *Spiranopora*) are suggestive of its higher placement to annelid as mentioned by Tournier *et al.* (1994).

***Kumamolites patulus* sp. nov.**

urn:lsid:zoobank.org:act:E238D346-359B-45CF-9458-E33892D63A9B

Fig. 2A–G

Type material: Holotype, NMNS PA20540. Paratype, NMNS PA20541.

Occurrence: Black calcareous mudstones at locality NAD-4, Mt. Tenshu-zan area, Yamato-cho, Kumamoto Pref., lower member of the Naidaijin Formation (see Niko, 2022).

Diagnosis: As for the genus.

Description: Two fragmentary coralla were examined; they are ramose having approximately 45 mm in preserved corallum diameter of the holotype; branches made by loosely aggregated bundles of corallites with many intra-branch lacunae, indicate botryoidal, irregularly lobated to subcircular transverse sections, and have variable diameters ranging from 8 to 24 mm; branching probably bifurcated. Except for early juvenile parts of corallites that are alveolite-like and adhere to parent or adjoining corallite surfaces, usual corallites cylindrical, subcylindrical to subprismatic; growth directions of corallites are parallel with branch axis in proximal (including early juvenile) parts, then turn outward in distal ones to form free and fanwise cali-

ces; transverse sections of corallites are hemi-circular to rounded subtrapezoidal in early juvenile parts and circular to subpolygonal with indistinct 5–6 sides in more distal ones including calices; corallite diameters of early juvenile parts are 0.4–0.7 mm, they rapidly inflate, after that to uniform as 1.4–2.1 mm; lengths of the distal free parts are 3.0–4.6 mm; calices very deep, usually oblique to branch axis, and nearly cylindrical to weakly inflated; increase of corallites may lateral; connecting tubule absent. Intercorallite walls uniformly thickened, 0.08–0.56 (usually 0.20–0.35) mm; they are structurally differentiated into distinct median dark line and stereoplasm; microstructure of stereoplasm is not preserved; tabularia (lumina) circular to subcircular in transvers section; mural pore not observable; no septal spine developed; tabulae mostly absent, but rarely crowded, where complete and weakly uparched tabulae developed; tabulae thickened by stereoplasmic layer, attaining 0.10 mm.

Etymology: The name of this new species is derived from the Latin, *patulus*, meaning patulous, in reference to its distal corallite shape.

Discussion: In its general branch and corallite characters, the closely resemble species to *Kumamolites patulus* sp. nov. is *Bajgolia? grandis* Webby (1977, p. 174, pl. 6, fig. 1, 2, pl. 7, fig. 11, 12), which occurs from the Upper Ordovician limestone in New South Wales. The principal difference between them is only the apparently thicker intercorallite walls of *B.? grandis*. Although there is a considerable chorological gap, it seems likely that *K. patulus* and the Ordovician species are phylogenetically related.

Superfamily Syringoporoidea de Fromentel, 1861

Family Syringoporidae de Fromentel, 1861

Genus *Syringopora* Goldfuss, 1826

Type species: *Syringopora ramulosa* Goldfuss, 1826.

***Syringopora* sp. indet.**

Fig. 1D–G

Material examined: NMNS PA20543.

Occurrence: Black calcareous mudstone at locality NAD-4.

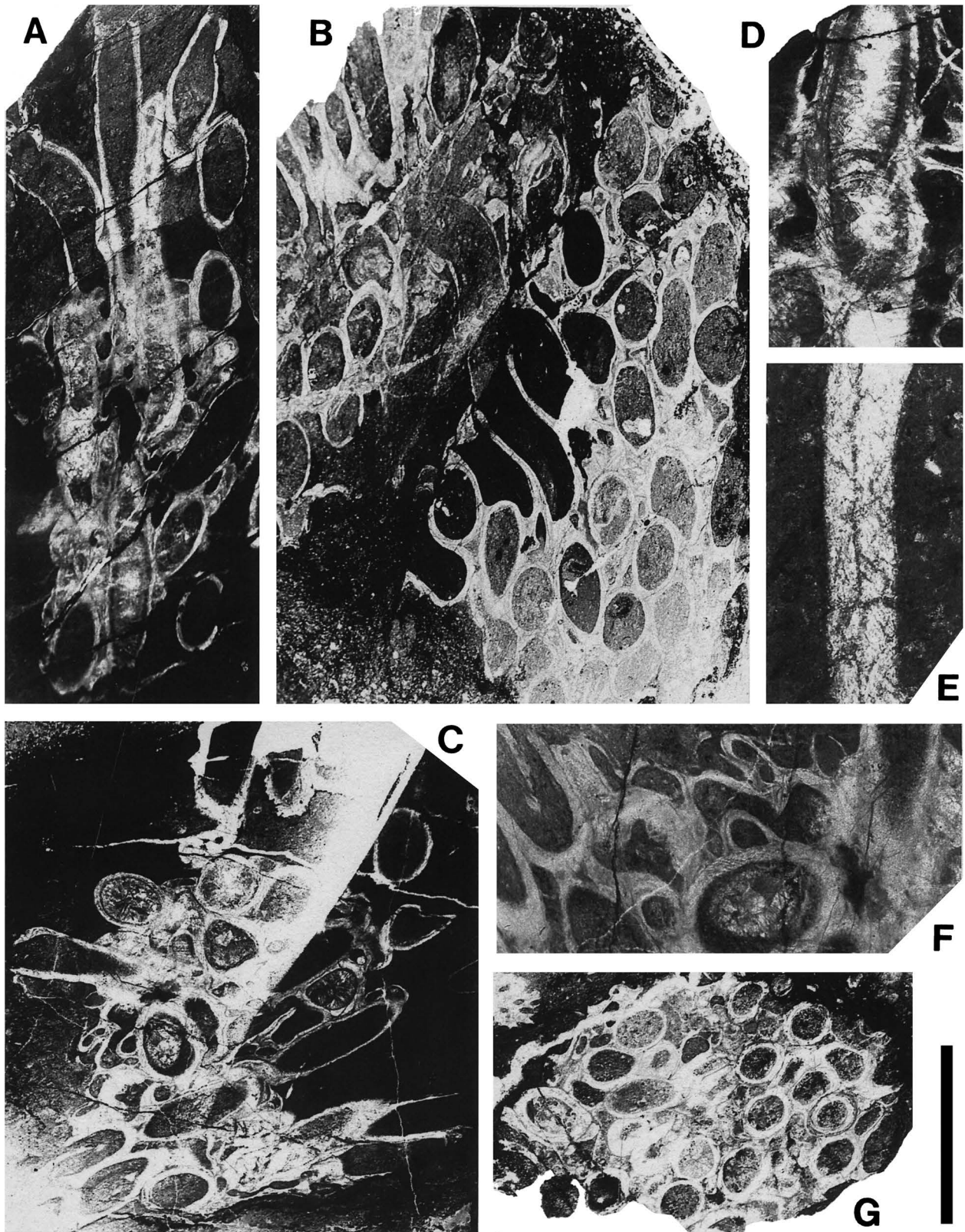


Fig. 2. *Kumamolites patulus* gen. et sp. nov., thin sections. A–C, E, F, holotype, NMNS PA20540; A, longitudinal section of branch, B, oblique sections of branches, C, oblique section of branch, E, partial enlargement to show details intercorallite wall structure, F, partial enlargement of C to show early growth stages of corallites. D, G, paratype, NMNS PA20541; D, longitudinal section of corallite, note complete tabulae, G, transverse section of branch. Scale bar: 6 mm in A–C, G; 3 mm in D, F; 0.6 mm in E.

Discussion: A single fragmentary and more or less distorted specimen is available for the study. Its characters are as follows: corallum fasciculate, consisting of cylindrical corallites that connected by tubules; corallite diameters 1.9–4.0 mm; corallite walls strongly thickened, attaining 1.21 mm; septal species usually rare, but partly crowded, high conical to needle-like; lengths of spines are variable and range from immersed in walls to protruded inwardly; tabulae infundibuliform, form indistinct axial syrinx, and rarely thickened. Although the specimen is not complete to enough for a confident identification of species, the possessions of the connecting tubules and the infundibuliform tabulae with an axial syrinx warrant it generic assignment.

Acknowledgements

I thank Teruo Ono, Yasuhiro Ishiguro, Haruyoshi Maeda and Yoshihito Senzai for their assistances in the field. Thanks also to Masayuki Fujikawa, who provided thoughtful comments as a reviewer. Takuma Haga registered the new name to ZooBank.

References

- Dzyubo, P. S. (1962) New genus of Tabulata from the Ordovician of Gornyy Altay. *Trudy Sibirskogo Nauchno-Issledovatel'skogo Instituta Geologii, Geofiziki i Mineralnogo Syria*, **23**: 154–157. (In Russian.)
- Fromentel, E. de (1861) Introduction à l'Étude des Polypiers Fossiles, 357 pp. F. Savy, Paris.
- Goldfuss, A. (1826, 1829) Petrefacta Germaniae, tam ea, quae in Museo Universitatis Regiae Borussicae Fridericiae Wilhelmae Rhenanae servantur, quam alia quae-tunque in Museis Hoeninghusiano, Muenstriano aliisque extant, iconibus et descriptionibus illustrata. Abbildungen und Beschreibungen der Petrefacten Deutschlands und der angränzenden Länder, unter Mitwirkung des Herrn Grafen Georg zu Münster. pp. 1–76, pls. 1–25 (1826), pp. 77–164, pls. 26–50 (1829), Arnz & Co., Düsseldorf.
- Hill, D. (1955) Ordovician corals from Ida Bav. Queenstown and Zeehan, Tasmania. *Papers and Proceedings of the Royal Society of Tasmania*, **89**: 235–254, pls. 1–3.
- Hill, D. (1957) Ordovician corals from New South Wales. *Journal and Proceedings of the Royal Society of New South Wales*, **91**: 97–107, pls. 2–4.
- Hill, D. (1981) Part F, Coelenterata. Supplement 1, Rugosa and Tabulata. pp. F1–F762. In: Moore R. C. *et al.* (Ed.), *Treatise on Invertebrate Paleontology*. The Geological Society of America, INC. and the University of Kansas, Boulder, Colorado and Lawrence, Kansas.
- Li, Y. X. (1981) The establishment of a new family Trypanoporidae and its significance. *Bulletin of the Chinese Academy of Geological Sciences, Series 10*, **2**: 113–119.
- Milne-Edwards, H. and Haime, J. (1851) Monographie des polypiers fossiles des terrains palaeozoïques, précédée d'un tableau général de la classification des polypes. *Archives du Muséum d'Histoire Naturelle, Paris*, **5**: 1–502, pls. 1–20.
- Niko, S. (2001) Devonian auloporid tabulate corals from the Fukui Formation, Gifu Prefecture. *Bulletin of the National Science Museum, Series C*, **27**: 73–88.
- Niko, S. (2009) Middle Permian tabulate corals from the Akasaka Limestone, Gifu Prefecture. *Bulletin of the National Science Museum, Series C*, **35**: 39–51.
- Niko, S. (2022) Middle Devonian favositine corals from the Naidaijin Formation, Kumamoto Prefecture, Southwest Japan. *Bulletin of the National Museum of Nature and Science, Series C*, **48**: 15–31.
- Niko, S. and Senzai, Y. (2006) Devonian auloporid tabulate corals from the Kamianama Formation, Fukui Prefecture. *Bulletin of the National Science Museum, Series C*, **32**: 31–40.
- Plusquellec, Y. and Gourvennec, R. (2000) *Spiranopora persica*, n. g. n. sp. (Annelida?) from the Frasnian of Chah-riseh, Central Iran. *Annales Société Géologique du Nord*, **8**: 55–59.
- Sokolov, B. S. (1947) New syringoporids from the Taymyr. *Byulleten Moskovskoe Ovschchestva Ispytatelei Prirody, Otdel Geologicheskii*, **22**: 19–28. (In Russian.)
- Tourneur, F. Lachkhem, H. and Mistiaen, B. (1994) *Trypanopora conili* sp. nov. (Annelida?) du Calcaire de Couvin, Eifelien du bord sud du Synclinerium de Dinant (Belgique). Affinités biologiques et relations avec les organismes hôtes. *Mémoires Institut Géologique de l'Université Catholique de Louvain*, **35**: 83–122.
- Webby, B. N. (1977) Upper Ordovician tabulate corals from central-western New South Wales. *Proceedings of the Linnean Society of New South Wales*, **101**: 167–183, pls. 2–10.
- Yabe, H. and Hayasaka, I. (1915) Palaeozoic corals from Japan, Korea and China. II. *Halysites*, *Syringopora*, *Romingeria*, *Striatopora*, *Tetrapora* and *Sylindropora*. *The Journal of the Geological Society of Tokyo*, **22**: 79–92.
- Yabe, H. and Sugiyama, T. (1941) *Pseudoromingeria*, a new genus of auloporids from Japan. *Proceedings of the Imperial Academy of Japan*, **17**: 379–382.