

**Devonian tabulate corals from pebbles in Mesozoic conglomerate,  
Kotaki, Niigata Prefecture, central Japan  
Part 3: Heliolitida**

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**Abstract**

As the third fascicle, this paper describes two species of heliolitid tabulate corals, namely *Heliolites porosus* (Goldfuss, 1826) and *H. sp. cf. H. opacus* (Dubatolov, 1963), from the Kotaki area, Niigata Prefecture, central Japan. The examined specimens were found in Mesozoic conglomerate. This discovery of *H. porosus* suggests that the coral-bearing limestone pebbles are Givetian (late Middle Devonian) in age. Besides the type locality in Europe, this species is widely known to occur from North Africa, Asia and Australia. Another species resembles closely *Heliolites opacus* (Dubatolov, 1963), from the Eifelian to Givetian (lower to upper Middle Devonian) of southern Siberia, with exception of slight differences of tabularium diameters.

*Key words*: Middle Devonian, heliolitid tabulae corals, *Heliolites*, Kotaki area, Mesozoic conglomerate.

**Introduction**

Following Niko et al. (2014, 2015), the present paper represents the third fascicle in a series of our descriptive works concerning the Devonian tabulate coral fauna in the Kotaki area of Itoigawa, Niigata Prefecture, central Japan. These coral fossils are preserved in pebbles in a float block of Mesozoic conglomerate. Two species of *Heliolites* are described

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herein on the basis of nine specimens that housed in the Fossa Magna Museum (abbreviation: FMM).

### Systematic Paleontology

Subclass Tabulata Milne-Edwards and Haime, 1850

Order Heliolitida Frech, 1897

Suborder Heliolitina Frech, 1897

Superfamily Heliolitoidea Lindström, 1876

Family Heliolitidae Lindström, 1876

Genus *Heliolites* Dana, 1846

[= *Pachycanalicula* Wentzel, 1895; see Laub, 1979, p. 351; Young and Noble, 1990, p. 49]

*Type species*.—*Astraea porosa* Goldfuss, 1826.

*Heliolites porosus* (Goldfuss, 1826)

Figs. 1-1-4

*Astraea porosa* Goldfuss, 1826, p. 64, pl. 21, figs. 7a-g.

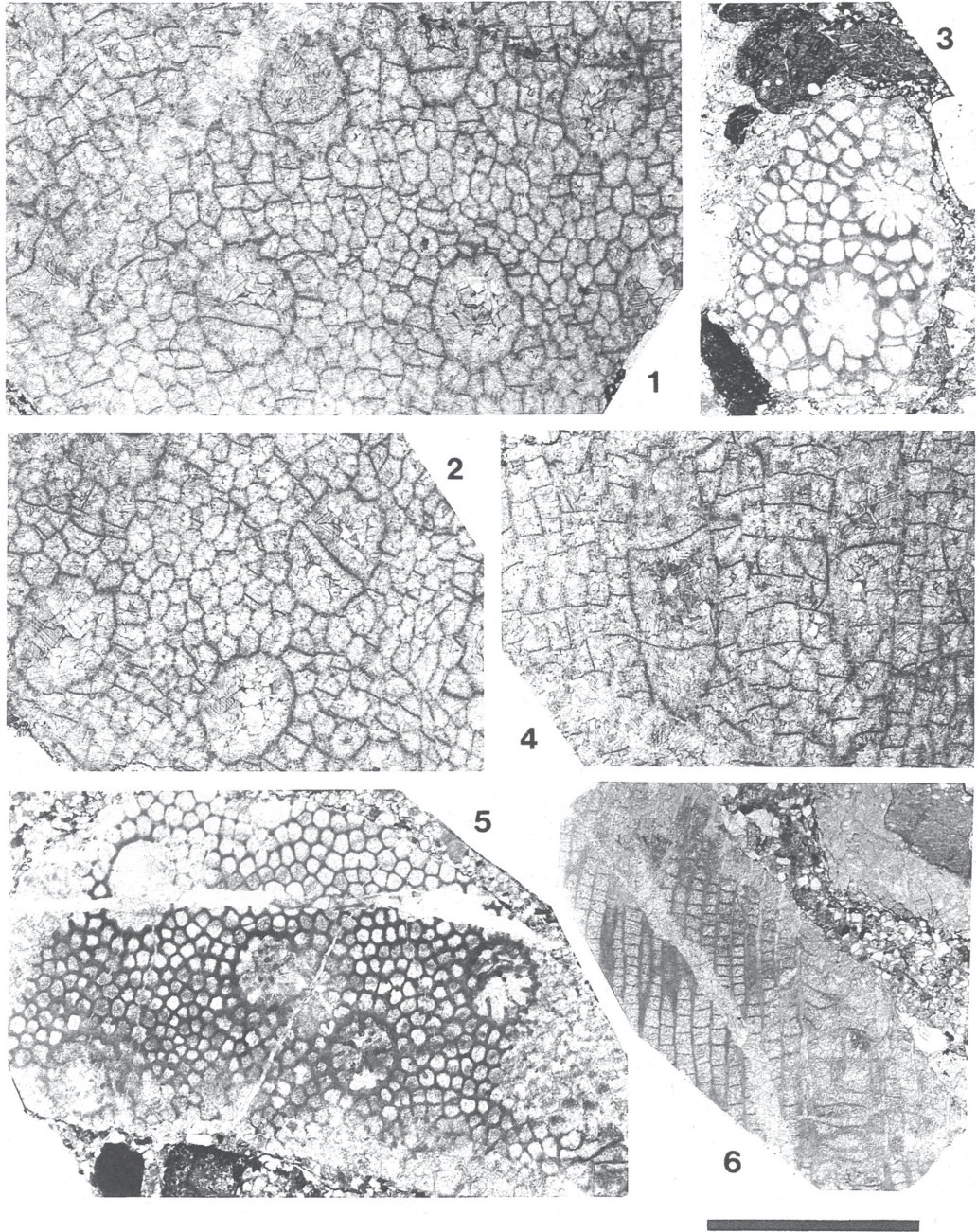
*Heliolites porosa* (Goldfuss); Milne-Edwards and Haime, 1851, p. 218, 219; Etheridge, 1899, p. 173, 174, pl. 19, figs. 3, 4, pl. 25, figs. 1, 2.

*Heliolites porosus* (Goldfuss); Lindström, 1899, p. 53-58, pl. 2, figs. 29-38, 371-VII, pl. 3, figs. 3-7; Lecompte, 1936, p. 93-96, pl. 14, figs. 2, 2a, 3, 3a, b, 4, 5, 5a; Jones and Hill, 1940, p. 204, pl. 9, figs. 3a, b; Termier and Termier, 1950, p. 67, pl. 14, fig. 13, pl. 15, figs. 3, 4; Chernyshev, 1951, p. 88, 89, pl. 22, figs. 3-5; Fontaine, 1954, p. 72, 73, pl. 8, figs. 10, 11; Stasińska, 1958, p. 223, 224, pl. 33, figs. 1-3; Yang et al., 1978, p. 240, pl. 89, fig. 8; Iven, 1980, p. 163, 165, 167; Hill, 1981, figs. 410.2a, b; Nowiński, 1993, figs. 15A, B; Fernández-Martínez, 1999, p. 104-107, 109, 110, figs. 3A, B, 6A-G; Brühl and Pohler, 1999, p. 277, 278, pl. 1, figs. 1-4.

*Heliolites (Heliolites) porosus* (Goldfuss); Flügel, 1956, p. 72, 73.

*Material*.—FMM6201-6207. They were recovered from gray to milky white limestone pebbles.

*Description*.—Seven specimens of incomplete coralla are available for this study; they are probably massive, at least 32 mm in diameter, and consist of cylindrical tabularia (= corallites) surrounded by coenenchyme of prismatic tubules. Tabularia have 1.1-1.5 mm in diameter and separated from one another 2-7 coenenchymal tubules; center to center distances of adjoining tabularia are 1.8-3.4 mm; walls of tabularia are weakly crenulate to smooth; thickness of walls is usually thin, having 0.03-0.05 mm, but it rarely attains to 0.15



**Fig. 1.** 1–4: *Heliolites porosus* (Goldfuss, 1826), thin sections. 1, 2, 4, FMM6202; 1, 2, transverse sections of corallum; 4, longitudinal section of corallum; 3, FMM6207, transverse section of corallum. 5, 6: *Heliolites* sp. cf. *H. opacus* (Dubatolov, 1963), FMM6209, thin sections. 5, transverse section of corallum; 6, longitudinal section of corallum. Scale bar = 3 mm.

mm in thickened parts; tabulae complete; septa lamellar or ridge-like in rare cases, 0.05–0.39 mm in length, or absent; basal parts of usual septa are inflated and indicate triangular profiles. Coenenchymal tubules 0.2–0.6 mm in diameter with 0.03–0.08 mm in wall thickness; dissepiments in tubules are complete.

*Discussion.*—Both in terms of shape and size, morphologies of the Kotaki material fall within the diagnosis of *Heliolites porosus* (Goldfuss, 1826) that indicates wide morphological variations and contains more than 20 subspecies (Flügel, 1956; Iven, 1980). The types of this species were recorded from the Givetian (upper Middle Devonian) of Eifel, Germany. The fragmentary nature of the material precludes confident assignation of subspecies, but the present discovery is useful for age determination of the coral-bearing limestone pebbles. Geographic distributions of *H. porosus* are wide. Except for Europe, it is widely known to occur in North Africa (Morocco; Termier and Termier, 1950), Asia including southern Siberia (Chernyshev, 1951), the Indochinese Peninsula (Fontaine, 1954) and South China (Yang et al., 1978), and Australia including New South Wales (Etheridge, 1899; Brühl and Pohler, 1999) and Queensland (Jones and Hill, 1940).

*Heliolites* sp. cf. *H. opacus* (Dubatolov, 1963)

Figs. 1-5, 6

*Compare with:*

*Pachycanalicula opaca* Dubatolov, 1963, p. 120, 121, pl. 43, figs. 3a, b, 4a, b.

*Material.*—FMM6208, 6209. They were recovered from gray limestone pebbles.

*Description.*—Two available specimens of fragmentary coralla are probably massive in outer form and consist of cylindrical tabularia (= corallites) and surrounding coenenchyme of prismatic tubules. Tabularia are relatively narrow, 1.0–1.2 mm in diameter and separated from one another 3–8 coenenchymal tubules; center to center distances of adjoining tabularia are 1.8–2.2 mm; walls of tabularia are weakly crenulate, thickened with 0.06–0.10 mm; tabulae complete or incomplete, closely spaced; septa thin lamellae with spinose in axial parts to low ridges, or absent; septal length approximately 0.04–0.27 mm. Coenenchymal tubules relatively narrow with 0.2–0.4 mm in diameter; walls of tubules are thin to moderately thick, having 0.03–0.06 mm in thickness; dissepiments in tubules are complete.

*Discussion.*—The Kotaki species resembles closely *Pachycanalicula opaca* Dubatolov, 1963 (= *Heliolites opacus* in current status) from the Eifelian to Givetian (lower to upper Middle Devonian) of Novokuznetsk, southern Siberia. However, it has slightly smaller diameters of the tabularia than those of the latter that indicates 1.2–1.4 mm.



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