

## ***Hemithiris woodwardi* (A. Adams) (Rhynchonellida, Brachiopoda) from the Pleistocene Shichiba Formation, Sado Island, central Japan**

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### **Abstract**

A rhynchonelloid brachiopod *Hemithiris woodwardi* (A. Adams) is described from the Pleistocene Shichiba Formation at Shichiba, Sawada-machi, Sado Island, central Japan. The occurrence of *H. woodwardi*, a rather cold and shallow water habitant, from the Shichiba Formation at Shichiba is well coincident with the abundant occurrence of cold water type molluscan shells (Omma-Manganzian fauna) from the same locality.

*Key words:* Brachiopoda, *Hemithiris woodwardi*, Pleistocene, Sado Island, Shichiba Formation.

### **Introduction**

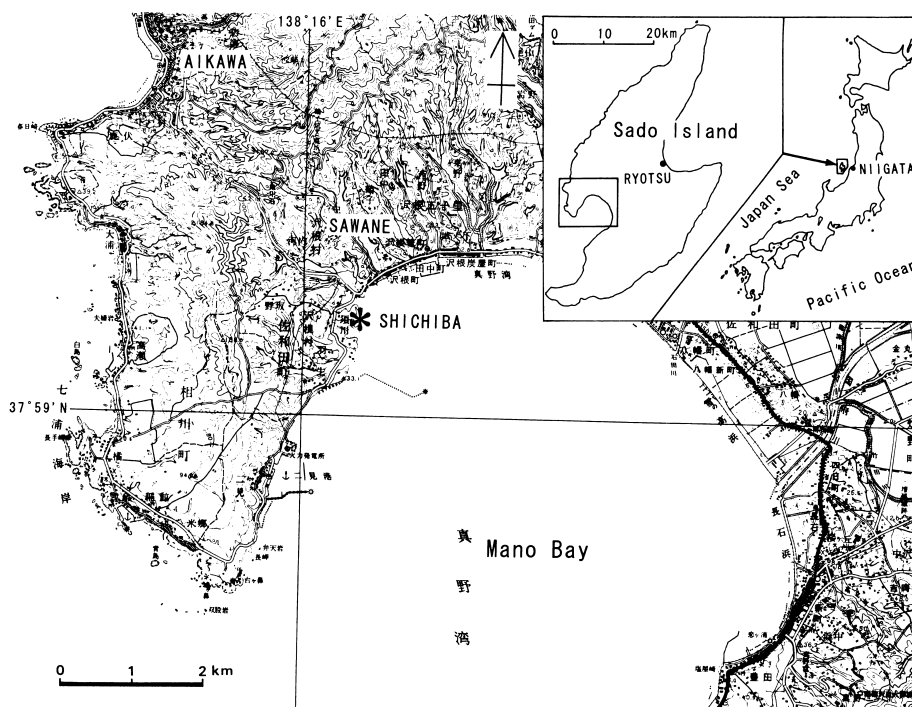
Recently the junior author (J. T.) collected many fossil specimens of a rhynchonelloid brachiopod from sandstone of the Pleistocene Shichiba Formation at the type locality, Shichiba (Sawaneshichiba), Sawada-machi, Sado Island, central Japan (Fig. 1). The brachiopod specimens from Shichiba were taxonomically studied by the senior author (M. S.), and assigned to *Hemithiris woodwardi* (A. Adams).

The Shichiba Formation was named by Niigata Foraminiferal Research Group (1967) for the upper part of the "Sawane Formation", distributed around the Sawane area in west-central Sado Island. According to Kobayashi (2000), the Shichiba Formation consists of sandstone in the lower part and alternation of sandstone and siltstone in the upper part, having a total thickness about 40 m, and correlated with the Pleistocene. This formation is characterized by the occurrence of cold water type molluscan shells belonging to the "Omma-Manganzian fauna" (Kobayashi et al., 1976; Ogasawara, 1986). The brachiopod specimens treated in this paper

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**Fig. 1.** Index map showing the fossil locality (asterisk). Using the topographical map of “Aikawa” and “Kawaharada” scale 1:50,000 published by the Geographical Survey Institution of Japan.

were collected from the sandstone at the cliff of Shichiba Coast, together with abundant fossils of a bivalve *Glycymeris yessoensis* (Sowerby).

*H. woodwardi* is distributed not only in northern Japan, but also in central Japan in the Japan Sea side such as the coast of Noto Peninsula and vicinity of Sado Island, and in southern Japan such as the west coast of Kyushu near Goto Islands and Tsushima Islands, with a total depth range of 23-353 m. In the living brachiopod collection of one of the authors (M. S.), *H. woodwardi* is restricted in the seas around northern Japan with a depth range of 20-166 m (Table 1). Therefore, although *H. woodwardi* has a wide distribution around Japan and inhabits waters of various depth, it is regarded as dominant in cold and shallow waters. The cold and shallow water habitat for *H. woodwardi* well accords with the depositional environment of the Shichiba Formation as inferred from the molluscan shell assemblages (Kobayashi et al., 1976; Ogasawara, 1986; Endo, 1986). On the other hand, *H. psittacea* (Gmelin), the type species of the genus *Hemithiris* and often confused with *H. woodwardi*, is rarely found in Japan. We only know a single instance of occurrence from off Abashiri, east Hokkaido from the depth of

**Table 1.** Localities of Recent *Hemithiris woodwardi* (A. Adams) and *Hemithiris psittacea* (Gmelin) used in this study.

Species	Locality	Depth range
<i>Hemithiris woodwardi</i>	uncertain [probably near Aniva Bay, Sakhalin (T. Miyauchi, pers. comm.)]	about 78 m
	off Yuchi, Hokkaido	30.3-30.5 m
	off Bakkai, Hokkaido	20-30 m
	Kita-musashi Bank, Hokkaido	97-99 m
	East off Rishiri, Hokkaido	52-53 m
	off Abashiri, Hokkaido	99-104m
	off Shiretoko Misaki, Hokkaido	60-72m
	off Matsumae, Hokkaido	129 m
	off Esashi, Hokkaido	98-99 m
	off Siriya-zaki, Aomori Prefecture	164-166 m
	Otsuchi Bay, Iwate Prefecture	58-124 m
<i>Hemithiris psittacea</i>	off Abashiri, Hokkaido	1306-1321 m

1,306-1,321 m (Table 1). Zezina (1997) reported *H. psittacea* from the seas off Chisima (Kuril Islands), which represents the southernmost record of this species in the Okhotsk Sea.

In this paper *Hemithiris woodwardi* (A. Adams), collected from the Shichiba Formation at Shichiba, Sado Island is described, and the stratigraphical and geographical distributions of *H. woodwardi* are summarized. The comparison between *H. woodwardi* and *H. psittacea* is also discussed in detail. All the specimens are housed in the University Museum, University of Tokyo.

### Systematic descriptions

Order Rhynchonellida Kuhn, 1949

Family Hemithyrididae Rzhonsnitskaya, 1956

Genus *Hemithiris* d'Orbigny, 1847

*Hemithiris woodwardi* (A. Adams, 1863)

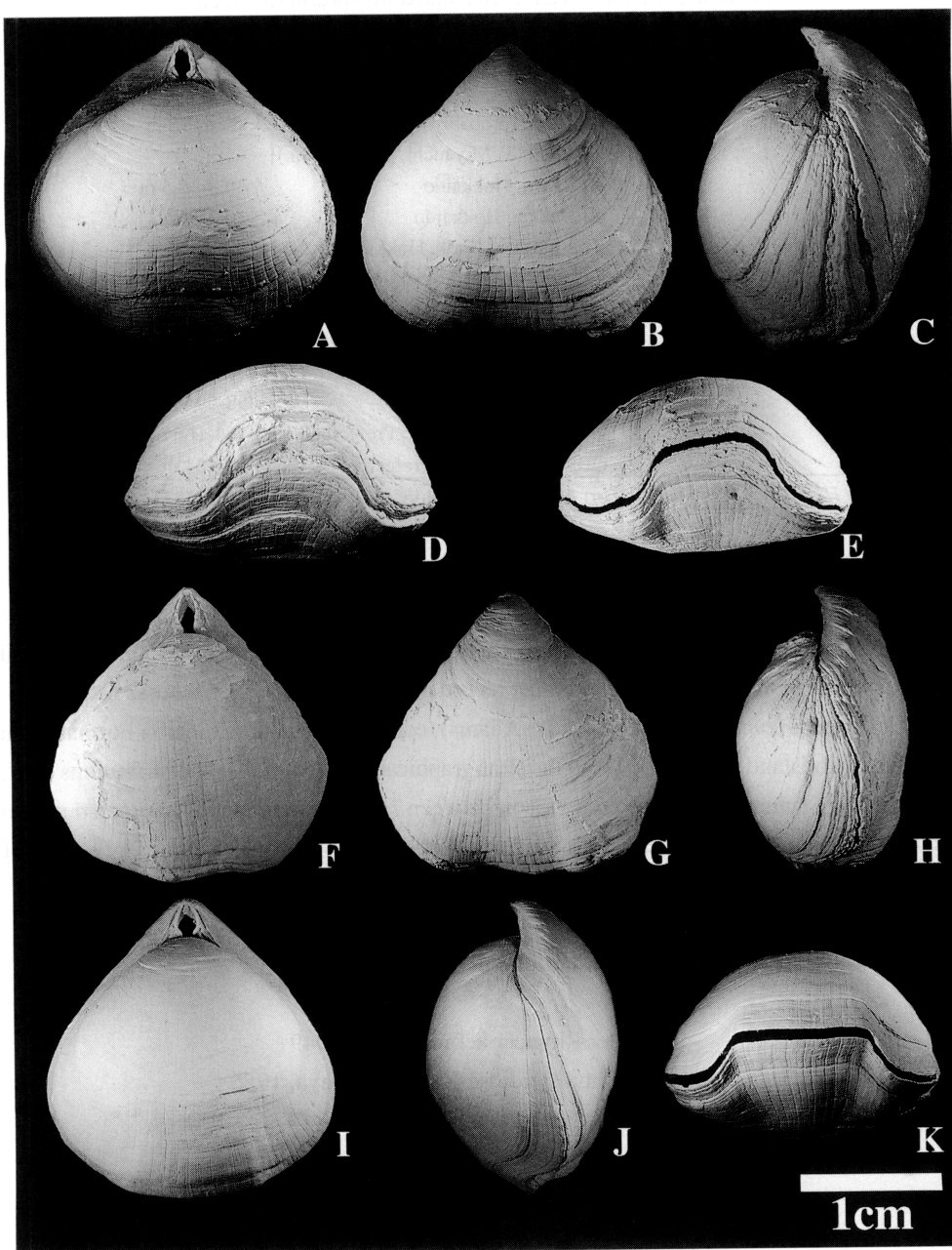
Figs. 2, 3.

*Rhynchonella woodwardii* A. Adams, 1863, p. 100.

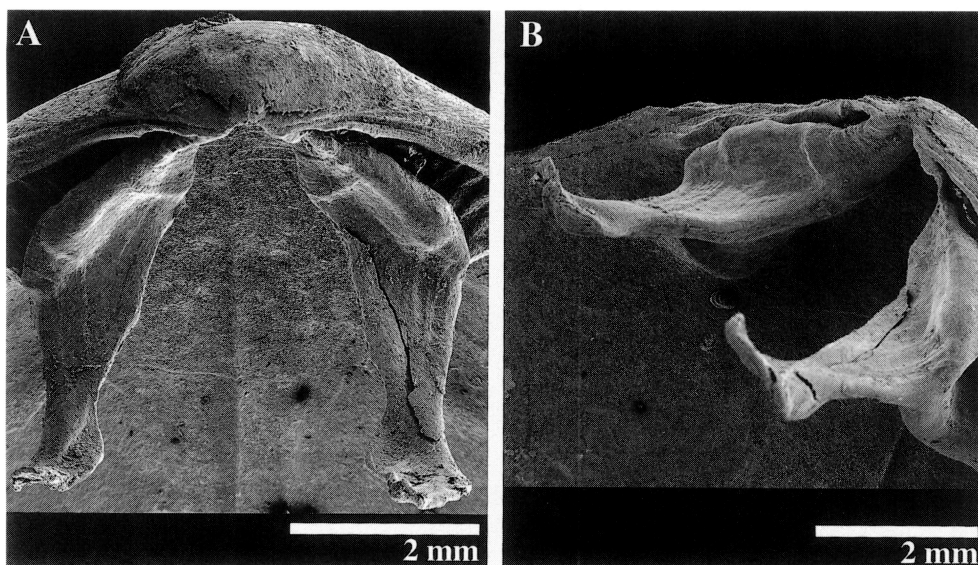
*Rhynchonella psittacea* var. *woodwardi* A. Adams: Davidson, 1871, p. 309, pl. 31, fig. 12;

Davidson, 1887, p. 168, pl. 24, figs. 12, 13; Yokoyama, 1922, p. 200, pl. 17, fig. 13.

*Hemithyris psittacea* var. *woodwardi* (A. Adams): Schuchert, 1911, p. 269; Hayasaka, 1922,



**Fig. 2.** A-K: *Hemithiris woodwardi* (A. Adams), A-D: dorsal, ventral, lateral and anterior views of the largest specimen (UMUT CB28070-1), collected from the Shichiba Formation at Shichiba, E-H: anterior, dorsal, ventral and lateral views of a younger specimen (UMUT CB28070-2), collected from the Shichiba Formation at Shichiba, I-K: dorsal, lateral and anterior views of a living individual, collected from off Wakkanai, north Hokkaido (UMUT RB28071).



**Fig. 3.** Dorsal valve interior (cardinalia) of *Hemithiris woodwardi* (A. Adams) in a specimen (UMUT CB28070-16), collected from the Shichiba Formation at Shichiba. A: posterior view, B: oblique view, showing the long slender crura.

p. 160, pl. 2, figs. 24a, b; Hayasaka and Nomura, 1922, p. 30; Hayasaka, 1923, p. 117; Yokoyama, 1925, p. 22, pl. 1, fig. 7; Yokoyama, 1926a, p. 310; Yokoyama, 1926b, p. 379; Yokoyama, 1928, p. 354; Hayasaka, 1931a, p. 364; Hayasaka, 1931b, p. 1, pl. 2, figs. 2a, b; Stiasny, 1933, p. 135; Nagao and Sassa, 1934, p. 232; Hatai, 1936a, p. 66; Hatai, 1936b, p. 197; Hatai, 1936c, p. 6; Nomura and Hatai, 1936, p. 186; Hatai, 1937, p. 64; Saito, 2001, p. 438.

*Hemithiris psittacea* subsp. *woodwardi* (A. Adams): Hayasaka, 1932, p. 4, pl. 1, figs. 2a-c; pl. 2, figs. 2a, b; Hatai, 1940, p. 203, pl. 6, figs. 50, 51, 55-63, 68, 74-76.

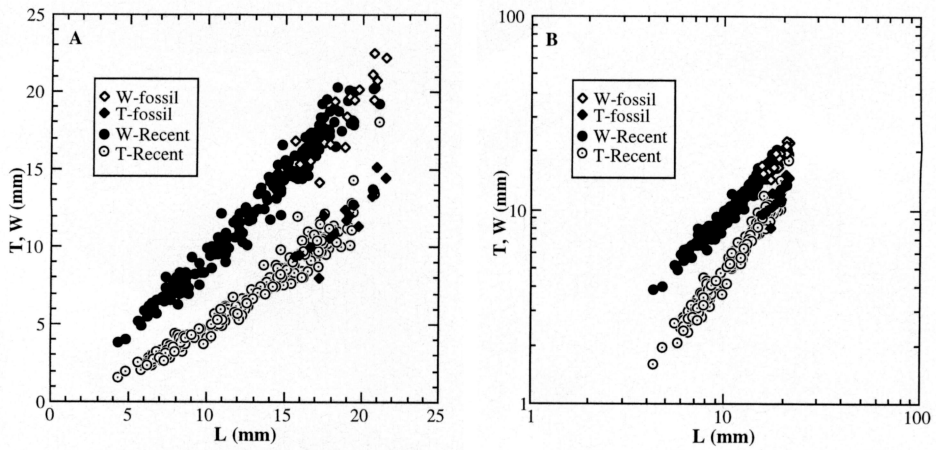
*Hemithiris psittacea* (Gmelin): Nomura and Hatai, 1934, p. 5, pl. 2, figs. 19-24; Hatai, 1940, p. 197, pl. 6, figs. 64-67, 77, 78 only.

*Hemithiris woodwardi* (A. Adams): Thomson, 1927, p. 151, Okada, 1930, p. 22; Cooper, 1959, p. 47, pl. 3, B; Zezina, 1976, p. 106; Zezina, 1985, p. 124.

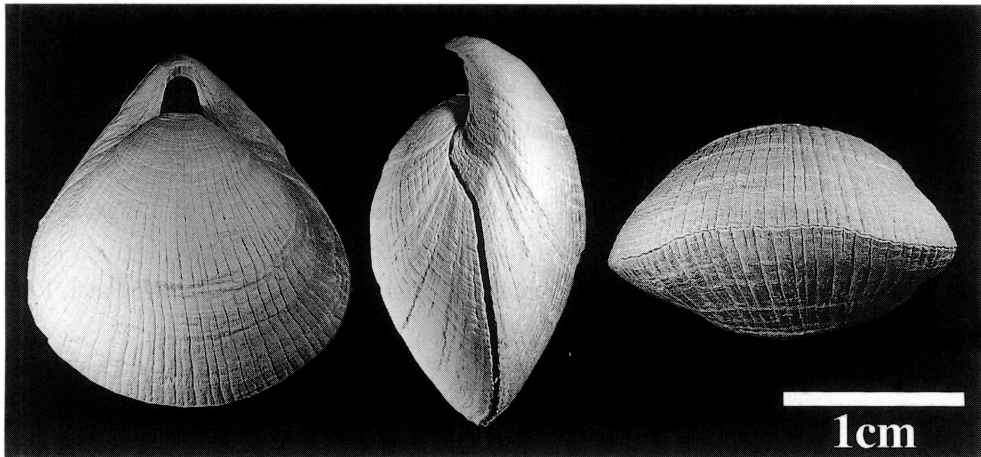
*Hemithiris woodwardi* (A. Adams): Ager, 1965, p. H623, figs. 508.1d, e.

*Hemithiris* sp. Saito, Kojima and Endo, 2000, figs. 4-6, table 1; Saito, Endo and Cohen, 2001, fig. 1, table 1.

*Material.*—Twenty-one specimens, from the Shichiba Formation at Schichiba, Sado Island: Sixteen conjunct specimens (UMUT CB28070-1 to -16), one conjunct but incomplete



**Fig. 4.** Shell measurement of the fossil specimens of *Hemithiris woodwardi* (A. Adams), collected from the Shichiba Formation at Shichiba (n=17, including the incomplete specimens), and of Recent specimens, collected from several localities around Japan (n=197). Scatter plots (A) and double logarithmic scatter plots (B) of shell length (L) versus maximum shell width (W) and thickness (T).



**Fig. 5.** A living specimen of *Hemithiris psittacea* (Gmelin), collected from off Abashiri, east Hokkaido (UMUT RB28072). Dorsal, lateral and anterior views from left to right.

specimen, lacking most part of the dorsal valve (UMUT CB28070-17), two ventral valves (UMUT CB28070-18, -19) and two dorsal valves (UMUT CB28070-20, -21).

*Diagnosis.*—*Hemithiris* with shell surface marked with very delicate, discontinuous and irregular radial striae.

*Description.*—Shell large in size, triangularly globose in outline, uniplicate, widest near middle of shell; length 21.60 mm, width 22.15 mm, thickness 14.45 mm in the largest specimen (UMUT CB28070-1). Both valves rather solid with very delicate, discontinuous and irregular radial striae and weak concentric growth lines. Beak long, suberect, hypothyriddid. Internally, ventral valve with disjunct deltidial plates; apical plate thick, elevated; dental plates vertical and strong. Dorsal valve interior with inconspicuous median ridge; crura long, curved, raduliform (UMUT CB28070-16; Fig. 3); no cardinal process and inner hinge plates.

*Comparison.*—The fossil specimens from Shichiba generally larger than Recent forms in size of the shell as can be seen from the scatter graphs for L/W and L/T (Fig. 4), but show similar linear trends of relative growth as in the living ones. *Hemithiris woodwardi* (A. Adams) was originally described by A. Adams in 1863 based on the Recent material from Rifunsiri (=Rishiri) and Gotto (=Goto Islands), Japan. This species is most similar to *Hemithiris psittacea* (Gmelin), which is widely distributed in the seas of the Northern Hemisphere, and has often been confused with the former. *H. woodwardi* is distinguished from *H. psittacea* by its much broad, triangular shell outline, absence of radial strong grooves or impressed lines on the shell surfaces, and possession of a smaller and less incurved beak. Fig. 5 shows a young living shell of *H. psittacea*, collected from off Abashiri, eastern Hokkaido, northern Japan, to show clearly the difference of shell ornamentation between these two species.

*Distribution.*—Upper Miocene: Taya Formation, Akita Prefecture. Pliocene: Daishaka Formation, Aomori Prefecture; Shigarami Formation, Nagano Prefecture; Nishiyama Formation, Niigata Prefecture. Pleistocene: Setana Formation, Hokkaido; Wakimoto and Shibikawa Formations, Akita Prefecture; Haizume and Shichiba Formations, Niigata Prefecture; Semata Formation, Chiba Prefecture; Miyata Formation, Kanagawa Prefecture. Recent: seas around Japan, Rifunsiri (=Rishiri), Gotto (=Goto Islands), coast of Hokkaido (for details, see Table 1), Mutsu Bay, off Shiriyazaki to Kinkazan, off Boso Peninsula, off Murotozaki in the Pacific Ocean side; coast of Noto Peninsula to Tsugaru Strait in the Japan Sea side; west coast of Kyushu, near Tsushima Islands and Goto Islands.

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