Enteletes gibbosus Chronic, 1949 (Permian Brachiopoda) from the Hachiman district, Mino Belt, Central Japan

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Abstract

Fifteen specimens of a brachiopod species *Enteletes gibbosus* Chronic, 1949, from the upper Lower- to lower Middle Permian (Yakhtashian to Kubergandian) limestone of the Hachiman district, Mino Belt, Central Japan, are described. This is the first description of Permian brachiopods from the Hachiman district.

Key words: *Enteletes gibbosus*, brachiopod, Permian, Hachiman district, Mino Belt, Central Japan

Introduction

A large limestone-chert-basalt block of about 1.5 km x 12 km, named and designated by Wakita (1984) as the Akuda Block in the Middle Jurassic melange of the Nabigawa Formation, is exposed in the Hachiman district, Mino Belt, Central Japan. Most of the Akuda Block consists of light grey to dark grey limestones of late Early Permian (Yakhtashian) to early Middle Permian (Kubergandian) in age (Horibo, 1990; Igo, 1996). Permian radiolarians (Horibo, 1990), fusulinaceans (Kanuma, 1958a, b; Igo, 1996), conodonts (Igo, 1981, 1989) and calcareous algae (Endo and Kanuma, 1954) have been described or listed from the limestone of the Akuda Block, but no brachiopods.

The purpose of this paper is to describe the specimens of a brachiopod species *Enteletes gibbosus* Chronic, 1949, collected by T. Ono of Hozumi-cho, Gifu Prefecture, from grey limestone of the Akuda Block, i.e., the Horikoshitoge Formation of Horibo (1990) at Higashiakuda, about 2.5 km SE of Hachiman-cho, Gujo-gun, Gifu Prefecture (Fig. 1). The brachiopod specimens are well preserved, and the internal structure of the shells can be studied by the transverse serial sections. All the specimens are housed in the Department of Geology, Faculty of Science, Niigata University.

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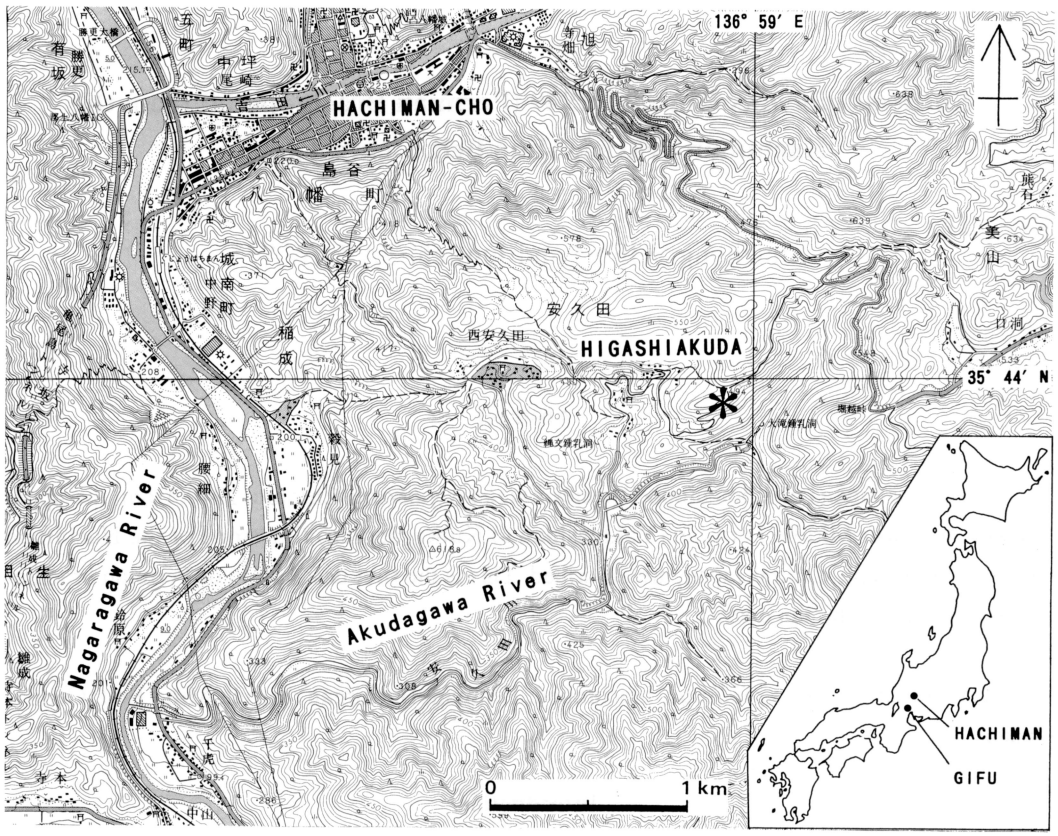

Fig. 1. Map showing the fossil locality (using the topographical map of "Gujohachiman" scale 1:25,000 published by Geographical Survey Institution of Japan)

Description of Species

Order Orthida Schuchert and Cooper, 1932

Superfamily Enteletoidea Waagen, 1884

Family Enteletidae Waagen, 1884

Genus *Enteletes* Fischer de Waldheim, 1825

Enteletes gibbosus Chronic, 1949

Figs. 2, 3.

1949 *Enteletes gibbosus* Chronic in Newell *et al.*, p. 97, pl. 16, figs. 9-14.

1953 *Enteletes gibbosus* Chronic: Chronic in Newell *et al.*, p. 92, pl. 16, figs. 9-14.

1966 *Enteletes gibbosus* Chronic: Hayasaka and Kato, p. 281, pl. 34, figs. 1-4; pl. 35, figs.14; text-figs. 1, 2.

1969 *Enteletes gibbosus* Chronic: Yanagida and Hirata, p. 96, pl. 11, figs. 12a-e.

1990 *Enteletes tschernyschewi* (sic) Diener: Liang, p. 362, pl. 5, figs. 1-16; pl. 7, figs. 1-15.

Material.–Fifteen conjoined valves, NU-B113-127.

Description.–Shell average size for genus; adults strongly unequally biconvex, globose, but juveniles moderately subequally biconvex in profile; subcircular to transversely elliptical in outline; greatest width at midvalve; hinge line shorter than half of shell width; anterior commissure strongly uniplicate and serrate.

Ventral valve less strongly convex than dorsal valve, gently convex in lateral profile, but strongly convex in anterior profile; maximum convexity at umbo; posterolateral slopes fairly steep in adults; flanks moderately inclined; sulcus originating at about 10 mm anterior to beak in mature specimens, deepening anteriorly, well defined by two boundary costae, and producing as sharply pointed tongue at anterior commissure; sulcal bottom broadly V-shaped.

Dorsal valve strongly convex in adults, maximum convexity at midvalve; beak fairly thick, strongly incurved and protruding slightly beyond hinge line; lateral slopes fairly sharp; fold developed in adults, originating just posterior to midvalve as a slightly elevated and rounded costa, and gradually becoming conspicuous and subangular anteriorly.

Surface costate and capillate in adults, but capillate in juveniles; costae originating at about midvalve, numbering 3-4 on each flank, becoming less strong laterally and having subangular crests; capillae very fine, regularly and evenly developed, numbering 6 per 1 mm on everywhere of the external surface of both valves, commonly 4-5 capillae separated and bounded by a coarser one in adults.

Ventral interior with strong, slightly convergent dental plates, supporting stout hinge teeth, becoming lower anteriorly, and extending to about one third of shell length; median septum occurring at delthyrial cavity, becoming higher anteriorly and having concave upper edge, coming to the point at front margin, then, directly plunging to valve floor. Dorsal interior with ridge-shaped cardinal process and strongly divergent brachiophore supporting plates (Figs. 2-15.6, 2-14.8, 2-14.4, 2-13.9).

Measurements in mm.–

Register no.	V. length	D. length	Width	Thickness
NU-B113	12.5	12.2	14.3	9.4
NU-B114	11.6	11.7	13.8	9.1
NU-B115	12.8	13.3	16.8	9.7
NU-B116	16.0	15.9	17.2	10.8
NU-B117	18.7	18.7	21.0	19.5
NU-B118	21.1	21.2	23.8	19.1
NU-B119	17.5	18.2	20.8	21.7
NU-B120	20.8	20.3	23.4	>18.4
NU-B121	16.2	17.5	20.5	15.0
NU-B122	18.0	19.5	21.5	17.2
NU-B123	18.1	20.6	23.9	>15.1
NU-B124	14.4	14.5	15.4	10.4
NU-B125	10.9	12.7	14.2	10.1
NU-B126	13.8	13.5	18.5	13.3
NU-B127	16.5	14.8	18.0	14.7

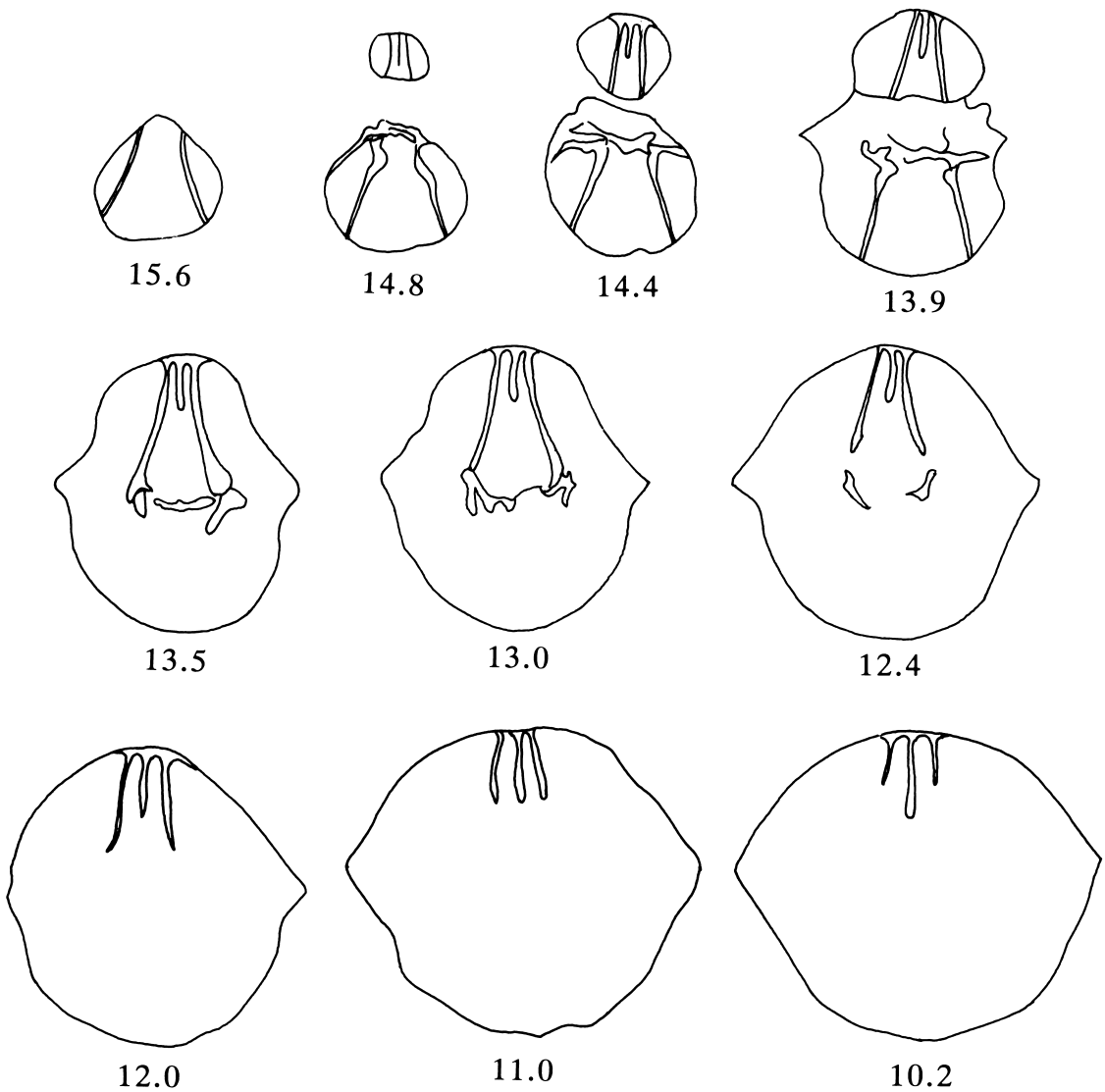

Fig. 2. Serial sections of *Enteletes gibbosus* Chronic, from the Hachiman district, NU-B127. Ventral valve on top, looking posteriorly. The Arabic numbers showing the distance in mm from the section to front margin. (All figures are X 3).

Remarks.–Enteletes gibbosus Chronic, 1949 evidently has a wide variation from juveniles to adults. The juveniles of this species have gently subequally biconvex and subelliptical shells, ornnamented with very fine numerous capillae, whereas the adults are characterized by their strongly and unequally biconvex profile and having several strong, subangular costae on the both valves. This species is most like *Enteletes kayseri* Waagen (1884, p. 553, text-figs. 13a-c), from the Wargal Formation of the Salt Range, in its outline, semicostate shell and 3-4 costae on each flank of the ventral valve, but the Salt Range species has smaller, less convex shell, with weaker costae and much wider fold and sulcus. *Enteletes dumblei* Girty (1908, p. 295, pl. 26, figs. 4-4b), from the Delaware Formation of the Diablo Mountains, West Texas, is somewhat similar to this

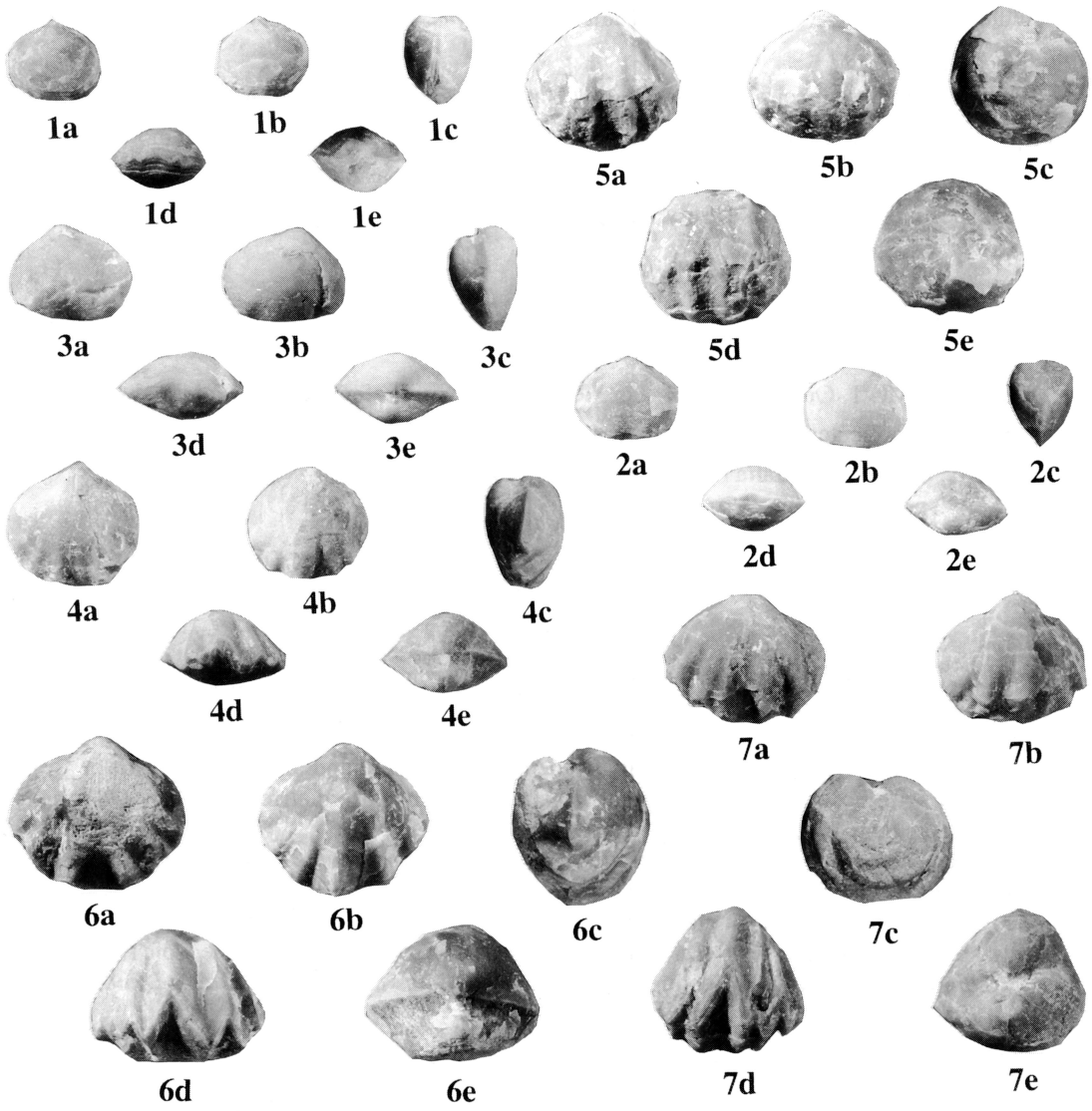

Fig. 3. *Enteletes gibbosus* Chronic, from the Hachiman district, 1-7: NU-B113-119; a, b, c, d, e: ventral, dorsal, anterior, and posterior views. (All figures are natural size).

species in its size and outline, but the costae of the Texan species usually occur much earlier and the hinge line is fairly wide. *E. gibbosus* is also very close to *Enteletes liumbonus* King (1930, p. 46, pl. 2, figs. 9-11; pl. 3, figs. 1-2), from the Hess Formation of the Glass Mountains and the Gym Formation of the Hueco Mountains, West Texas, in its size, outline and semicostate shell, but the former is distinguished from the latter by its stronger biconvex shell, much deeper ventral sulcus and higher dorsal fold.

Liang (1990, p. 362, pl. 5, figs. 1-16; pl. 7, figs. 1-15) described and figured many specimens from the Lengwu Formation of Zhejiang, South China as *Enteletes tschernyschewi* (sic) Diener, 1897. However, as he noted (Liang, 1990, p. 363), the Chinese specimens differ from the type

specimen of *Enteletes tschernyscheffi* Diener (1897, p. 67, pl. 5, figs. 7-10, non fig. 11), from the Middle Permian of Chitichun No. 1, Kumaon Himalayas, in its relatively late costation as for *Enteletes gibbosus*.

The Miharanoro specimens described by Hayasaka and Kato (1966) are basically identical with the type specimen in size, outline and convexity, but seemingly have wider and more roundly-crested costae. The Nakakuko specimens described by Yanagida and Hirata (1969) agree with our mature specimen (Figs. 3–7a-e) very well.

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References

Diener, C., 1897, Himalayan fossils, Vol. 1, Pt. 3. The Permocarboniferous fauna of Chitichun, No. 1. *Palaeont. Indica, Ser. 15*, **1**, 1-105.

Endo, R. and Kanuma, M., 1954, Stratigraphical and paleontological studies of the later Paleozoic calcareous algae in Japan, 7. Geology of the Mino Mountainland and southern part of Hida Plateau, with descriptions of the algal remains found in those districts. *Sci. Rep., Saitama Univ., Ser. B*, **1**, 177-208.

Fischer de Waldheim, G., 1825, *Notice sur la Choristite: Programme d'invitation à la Société Impériale des Naturalistes de Moscou.* Moskva, 12p.

Girty, G.H., 1908, The Guadalupian Fauna. *U. S. Geol. Surv., Prof. Pap.*, **58**, 1-651.

Hayasaka, I. and Kato, M., 1966, On *Enteletes gibbosus* Chronic (An Upper Palaeozoic fauna from Miharanoro, Hiroshima Prefecture, Japan, 3rd note). *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, **13**, 281-286.

Horibo, K., 1990, Petrography and depositional environment of Permian limestone of Mino terrane, Gujo-Hachiman, Gifu Prefecture, central Japan. *Jour. Geol. Soc. Japan*, **96**, 437-451. (In Japanese).

Igo, Hh., 1981, Permian conodont biostratigraphy of Japan. *Palaeont. Soc. Japan, Spec. Pap.*, no. 24, 1-50.

Igo, Hh., 1989, Mixed conodont elements from Hachiman Town, Mino Terrane, central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, no. 156, 270-285.

Igo, Hh., 1996, Permian fusulinaceans from the Akuda and Horikoshitoge Formations, Hachiman town, Gifu Prefecture, Central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, no. 184, 623-650.

Kanuma, M., 1958a, Stratigraphical and paleontological studies of the southern part of the Hida Plateau and the north-eastern part of the Mino Mountainland. *Jub. Pub. Commem. Prof. H. Fujimoto*, 1-48.

Kanuma, M., 1958b, Stratigraphical and paleontological studies of the southern part of the Hida Plateau and north-eastern part of the Mino Mountainland, Pt. 2. Paleontology. *Bull. Tokyo Gakugei Univ.*, **9**, 27-57.

King, R.E., 1930, The Geology of the Glass Mountains, Texas, Pt. 2. Faunal summary and correlation of the Permian formations with description of Brachiopoda. *Univ. Texas, Bull.*, no. 3042, 1-245.

Liang, W., 1990, Lengwu Formation of Permian and its brachiopod fauna in Zhejiang Province. *Geol. Mem., Min. Geol. Min. Res., P. R. China, Ser. 2*, no. 10, 1-522. (In Chinese).

Newell, N.D., Chronic, J. and Roberts, T.G., 1949, *Upper Paleozoic of Peru*. Columbia University, New York, 241p.

Newell, N.D., Chronic, J. and Roberts, T.G., 1953, Upper Paleozoic of Peru. *Geol. Soc. Amer., Mem.*, **58**, 1-276.

Schuchert, C. and Cooper, G.A., 1932, Brachiopod genera of the suborders Orthoidea and Pentameroidea. *Peabody Mus. Nat. Hist., Mem.*, **4**, 1-270.

Waagen, W., 1884, Salt Range fossils. 1. Productus-Limestone fossils. *Palaeont. Indica, Ser.13*, **1**, 547- 610.

Wakita, K., 1984, *Geology of the Hachiman district*. Quadrangle series, scale 1:50,000, Geol. Surv. Japan, 90p. (In Japanese).

Yanagida, J. and Hirata, M., 1969, Lower Permian brachiopods from Nakakubo, west-central Shikoku, Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, no. 73, 89-111.