Aulacocerid coleoids from the Triassic of the South Kitakami Belt, Northeast Japan

Bull. Tohoku Univ. Museum, No. 17, pp. 1–8, 2018

Aulacocerid coleoids from the Triassic of the South Kitakami Belt, Northeast Japan

Shuji Niko and Masayuki Ehiro***

** Department of Environmental Studies, Faculty of Integrated Arts and Sciences, Hiroshima University, Higashihiroshima 739-8521, Japan, ** The Tohoku University Museum, Sendai 980-8578, Japan*

Abstract: Three species of aulacocerid coleoids from the South Kitakami Belt of Northeast Japan deal herein. *Miyagiteuthis* gen. nov. is proposed for a Norian (Late Triassic) aulacoceratid species *Dictyoconites nipponicus* Shimizu and Mabuti, 1941, by taxonomic revisions of the original material and newly collected topotypes. The original two specimens of a Ladinian (Middle Triassic) xiphoteuthidid species *Atractites hatai* Bando, 1963, are revised and assigned this species to *Choanoteuthis*. A new xiphoteuthidid species *Calliconites*? *shimizui* is described from the Olenekian (Early Triassic) mudstones of the Osawa Formation in the Utatsu area.

Introduction

Aulacocerida is an order of coleoid cephalopods characterized by the possession of aragonitic rostrum, longiconic phragmocone with relatively low expansion angle, long body chamber and prochoanitic (or achoanitic in specialized taxa) in adult septal necks, and the absence of proostracum and hyperbolar zone. It comprises three families, namely Aulacoceratidae, Dictyoconitidae, and Xiphoteuthididae (Jeletzky, 1966; Keupp and Fuchs, 2014). Although aulacocerids occur widely in the Upper Permian to the Upper Jurassic strata in the Tethyan region (Doyle, 1990), reports in Japan are scarce and restricted in the Triassic of the South Kitakami Belt. Previously only two species have been known. The first aulacocerid species from the area described by Shimizu and Mabuti (1941), who reported *Dictyoconites nipponicus* on the basis of specimens collected from the early Norian (Late Triassic) sandstones of the Chonomori Formation, Saragai Group at the Niranohama locality (38° 41’ 26’’ N, 141° 30’ 11’’ E; loc. A in Figure 1), western coast of Niranohama in the Hosoura area, Minamisanriku Town, Miyagi Prefecture. Subsequently, Bando (1963) described *Atractites hatai* from the early Ladinian (Middle Triassic) sandy mudstones of the Rifu Formation. Collecting site of the type specimens of *A. hatai* is a quarry (38° 21’ N, 141° 2’ E, the second time scales unknown because detailed documentations about collecting site did not note in an original designation and this quarry has a span of ca. 0.7 km; loc. B in Figure 1) in the Rifu area, Rifu Town, Miyagi Prefecture. The main objectives of this contribution are to revise their taxonomic position. In addition, we describe *Calliconites*? *shimizui* sp. nov. to further knowledge of the aulacocerid fauna of the South Kitakami Belt. The new species is recovered from the late Olenekian (Early Triassic) laminated mudstones of the Osawa Formation at the Tatezaki locality (38° 42’ 50’’ N, 141° 32’ 07’’ E; loc. C in Figure 1; see Ehiro et al., 2015, 2016 for its stratigraphy and fauna) in the Utatsu area, Minamisanriku Town, Miyagi Prefecture.

Abbreviation: IGPS (Institute of Geology and Paleontology, Faculty of Science, Tohoku University, Sendai; kept in the Tohoku University Museum).

Systematic Paleontology

Subclass Coleoidea Bather, 1888
Order Aulacocerida Stolley, 1919
Family Aulacoceratidae Mojsisovics, 1882
Genus ***Miyagiteuthis*** gen. nov.

Type species.—*Dictyoconites nipponicus* Shimizu and Mabuti, 1941, by monotypy.

Diagnosis.—Aulacoceratid genus with cylindriconical rostrum having strongly compressed panduriform to sub-elliptical cross sections and well-developed pared dorsolateral depressions in apical and stem regions; dorsal part of rostrum forms protrusion having fan-shaped cross section; surface ribs coarse.

Etymology.—The generic name is combination of prefecture of the type locality, named Miyagi, and a suffix *teuthis* meaning squid.

Discussion.—*Miyagiteuthis* gen. nov. resembles a Late

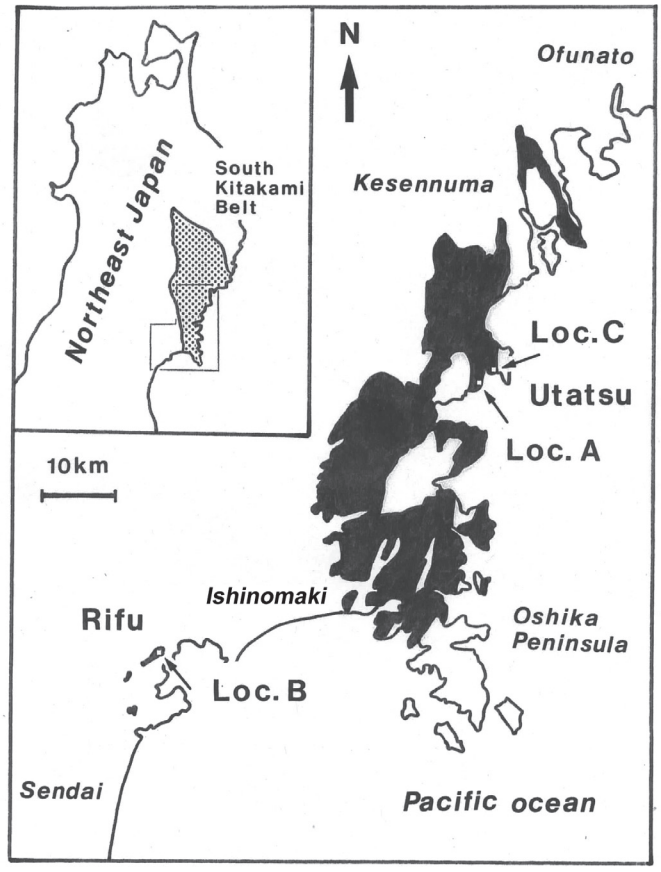


Figure 1. Map of southern part of the South Kitakami Belt from which aulacocerids were collected. Black areas represent distributions of Triassic sedimentary rocks.

Triassic genus *Aulacoceras* Hauer (1860; type species, *A. sulcatum* Hauer, 1860) that was an only representative of the family. However, strongly compressed rostrum at the apical and stem regions with panduriform to sub-elliptical cross sections of the new genus is the most distinctive feature from *Aulacoceras*, whose cross sections of rostrum are invaluably subcircular. Laterally compressed rostra are common features in the more primitive genera (such as *Calliconites* Gemmellaro, 1904, and *Metabelemnites* Flower, 1944) belonging to the family Xiphoteuthididae. *Miyagiteuthis* may be an ancestor of *Aulacoceras*.

Two dictyoconitid genera *Prographularia* Frech (1890; type species, *P. triadica* Frech, 1890) and *Dictyoconites* Mojsisovics (1902; type species, *Orthoceras reticulatum* Hauer, 1847) are easily separated from *Miyagiteuthis* by their significantly finer ribs. This difference warrants a familial assignment of *Miyagiteuthis*.

Miyagiteuthis nipponica (Shimizu and Mabuti, 1941)
Figures 2.1–2.12

Dictyoconites sp. nov., Shimizu and Mabuti, 1932, p. 314; Inai, 1939, p. 237.

Dictyoconites nipponicus Shimizu and Mabuti, 1941, p. 923–925, pl. 48, figs. 1, 2, 3a, b, 4a, b, 5a, b, 6, 7a–c, 8, pl. 49, figs. 1–7; Ichikawa, 1951, p. 19; Onuki and Bando, 1958, p. 488; Bando, 1964, p. 12; Nakazawa, 1964a, p. 23; Nakazawa, 1964b, p. 524.

Dictyoconites japonicus [sic]. Ando, 1986, p. 41; Kamada, 1993, p. 36.

Prographularia nipponica. Doyle, 1990, p. 269.

Diagnosis.—As for the genus.

Description.—Rostrum cylindriconical, large, more than 132 mm in length and 25 mm in diameter; a distinct transverse constriction may develop at alveolar region; in apical to stem regions cross sections of rostrum are panduriform to sub-elliptical with strong lateral compression and a well-developed dorsolateral depression with bilateral distribution,

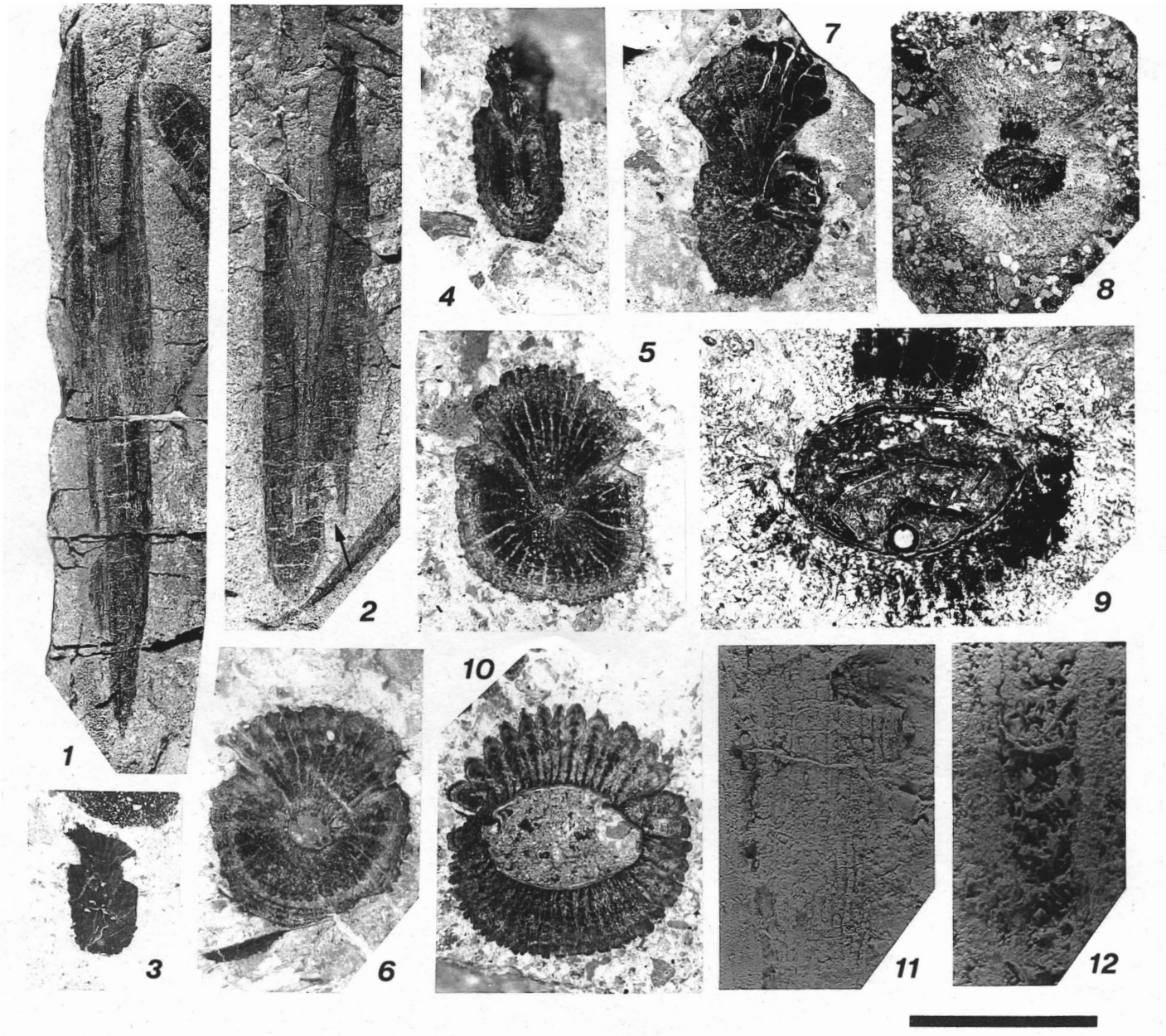


Figure 2. *Miyagiteuthis nipponica* (Shimizu and Mabuti, 1941). **1.** Lectotype, IGPS coll. cat. no. 49600-1, longitudinal section of rostrum, weathered surface. **2.** Paralectotype, IGPS coll. cat. no. 49600-2, dorsoventral section of rostrum, weathered surface, venter on left, arrow indicates dorsolateral depression. **3.** Paralectotype, IGPS coll. cat. no. 49600-34, cross section at apical region of rostrum, polished surface, venter down. **4.** Topotype, IGPS coll. cat. no. 111755, cross section at stem region of rostrum, polished surface, venter down. **5, 10.** Paralectotype, IGPS coll. cat. no. 49600-41, alveolar region of rostrum: 5, cross polished section at apical end, polished surface, venter down; 10, cross section at adoral end, polished surface, venter down. **6.** Topotype, IGPS coll. cat. no. 111753, cross section at alveolar region of rostrum, polished surface, venter down. **7.** Paralectotype, IGPS coll. cat. no. 49600-18, cross section at stem region of rostrum, polished surface, venter down. **8, 9.** Paralectotype, IGPS coll. cat. no. 49600-47, alveolar region of rostrum: 8, cross thin section, venter down; 9, partial enlargement of Figure 2.8 to show details of siphuncle. **11.** Paralectotype, IGPS coll. cat. no. 49600-11, external view of rostrum, silicon rubber replica, coated by ammonium chloride. **12.** Paralectotype, IGPS coll. cat. no. 49600-16, longitudinal section of phragmocone, weathered surface, coated by ammonium chloride. Scale bar is 30 mm in Figures 2.1, 2.2; 10 mm in Figures 2.3–2.8, 2.10, 2.11; 3 mm in Figure 2.9; 5 mm in Figure 2.12.

then they shift to subcircular and depressions become diminished in their width and depth in alveolar region; dorsal part defined by dorsolateral depressions forms protrusion having fan-shaped cross section; surface of rostrum marked by coarse longitudinal ribs and narrow furrows; no apex of rostrum and body chamber preserved. Alveolus cylindrical with approximately 10° in dorsoventral section, dorsoventrally depressed cross sections and dorsolateral grooves; length of alveolus is less than half of total robustum length. Phragmocone is not well preserved, but relatively long camerae with deep and adapically concaved septa and marginal siphuncle are discernible; wall of siphuncle probably contact with ventral wall of phragmocone.

Material examined.—In the original description of this species by Shimizu and Mabuti (1941), no holotype was designated. Subsequent authors also have not designate a lectotype. Therefore, we designate IGPS coll. no. 49600-1 as the lectotype, and forty-six specimens 49600-2–47 become the paralectotypes. In addition, thirteen newly collected specimens (topotypes), IGPS coll. cat. no. 111745–111757, from the type locality were also examined.

Occurrence.—Early Norian, the Chonomori Formation, Northeast Japan.

Family Xiphoteuthididae Naef, 1922
Genus ***Calliconites*** Gemmellaro, 1904
Type species.—*Calliconites dieneri* Gemmellaro, 1904.

Calliconites*? *shimizui sp. nov.
Figure 3.1–3.7

Diagnosis.—Rostrum asymmetrical subhastate in profile, and cylindriconical in outline; cross sections of rostrum laterally compressed elliptical; surface of rostrum marked by ventral and lateral grooves.

Description.—Two external molds of imperfect rostra are available for study; they relatively small, respectively 39 mm (holotype) and 33 mm (paratype) in length; profile of rostrum asymmetrical subhastate and outline cylindriconical; apex slightly displaced toward dorsum; cross sections of rostra are elliptical having lateral compression; form ratios (lateral diameter/dorsoventral diameter) of rostrum are approximately 0.7; the most inflated part of rostrum in the holotype is 5 mm in dorsoventral diameter; surface of rostrum is smooth, except for three grooves consisting of a distinct median ventral groove and a very shallow lateral groove on each flank. Internal structure unknown.

Material examined.—Holotype, IGPS coll. cat. no. 111759. Paratype, IGPS coll. cat. no. 111758.

Occurrence.—Late Olenekian, the Osawa Formation, Northeast Japan.

Etymology.—The specific name honors the late Dr. Saburo Shimizu, in recognition of his early work of aulacocerids from the South Kitakami Belt.

Discussion.—Its general rostrum shape of this species suggests affinity with *Calliconites*, but the presence of a ventral groove deviates the diagnosis of the genus. In addition, grooves on each flank of *Calliconites* occur at the ventrolateral and dorsolateral positions forming a pair. A lateral groove on each flank is also diagnostic character in *Atractites* Gümbel (1861; type species, *A. alpinus* Gümbel, 1861), but the rostrum of the genus is extremely narrow-waisted and circular to subcircular in cross sections. The generic assignment is indicated with question, because no internal structure is preserved in the type specimens. *Calliconites*? *shimizui* sp. nov. represents the first Early Triassic and oldest records of aulacocerids in Japan.

Genus ***Choanoteuthis*** Fisher, 1951
Type species.—*Choanoteuthis milleri* Fisher, 1951.

Choanoteuthis hatai (Bando, 1963)
Figures 4.1–4.9

Atractites hatai Bando, 1963, p. 48, 49, pl. 8, figs. 1–6.

Description.—The original two specimens represent imperfect stem and alveolar regions of rostrum that is nearly cylindrical with a shallow transverse constriction near junction of these regions; no apical region preserved; cross sections of rostra are elliptical indicating slight lateral compression in stem region and nearly circular in alveolar region; adoral end of alveolar region in a larger specimen (lectotype, see below, IGPS coll. cat. no. 79170-1) is 18 mm in diameter; surface of rostrum is smooth lacking groove; no apical part of rostrum and body chamber preserved. Alveolus very deep, more than 32 mm in depth. Phragmocone orthoconic with expansion angle of approximately 10° in dorsoventral section and nearly circular to slightly compressed cross sections; septa deep, concave adapically; septal spacing relatively wide; there are 2–4 camerae in corresponding phragmocone diameter; siphuncular position is close to ventral margin; ventral septal necks retrochoanitic and straight (holoochoanitic?); dorsal septal necks bifurcate into prochoanitic and retrochoanitic parts, the latter of which recurved (cyrtochoanitic); connecting rings thickened and cylindrical.

Material examined.—In Bando's (1963) original description of this species, he did not designated a holotype. Therefore, we designate IGPS coll. cat. no. 79170-1 as the lectotype and, a specimen 79170-2 becomes the paralectotype.

Occurrence.—Early Ladinian, the Rifu Formation, Northeast Japan.

Discussion.—Although Bando (1963) assigned this species

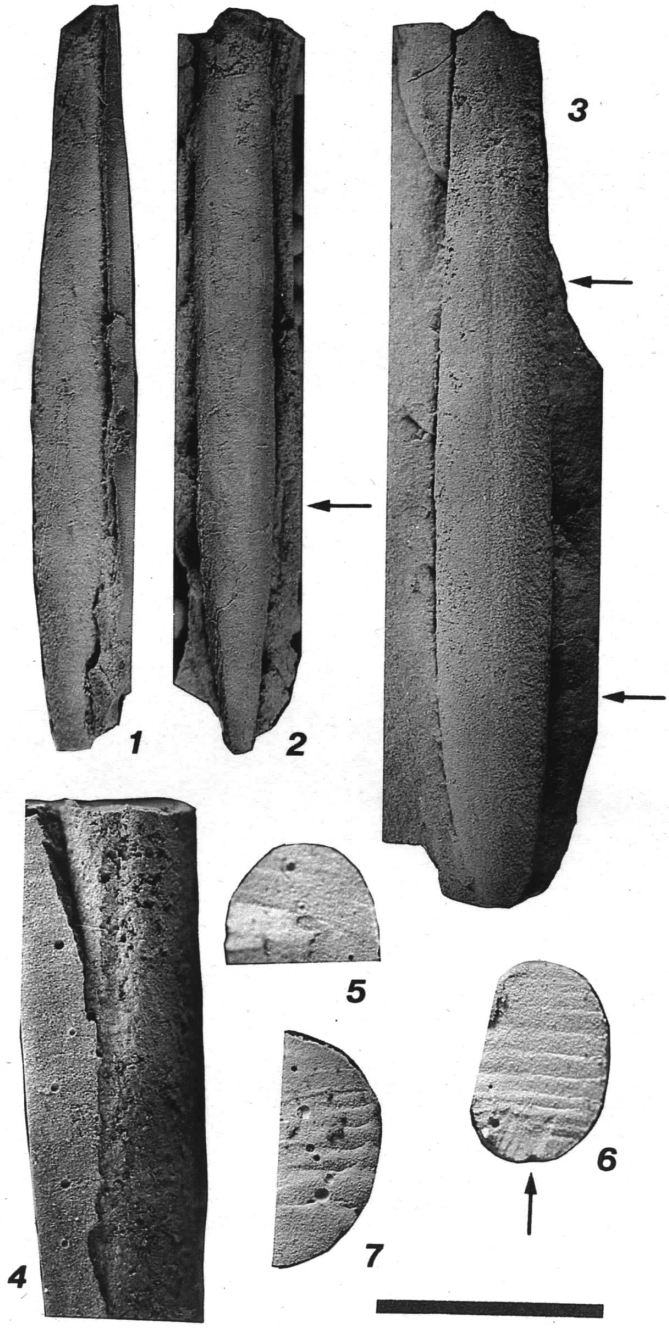
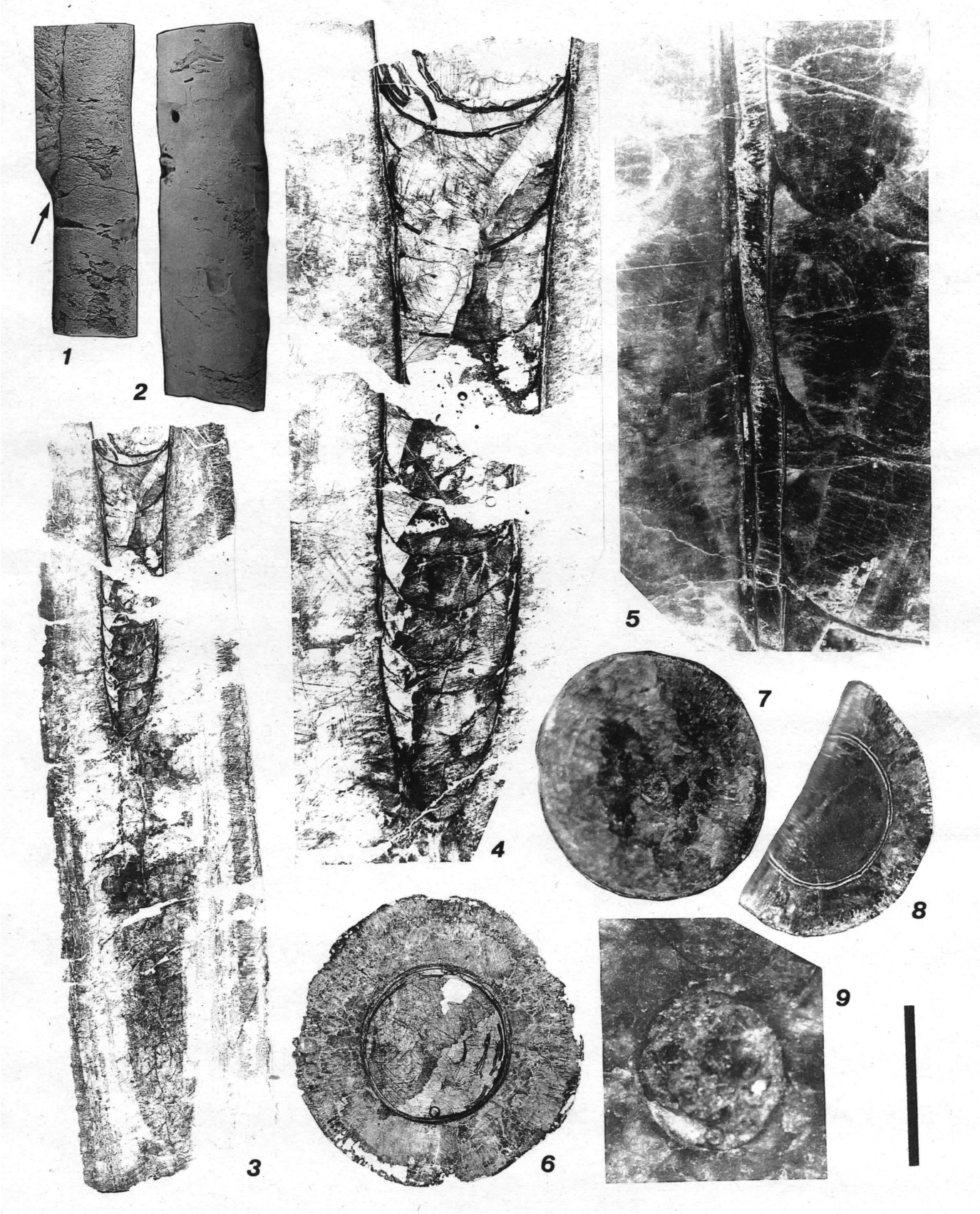


Figure 3. *Calliconites*? *shimizui* sp. nov. **1, 2, 5.** Paratype, IGPS coll. cat. no. 111758, silicon rubber replica of rostrum, coated by ammonium chloride: 1, lateral view, venter on right; 2, dorsal view, arrow indicates position of Figure 3.5; 5, cross section, venter down. **3, 4, 6, 7.** Holotype, IGPS coll. cat. no. 111759, silicon rubber replica of rostrum, coated by ammonium chloride: 3, lateral view, venter on left, upper and lower arrows indicate positions of respectively Figure 3.6 and 3.7; 4, ventral view; 6, cross section, venter down, arrow indicates ventral groove; 7, cross section, venter down. Scale bar is 10 mm in Figures 3.1–3.3; 5 mm in Figures 3.4–3.7.


1
2
3
4
5
6
7
8
9

to *Atractites*, it is removed from the genus and placed in *Choanoteuthis* from the following morphological respects: nearly cylindrical shape in the stem and alveolar regions of rostrum that does not exhibit extremely narrow-waist; very deep rather than shallow alveolus; and the absence of lateral grooves. *Choanoteuthis milleri* Fisher (1951, p. 387, 388, 390, pl. 1, figs. 1-3, pl. 2, figs. 1, 2, text-fig. 1) from the Norian of Nevada differs from *C. hatai* by its more longer camerae. Mariotti and Pignatti (1992) advocated a new genus, *Crassiatractites*, based on *Atractites crassirostris* Hauer, 1888, whose species occurs from the Anisian to Ladinian of Bosnia, Albania and Austria, and has similar features with *C. hatai* except for its conical stem region of rostrum. There is a possibility that *Crassiatractites* is a junior subjective synonym of *Choanoteuthis*.

Acknowledgements

We are grateful to Dr. Jun Nemoto for assistance in examining the original type series. We thank the Educational Committee of Minamisanriku Town and Abei-Gumi Co. Ltd. for permissions to excavate fossiliferous beds at the Tatezaki locality. The manuscript has been improved by an anonymous reviewer for which we are also appreciative.

References

Ando, H., 1986, On the Upper Triassic Saragai Group in the Utatsu area of Miyagi Prefecture, Northeast Japan. *The Scientific Researches, Biology・Geology, The School of Education, Waseda University*, no. 35, p. 35–49. (in Japanese with English abstract)

Bando, Y., 1963, A dibranchiate cephalopod from the Rifu Formation (Triassic) near Hamada, Shiogama City, Miyagi Prefecture, Japan. *Transactions and Proceedings of the Palaeontological Society of Japan, New Series*, no. 50, p. 46–50, pl. 8.

Bando, Y., 1964, The Triassic stratigraphy and ammonite fauna of Japan. *Science Reports of the Tohoku University, Second Series*, vol. 36, p. 1–137, pls. 1–15.

Bather, F. A., 1888, Professor Blake and shell-growth in Cephalopoda. *The Annals and Magazine of Natural History*, Sixth Series, vol. 1, p. 421–427.

Doyle, P., 1990, The biogeography of the Aulacocerida (Coleoidea). *In*, Pallini, G. et al., (eds.), *Atti del Secondo Convegno Internazionale*, *Fossili, Evoluzione*, *Ambiente*, p. 263–271. Editore Comitato Centenario Raffaele Piccinini, Pergola.

Ehiro, M., Sasaki, O., Kano, H., Nemoto, J. and Kato, H., 2015, Thylacocephala (Arthropoda) from the Lower Triassic of the South Kitakami Belt, Northeast Japan. *Paleontological Research*, vol. 19, p. 269–281.

Ehiro, M., Sasaki, O. and Kano, H., 2016, Ammonoid fauna of the upper Olenekian Osawa Formation in the Utatsu area, South Kitakami Belt, Northeast Japan. *Paleontological Research*, vol. 20, p. 90–104.

Fisher, A. G., 1951, A new belemnoid from the Triassic of Nevada. *American Journal of Science*, vol. 249, p. 385–393.

Flower, R. H., 1944, *Atractites* and related coleoid cephalopods. *The American Midland Naturalist*, vol. 32, p. 756–770.

Frech, F., 1890, Die Korallenfauna der Trias. *Palaeontographica*, vol. 37, p. 1–116, pls. 1–21.

Gemmellaro, G. G., 1904, I cefalopodi del Trias superiore della regione occidentale della Sicillia. *Giornale di Scienze Naturali ed Economiche, Palermo*, vol. 24, p. 1–319, pls. 1–30.

Gümbel, C. W., 1861, *Geognostische Beschreibung des Bayerischen Alpengebirges und Seines Vorlandes*, 950 p. Justus Perthes, Gotha.

Hauer, F. R. von, 1847, Neue Cephalopoden aus dem rothen Marmor von Aussee. *Naturwissenschaftliche Abhandlungen,* vol.1, p. 257–277, pls. 7–9.

Hauer, F. R. von, 1860, Nachträge zur Kenntniss der Cephalopoden-Fauna der Hallstätter Schichten. *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche*, vol. 41, p. 113–150, pls. 1–5.

Hauer, F. R. von, 1888, Die Cephalopoden des Bosnischen Muschelkalkes von Han Bulog bei Sarajevo. *Denkschriften der Kaiserlichen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Classe*, vol. 54, p. 1–50, pls. 1–8.

Ichikawa, K., 1951, Triassic System in the southern Kitakami Mountainland. *Geological Survey of Japan, Special Report*, p. 7–23. (in Japanese)

Inai, Y., 1939, Geology of the environs of Shizugawa-machi, Miyagi Prefecture. *Journal of the Geological Society of Japan*, vol. 46, p. 231–242. (in Japanese)

Jeletzky, J. A., 1966, Comparative morphology, phylogeny, and classification of fossil Coleoidea. *The University of Kansas Paleontological Contributions*, *Mollusca*, *Article 7*, p. 1–162.

Kamada, K., 1993, *Geology of the Tsuya District: With Geological Sheet Map at 1:50,000*, 70 p. Geological Survey of Japan, Tsukuba. (in Japanese with English abstract)

Keupp, H. and Fuchs, D., 2014, Different regeneration mechanisms in the rostra of aulacocerids (Coleoidea) and their phylogenetic implications. *Göttingen Contributions to Geosciences*, vol. 77, p. 13–20.

Mariotti, N. and Pignatti, J. S., 1992, Systematic remarks on *Atractites*-like coleoid cephalopods: *Crassiatractites* gen. nov., *Breviatractites* gen. nov. *Paleopelagos*, vol. 2, p. 109–141.

Mojsisovics, E. von, 1882, Die Cephalopoden der Mediterranen

←

Figure 4. *Choanoteuthis hatai* (Bando, 1963). **1, 7–9.** Paralectotype, IGPS coll. cat. no. 79170-2, stem and alveolar regions of rostrum: 1, ventral view, arrow indicates position of Figures 4.7, 4.9, coated by ammonium chloride; 7, cross section at alveolar region, fracture surface, venter down; 8, cross section near adoral end, polished surface, venter down; 9, partial enlargement of Figure 4.7 to show cross section of phragmocone. **2–6.** Lectotype, IGPS coll. cat. no. 79170-1, stem and alveolar regions of rostrum: 2, lateral view, venter on right, coated by ammonium chloride; 3, longitudinal thin section; 4, partial enlargement of Figure 4.3 to show details of phragmocone; 5, dorsoventral section, polished surface, showing structure of siphuncle, venter on left; 6, cross thin section at alveolar region, venter down. Scale bar is 30 mm in Figures 4.1, 4.2; 15 mm in Figure 4.3; 6 mm in Figure 4.4; 3 mm in Figure 4.5; 10 mm in Figures 4.6–4.8; 2 mm in Figure 4.9.

Triasprovinz. *Abhandlungen der Kaiserlich-Königlichen Geologischen Reichsanstalt*, vol. 10, p. 1–322, pls. 1–94.

Mojsisovics, E. von, 1902, Das Gebirge um Hallstatt. I. Abtheilung. Die Cephalopoden der Hallstätter Kalke. I. Dibranchiata. *Abhandlungen der Kaiserlich-Königlichen Geologischen Reichsanstalt, Supplement*, vol. 6, p. 177–199, pls. 13–16, 20, 21, 23.

Naef, A., 1922, *Die Fossilien Tintenfishe*, 322 p., Gustav Fisher, Jena.

Nakazawa, K.,1964a, On the *Monotis typica* zone in Japan. *Memoirs of the College of Science, University of Kyoto, Series B*, vol. 30, p. 21–39, pls. 3–5.

Nakazawa, K., 1964b, On the Upper Triassic *Monotis* beds, especially, on the *Monotis typica* zone. *Journal of the Geological Society of Japan*, vol. 70, p. 523–535. (in Japanese with English abstract)

Onuki Y. and Bando, Y., 1958, On the Saragai Group of the Upper Triassic System. *Journal of the Geological Society of Japan*, vol. 64, p. 481–493. (in Japanese with English abstract)

Shimizu, S. and Mabuti, S., 1932, The Upper Triassic beds of the Kitakami Mountainland. *Journal of the Geological Society of Tokyo*, vol. 29, p. 313–317. (in Japanese)

Shimizu, S. and Mabuti, S., 1941, First discovery of *Dictyoconites* from the Upper Triassic of the Kitakami Mountainland, Northeast Japan. *Jubilee Publication in the Commemoration of Professor H. Yabe, M. I. A. Sixtieth Birthday*, vol. 2, p. 919–925, pls. 48, 49.

Stolley, E., 1919, Die Systematik der Belemniten. *Jahresberichte des Niedersächsischen Geologischen Vereins*, vol. 11, p. 1–59.