Additional brachiopod species from the upper Permian (Changhsingian) of Nabekoshiyama in the Kesennuma area, South Kitakami Belt, northeast Japan

Jun-ichi TAZAWA and Hideo ARAKI

SCIENCE REPORTS OF NIIGATA UNIVERSITY (GEOLOGY)
No. 29 (2014)

Published by
The Department of Geology, Faculty of Science
Niigata University, Niigata, Japan
31 March 2014

Additional brachiopod species from the upper Permian (Changhsingian) of Nabekoshiyama in the Kesennuma area, South Kitakami Belt, northeast Japan

Jun-ichi TAZAWA* and Hideo ARAKI**

Abstract

Four brachiopod spesies, *Edriosteges* sp. A, *Oldhamina ehiroi* (Tazawa in Tazawa and Miyake, 2011), *Meekella* sp. and *Attenuatella bandoi* Tazawa, 1987 are described as additional species of the Nabekoshiyama fauna from the Nabekoshiyama Formation (Changhsingian) of Nabekoshiyama in the Kesennuma area, South Kitakami Belt, northeastern Japan. Among the newly described species, *Attenuatella bandoi* is an antitropical element, and *Oldhamina ehiroi* and *Meekella* sp. are tropical elements. Therefore, the additional brachiopods indicate that the Nabekoshiyama fauna is a mixed Boreal–Tethyan fauna in the Changhsingian.

Key words: brachiopod, Changhsingian, mixed Boreal–Tethyan fauna, Nabekoshiyama, palaeobiogeography.

Introduction

This paper is the third report for Changhsingian brachiopod fauna of Nabekoshiyama (around Mt. Nabekoshiyama), Kesennuma area (Fig. 1), southern Kitakami Mountains (South Kitakami Belt), northeastern Japan. The present paper describes four species newly found from the Nabekoshiyama Formation in Nabekoshiyama: *Edriosteges* sp. A, *Oldhamina ehiroi* (Tazawa in Tazawa and Miyake, 2011), *Meekella* sp. and *Attenuatella bandoi* Tazawa, 1987. The brachiopod specimens described herein were prepared by the second author (H.A.); and they are now registered and housed in the Kesennuma Board of Education, Kesennuma City, Miyagi Prefecture.

* Hamaura-cho 1–260–1, Chuo-ku, Niigata 951-8151, Japan
** Ota 2–6–105, Kesennuma 988-0082, Japan
(Manuscript received 18 December, 2013; accepted 5 March, 2014)

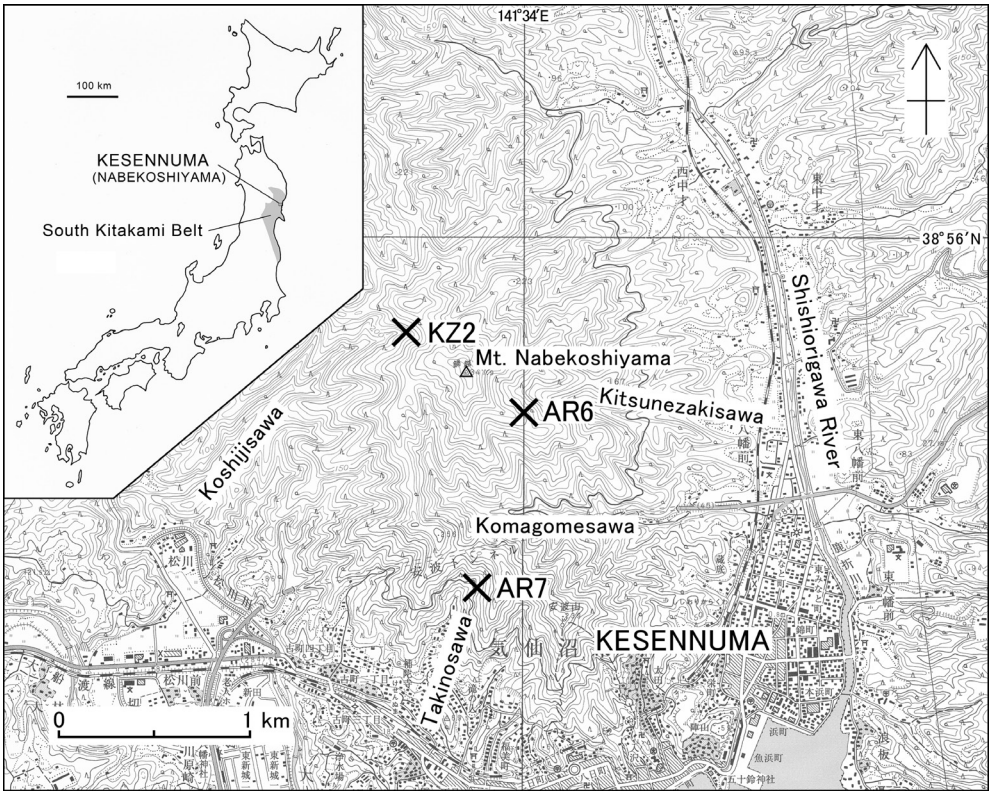

Fig. 1. Map showing the fossil localities AR6, AR7 and KZ2 in Nabekoshiyama, Kesennuma area, South Kitakami Belt, using the topographical maps of "Shishiori" and "Kesennuma", scale 1 : 25,000 published by the Geospatial Information Authority of Japan.

Stratigraphy

The Permian of Nabekoshiyama in the Kesennuma area is divided into two formations, the lower, Kurosawa Formation (named by Misaki and Ehiro, 2004; equivalent to the lower Toyoma Series of Tazawa, 1975, and to the lower Toyoma Formation of Kobayashi, 2002) and the upper, Nabekoshiyama Formation (named by Ehiro, 1974, revised by Tazawa, 1975; equivalent to the upper Toyoma Series of Tazawa, 1975, and to the upper Toyoma Formation of Kobayashi, 2002) (Fig. 2). According to Tazawa (1975), the Nabekoshiyama Formation is composed mainly of sandstone and shale with intercalated conglomerate and limestone, 525 m+ in total thickness. The brachiopods, treated in this paper, were collected by Hideo Araki and the late Hitoshi Koizumi from sandstone and shale at three fossil localities, AR6, AR7 and KZ2 (see Figs. 1, 2).

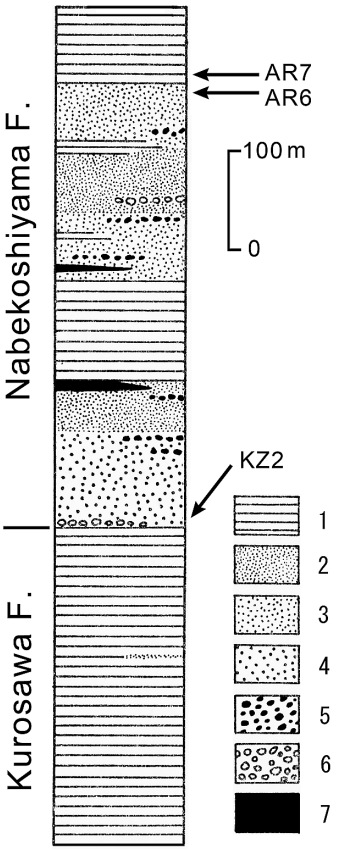

Fig. 2. Generalized columnar section of the upper Permian of Nabekoshiyama, showing the fossil horizons AR6, AR7 and KZ2. Legend 1: shale, 2: fine-grained sandstone, 3: medium-grained sandstone, 4: coarse-grained sandstone, 5: granule conglomerate, 6: pebble conglomerate, 7: limestone. Modified and adapted from Tazawa (1975).

AR6 (38° 55′ 29″ N, 141° 34′ 00″ E): grey to light brown coarse-grained sandstone, 438 m above the base of the Nabekoshiyama Formation, in the upper Kitsunezakisawa Valley, with *Oldhamina ehiroi*.

AR7 (38° 54′ 58″ N, 141° 33′ 50″ E): dark grey to black shale, 438 m above the base of the Nabekoshiyama Formation, in the upper Takinosawa Valley, with *Attenuatella bandoi*.

KZ2 (38° 55′ 43″ N, 141° 33′ 34″ E): grey fine-grained sandstone, 14 m above the base of the Nabekoshiyama Formation, in the upper Koshijisawa Valley, with *Edriosteges* sp. A and *Meekella* sp.

The Nabekoshiyama fauna

The Nabekoshiyama fauna has been described by Tazawa (1975, 2012) and contains the following 25 species in 19 genera: *Neochonetes* sp., *Spinomarginifera lopingensis* (Kayser, 1883), *Lamnimargus peregrinus* (Fredericks, 1924), *Lamnimargus japonicus* (Tazawa, 1975), *Linoproductus* sp., *Megousia auriculata* Muir-Wood and Cooper, 1960, *Megousia nakamurai*

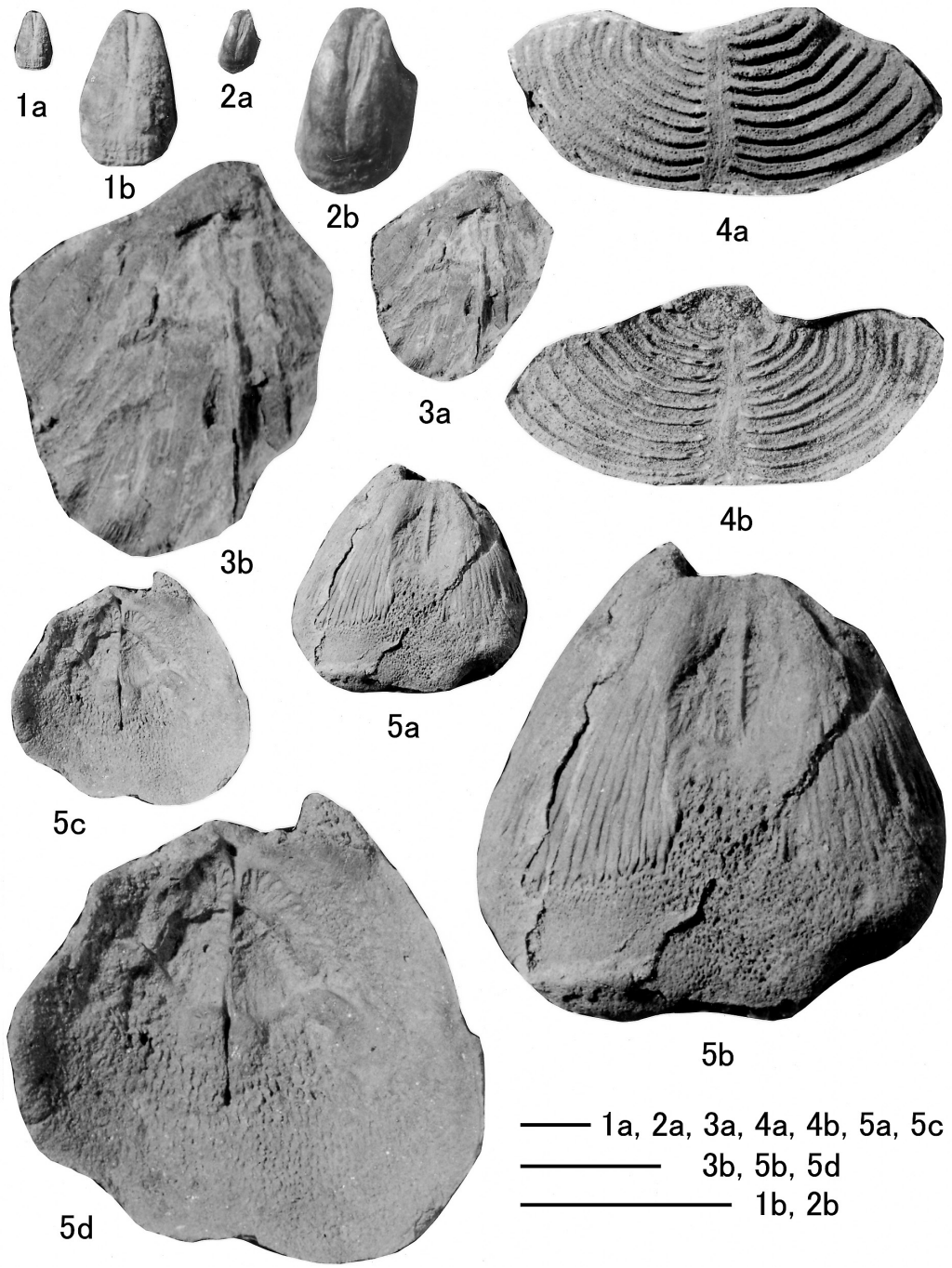

Fig. 3. 1, 2, *Attenuatella bandoi* Tazawa; 1a, 1b, internal mould of ventral valve, KCG010; 2a, 2b, internal mould of ventral valve, KCG009. **3**, *Meekella* sp.; 3a, 3b, internal mould of ventral valve, KCG012. **4**, *Oldhamina ehiroi* (Tazawa); 4a, 4b, internal mould and internal latex cast of ventral valve, KCG005. **5**, *Edriosteges* sp. A; 5a, 5b, internal mould of ventral valve; 5c, 5d, internal mould of dorsal valve, KCG013. Scale bars represent 1 cm.

Tazawa, 1975, *Terrakea nabekoshiyamensis* Tazawa, 2012, *Orthothrix sudoi* Tazawa, 2012, *Edriosteges* sp., *Tschernyschewia typica* Stoyanow, 1910, *Eolyttonia tenuis* (Waagen, 1883), *Eolyttonia mira* (Fredericks, 1916), *Oldhamina squamosa* Huang, 1932, *Oldhamina anshunensis* Huang, 1932, *Oldhamina kitakamiensis* Tazawa, 1982, *Derbyia* sp., *Enteletes* sp., *Peltichia* cf. *transversa* (Huang, 1933), *Orthotichia* sp., *Hustedia indica* (Waagen, 1883), *Hustedia minuta* Tazawa in Tazawa and Miyake, 2011, *Martinia* sp., *Choristitella wynnei* (Waagen, 1883) and *Spiriferellina cristata* (Schlotheim, 1816). The Nabekoshiyama fauna is a mixed Boreal–Tethyan fauna in the latest Permian (Changhsingian) (Tazawa, 2012).

In the present paper, four brachiopod spesies, *Edriosteges* sp. A, *Oldhamina ehiroi* (Tazawa in Tazawa and Miyake, 2011), *Meekella* sp. and *Attenuatella bandoi* Tazawa, 1987 are described as additional species of the Nabekoshiyama fauna. Among the newly described species, *Attenuatella bandoi* is an antitropical element (Tazawa, 1987, 2011), and *Oldhamina ehiroi* and *Meekella* sp. are tropical elements (Tazawa, 2002, 2012; Tazawa and Miyake, 2011). Therefore, the additional brachiopods also indicate that the Nabekoshiyama fauna is a mixed Boreal–Tethyan fauna in the uppermost Permian (Changhsingian) of the South Kitakami Belt, northeastern Japan.

Systematic descriptions

Order Productida Sarytcheva and Sokolskaya, 1959
Suborder Productidina Waagen, 1883
Superfamily Aulostegoidea Muir-Wood and Cooper, 1960
Family Echinostegidae Muir-Wood and Cooper, 1960
Subfamily Echinosteginae Muir-Wood and Cooper, 1960
Genus *Edriosteges* Muir-Wood and Cooper, 1960

Type species.—*Edriosteges multispinosus* Muir-Wood and Cooper, 1960.

Edriosteges sp. A
Fig. 3.5

Edriosteges sp. Tazawa, 2012, p. 29, fig. 2.20.

Material.—One specimen from locality KZ2, internal mould of a conjoined shell, KCG013.

Remarks.—This specimen is safely assigned to the genus *Edriosteges* by its medium sized (length about 35 mm, width about 35 mm), slightly concavo-convex shell, with narrow and shallow ventral sulcus anteriorly, and strongly dendritic adductor scars in both ventral and dorsal valves. The Nabekoshiyama species, tentatively named as *Edriosteges* sp. A,

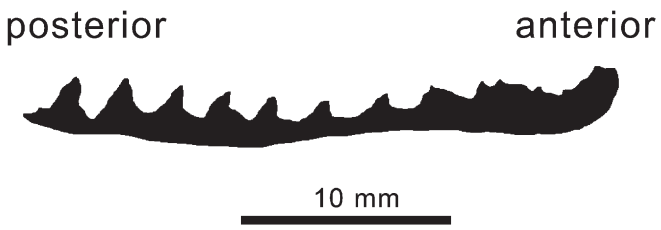

Fig. 4. Longitudinal section of ventral internal latex cast of *Oldhamina ehiroi* (Tazawa), from the Nabekoshiyama Formation of Nabekoshiyama, KCG005, showing acute crests of lateral septa.

may be a new species of *Edriosteges*, together with the ventral valve specimen of *Edriosteges* sp. Tazawa, 2012, from the middle Nabekoshiyama Formation at locality KF107, east of the summit of Mt. Nabekoshiyama.

An *Edriosteges* shell, figured by Kotlyar (1989, pl. 23, fig. 15) as *Edriosteges poyangensis* (Kayer, 1883) from the Nakhodka Reef (Wuchiapingian) of South Primorye, eastern Russia is like to the Nabekoshiyama species in size and outline, and probably identical with the latter.

Distribution.—Changhsingian: northeastern Japan (Kesennuma in the South Kitakami Belt).

Suborder Lyttoniidina Williams, Harper and Grant, 2000
Superfamily Lyttonioidea Waagen, 1883
Family Lyttoniidae Waagen, 1883
Subfamily Lyttoniinae Waagen, 1883
Genus *Oldhamina* Waagen, 1883

Type species.—*Bellerophon decipiens* de Koninck, 1863.

Oldhamina ehiroi (Tazawa in Tazawa and Miyake, 2011)
Figs. 3.4, 4

Petasmaia ehiroi Tazawa in Tazawa and Miyake, 2011, p. 8, figs. 3.10, 3.11, 4.

Material.—One specimen from locality AR6, internal mould of a ventral valve, KCG005.

Remarks.—The single specimen from Nabekoshiyama is referred to *Oldhamina ehiroi* (Tazawa in Tazawa and Miyake, 2011), from the upper Toyoma Formation of Maeda in the Ofunato area, South Kitakami Belt, by its strongly arcuate, thin and closely arranged lateral

septa, with acute crests (see Fig. 4), in the ventral valve.

Oldhamina transversa Jin and Ye (in Jin et al., 1979, p. 82, pl. 23, figs. 18, 19), from the Uli Group (Lopingian) of Qinghai, northwestern China, is most closest to *O. ehiroi* in having strongly arcuate lateral septa in the ventral valve, but the Chinese species differs from the latter in its larger size and the lateral septa with broader interspaces.

Distribution.—Changhsingian: northeastern Japan (Ofunato and Kesennuma in the South Kitakami Belt).

Order Orthotetida Waagen, 1884
Suborder Orthotetidina Waagen, 1884
Superfamily Orthotetoidea Waagen, 1884
Family Meekellidae Stehli, 1954
Subfamily Meekellinae Stehli, 1954
Genus *Meekella* White and St. John, 1867

Type species.—*Plicatula striatocostata* Cox, 1857.

Meekella sp.
Fig. 3.3

Material.—One specimen from locality KZ2, internal mould of a ventral valve, KCG012.

Remarks.—The single ventral valve specimen from Kesennuma is small to medium in size (length more than 33 mm, width about 31 mm), subcircular in outline, and slightly convex in both anterior and lateral profiles. External surface of the ventral valve is ornamented by strong costae and numerous capillae; costae numbering 6 on one side of lateral slope. The Kesennuma species most resembles *Meekella deltoides* Liao (1980, p. 256, pl. 3, figs. 1–4), from the Longtanian of Guizhou, southwestern China, in size and shape of the ventral valve, but accurate comparison is difficult for the poorly preserved specimen.

Order Spiriferida Waagen, 1883
Suborder Spiriferidina Waagen, 1883
Superfamily Ambocoelioidea George, 1931
Family Ambocoeliidae George, 1931
Subfamily Ambocoeliinae George, 1931
Genus *Attenuatella* Stehli, 1954

Type species.—*Attenuatella texana* Stehli, 1954.

Attenuatella bandoi Tazawa, 1987
Figs. 3.1, 3.2

Attenuatella bandoi Tazawa, 1987, p. 281, figs. 3, 4; Tazawa, 2011, p. 177, figs. 5.1–5.3.
Attenuatella sp. Tazawa and Niigata Pre-Tertiary Research Group, 1999, figs. 2.6–2.9; Tazawa, 2001, figs. 38.2F–38.2H

Material.—Two specimens from locality AR7, internal moulds of two ventral valves, KCG009 and KCG010.

Remarks.—These specimens are referred to *Attenuatella bandoi* Tazawa, 1987, from the lower Toyoma Formation of Ishihama in the Utatsu area, South Kitakami Belt, northeastern Japan by their relatively large size for the genus (length 10 mm, width 6 mm in the larger specimen, KCG009) and in having long and broad adductor scars in the ventral valve.

Attenuatella incurvata Waterhouse (1964, p. 108, pl. 20, figs. 1–12; pl. 21, figs. 1–9; text-figs. 47–52), from the middle Permian (Kungurian–Kazanian) of New Zealand, differs from *A. bandoi* in its wider shell outline.

Attenuatella mengi He, Shi, Feng and Peng (2007, p. 276, figs. 5A–P, 6A–H), from the upper Permian (Changhsingian) of Guangxi, central-southern China, is distinguished from the present species by its less elongate outline and shorter adductor scars in the ventral valve.

Distribution.—Wuchiapingian–Changhsingian: northeastern Japan (Kesennuma and Utatsu in the South Kitakami Belt) and central Japan (Okutadami in the Joetsu Belt).

Acknowredgements

We sincerely thank Yousuke Ibaraki (Fossa Magna Museum, Itoigawa) and Naotomo Kaneko (Geological Museum, Geological Survey of Japan, AIST, Tsukuba) for their help in drawing figures; and Atsushi Matsuoka (Department of Geology, Niigata University, Niigata) for his critical review of the manuscript.

References

Cox, E. T., 1857, A description of some of the most characteristic shells of the principal coal seams in the western basin of Kentucky. *Rep. Geol. Surv. Kentucky,* **3**, 557–576.

Ehiro, M., 1974, Geological and structural studies of the area along the Hizume–Kesennuma Tectonic Line, in Southern Kitakami Massif. *Jour. Geol. Soc. Japan,* **80**, 457–474 (in Japanese).

Fredericks, G., 1916, Paleontologicheskiya zamtki, 2. O nekotorykh verkhne-paleozoyskikh brakhiopodakh Evrazii. *Tr. Geol. Kom., N. S.,* **156**, 1–87 (in Russian).

Fredericks, G., 1924, Ussuriyskiy verkhniy paleozoy, 1. Brachiopoda. *Mater. Geol. Polezn. Iskopaem. Dalnego Vostoka,* no. 28, 1–52 (in Russian).

George, T. N., 1931, *Ambocoelia* Hall and certain similar British Spiriferidae. *Quart. Jour. Geol. Soc. London,* **87**, 30–61.

He, W., Shi, G. R., Feng, Q. and Peng, Y., 2007, Discovery of late Changhsingian (latest Permian) brachiopod *Attenuatella* species from South China. *Alcheringa,* **31**, 271–284.

Huang, T. K., 1932, Late Permian Brachiopoda of southwestern China. *Palaeont. Sinica, Ser. B,* **9**, fasc. 1, 1–139.

Huang, T. K., 1933, Late Permian Brachiopoda of southwestern China, Part 2. *Palaeont. Sinica, Ser. B,* **9**, fasc. 2, 1–172.

Jin, Y., Ye, S., Xu, H. and Sun, D., 1979, Phylum Brachiopoda. *In* Nanjing Institute of Geology and Palaeontology, Academia Sinica and Qinghai Geological Science Institute, eds., *Palaeontological Atlas of Northwest China; Qinghai Section, Part 1*, Geol. Pub. House, Beijing, 60–217 (in Chinese).

Kayser, E., 1883, Obercarbonische Fauna von Lo-ping. *In* von Richthofen, F. F., ed., *China, Bd. 4,* Dietrich Reimer, Berlin, 160–208.

Kobayashi, F., 2002, Lithology and foraminiferal fauna of allochthonous limestones (Changhsingian) in the upper part of the Toyoma Formation in the South Kitakami Belt, Northeaet Japan. *Paleont. Res.,* **6**, 331–342.

de Koninck, L. G., 1863, *Mémoire sur les Fossiles Paléozoiques Recueillis dans l' Inde par M. le Docteur Fleming.* H. Dessaain, Liège, 44p.

Kotlyar, G. V., 1989, Yuzhnoe Primorye: Brakhiopody. *In* Kotlyar, G. V. and Zakharov, Yu. D., eds., *Pozdnepermskiy Etap Evolyutsii Organicheskogo Mira: Midiyskiy Yarus SSSR,* Nauka, Leningrad, 60–64 (in Russian).

Liao, Z., 1980, Upper Permian brachiopods from western Guizhou. *In* Nanjing Institute of Geology and Palaeontology, Academia Sinica, ed., *Stratigraphy and Palaeontology of the Upper Permian of Coal-bearing Formation in Western Guizhou and Eastern Yunnan,* Sci. Press, Beijing, 241–277 (in Chinese).

Misaki, A. and Ehiro, M., 2004, Stratigraphy and geologic age of the Middle Permian in the Kamiyasse–Imo district, Southern Kitakami Massif, Northeast Japan. *Jour. Geol. Soc. Japan,* **110**, 129–145 (in Japanese).

Muir-Wood, H. M. and Cooper, G. A., 1960, *Morphology, Classification and Life Habits of the Productoidea (Brachiopoda).* Geol. Soc. Amer. Mem., 81, 447p.

Sarytcheva, T. G. and Sokolskaya, A. N., 1959, O klassifikatsin lozhnoporistykh brakhiopod. *Doklady, Akad. Nauk SSSR,* **125**, 181–184 (in Russian).

von Schlotheim, E. F., 1816, Beitrage zur Naturgeschichte der Versteinerungen in geognostischen Hinsicht. *Denkschr. Bayer. Akad. Wissenschaft.,* **6**, 13–36.

Stehli, F. G., 1954, Lower Leonardian Brachiopoda of Sierra Diablo. *Bull. Amer. Mus. Nat. Hist.,* **105**, 263–358.

Stoyanow, A. A., 1910, O novom rode Brachiopoda. *Bull. Acad. Imp. Sci. St. Petersbourg, Ser. 6*, **4**, 853–855 (in Russian).

Tazawa, J., 1975, Uppermost Permian fossils from the Southern Kitakami Mountains, Northeast Japan. *Jour. Geol. Soc. Japan*, **81**, 629–640.

Tazawa, J, 1982, *Oldhamina* from the Upper Permian of the Kitakami Mountains, Japan and its Tethyan province distribution. *Trans. Proc. Palaeont. Soc. Japan, N. S.,* no. 128, 445–451.

Tazawa, J., 1987, *Attenuatella* (Brachiopoda) from the Upper Permian of Northeast Japan and its bipolar distribution. *Trans. Proc. Palaeont. Soc. Japan, N. S.,* no. 148, 276–284.

Tazawa, J., 2001, A Permian Boreal brachiopod fauna from Okutadami, central Japan, and its tectonic implication. *In* Brunton, C. H. C., Cocks, L. R. M. and Long, S. L., eds., *Brachiopods Past and Present,* The Systematics Association Special Volume Series 63, Taylor and Francis, London, 373–383.

Tazawa, J., 2002, Late Paleozoic brachiopod faunas of the South Kitakami Belt, northeast Japan, and their paleobiogeographic and tectonic implications. *Island Arc*, **11**, 287–301.

Tazawa, J., 2011, Late Permian (Wuchiapingian) brachiopod fauna from Okutadami, central Japan: Systematics, palaeobiogeography and tectonic implications. *Paleont. Res.*, **15**, 168–180.

Tazawa, J., 2012, Late Permian (Changhsingian) brachiopod fauna from Nabekoshiyama in the Kesennuma area, South Kitakami Belt, northeast Japan. *Sci. Rep., Niigata Univ.* (*Geol.*), no. 27, 15–50.

Tazawa, J. and Miyake, Y., 2011, Late Permian (Chnaghsingian) brachiopod fauna from Maeda in the Ofunato area, South Kitakami Belt, NE Japan. *Sci. Rep., Niigata Univ.* (*Geol.*), no. 26, 1–22.

Tazawa, J. and Niigata Pre-Tertiary Research Group, 1999, Permian brachiopods from the Okutadami area, near the boundary between Niigata and Fukushima Prefectures, central Japan and their tectonic implications. *Jour. Geol. Soc. Japan,* **105**, 729–732 (in Japanese).

Waagen, W., 1883–1884, Salt Range fossils, 1. Productus-Limestone fossils: Brachiopoda. *Palaeont. Indica, Ser. 13,* **1**, pt. 4, fasc. 2, 391–546 (1883); fasc. 3, 547–610 (1884).

Waterhouse, J. B., 1964, Permian brachiopods of New Zealand. *New Zealand Geol. Surv., Paleont. Bull.,* no. 35, 1–287.

White, C. A. and St. John, O., 1867, Descriptions of new Sub-Carboniferous Coal-Measure fossils, collected upon the geological survey of Iowa, together with a notice of new generic characters involved in two species of Brachiopoda. *Trans. Chicago Acad. Sci.,* **1**, 115–127.

Williams, A., Harper, D. A. T. and Grant, R. E., 2000, Lyttoniidina. *In* Williams, A., Brunton, C. H. C. and Carlson, S. J., eds., *Treatise on Invertebrate Paleontology, Part H. Brachiopoda Revised, Vol. 3: Linguliformea, Craniiformea, and Rhynchonelliformea* (*Part*). Geol. Soc. Amer., Boulder and Univ. Kansas, Lawrence, 619–642.