Early Carboniferous (early Visean) brachiopod fauna from the middle part of the Arisu Formation in the Yokota area, South Kitakami Belt, Japan

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Abstract

In this paper, we describe an early Carboniferous (early Visean) brachiopod fauna (the Odairayama fauna) from the middle part of the Arisu Formation in the Yokota area, South Kitakami Belt, northeastern Japan. The Odairayama fauna consists of six species in six genera: *Tomiproductus elegantulus, Marginatia burlingtonensis, Rhipidomella michelini, Cleiothyridina harkeri, Kitakamithyris hikoroitiensis* and *Asyrinxia nipponotrigonalis*. The age of the fauna is assigned to early Visean. Therefore, the middle part of the Arisu Formation is correlated with the lower Visean.

Key words: Arisu Formation, Brachiopoda, South Kitakami Belt, Visean, Yokota.

Introduction

Carboniferous rocks are well developed and exposed in the South Kitakami Belt, northeastern Japan. The Yokota area in the central part of the belt (i.e., Yokota-cho, Rikuzentakata City, Iwate Prefecture; Fig. 1) is a classical area for Carboniferous stratigraphy in Japan. Since the pioneering work of Minato (1941), the Carboniferous rocks in the Yokota area have been studied by Minato et al. (1953, 1979b), Saito (1966, 1968), Tazawa and Katayama (1979) and Kawamura (1985). Consequently, the Carboniferous strata in the Yokota area are classified into five formations, which are in ascending stratigraphic

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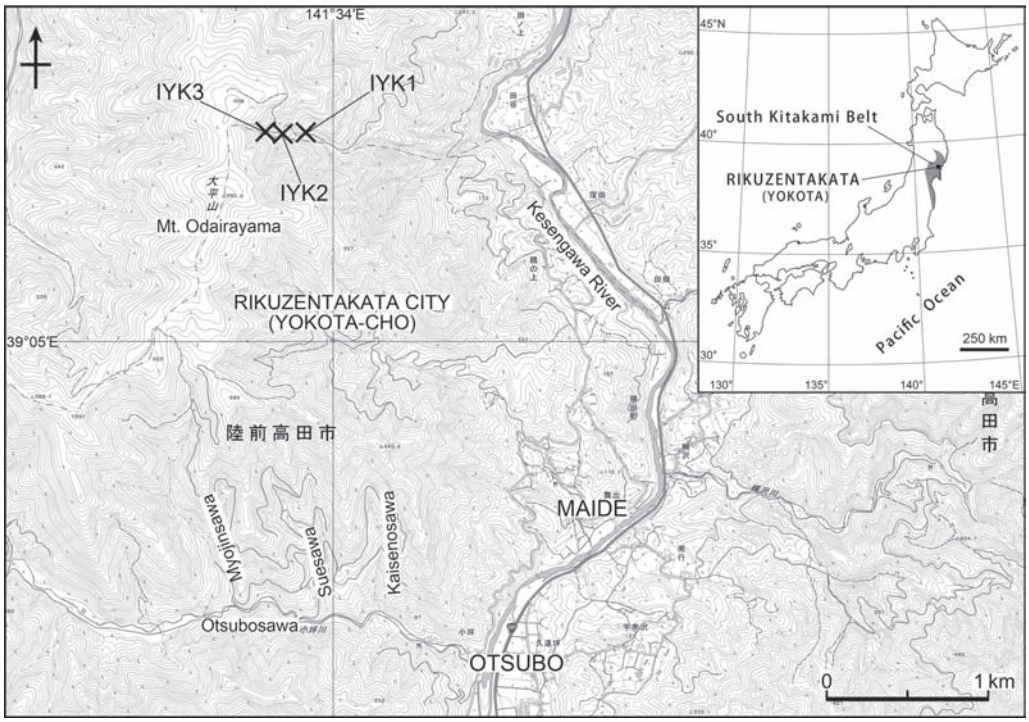

Fig. 1. Map showing the fossil localities IYK1, IYK2 and IYK3 at the northeastern slope of Mt. Odairayama in the Yokota area, South Kitakami Belt (using a digital topographic map of the Geospatial Information Authority of Japan).

order the Shittakazawa, Arisu, Odaira, Onimaru and Nagaiwa formations (Fig. 2). However, the ages of the lower three formations (Shittakazawa, Arisu and Odaira formations) are still uncertain, because of the lack of palaeontological data.

In the present study, we describe the brachiopods from the middle part of the Arisu Formation in the Yokota area, and discuss the age of the fossil fauna. The material was collected by Y. Ibaraki in 1996, in the course of his graduation thesis at the Department of Geology, Faculty of Science, Niigata University, under the supervision of J. Tazawa. The brachiopod specimens described herein are now registered and housed in the Faculty of Science, Niigata University, Niigata, Japan (prefix NU-B, numbers 2256 to 2265).

Stratigraphy and material

In the Yokota area, the Arisu Formation (330 m thick) is subdivided into a lower part (green to dark green andesitic lapilli tuff, 40 m thick), a middle part (sandstone with subordinate andesitic tuff and limestone, 260 m thick) and an upper part (black shale with a thin limestone bed in the topmost bed, 130 m thick). The brachiopod specimens were collected from dark grey fine-grained calcareous sandstone near (about 10 m below) the top

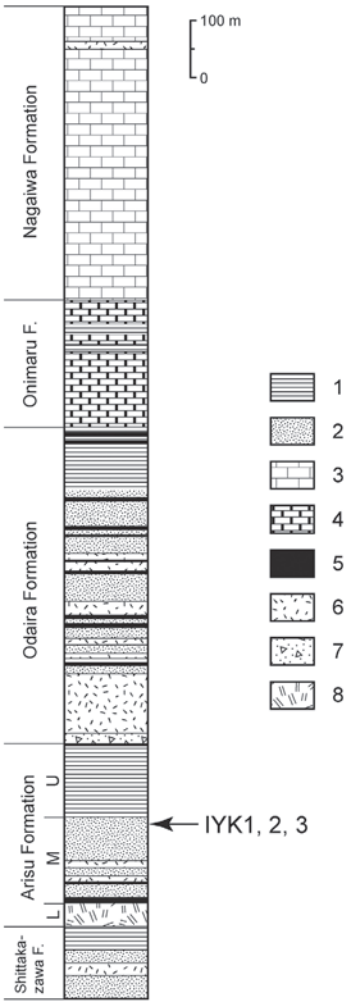

Fig. 2. Generalized columnar section of the Carboniferous formations in the Yokota area, showing the fossil horizons IYK1, IYK2 and IYK3 (adapted from Tazawa, 2017). L, lower part; M, middle part; U, upper part; 1, shale; 2, sandstone; 3, limestone of the Nagaiwa Formation; 4, limestone of the Onimaru Formation; 5, limestone of the Arisu and Odaira formations; 6, tuff, 7, tuff breccia; 8, lapilli tuff.

of the middle part of the Arisu Formation at three localities (IYK1, IYK2 and IYK3) on the northeastern slope of Mt. Odairayama in the Yokota area. The fossil horizon is equivalent to the E_0 Zone (Horizon) in unit Ⅲ of Minato et al. (1979b). The topographic and stratigraphic locations of the fossil localities and fossil contents are described below, and marked in Figs. 1 and 2.

IYK1: Northeastern slope of Mt. Odairayama (39°06′41″N, 141°33′53″E), dark grey calcareous sandstone, with *Tomiproductus elegantulus, Rhipidomella michelini* and *Kitakamithyris hikoroitiensis*.

IYK2: Northeastern slope of Mt. Odairayama (39°06′41″N, 141°33′47″E), dark grey calcareous sandstone, with *Tomiproductus elegantulus, Marginatia burlingtonensis* and *Cleiothyridina harkeri*.

IYK3: Northeastern slope of Mt. Odairayama (39 °06 ′42 ″N, 141 °33 ′42″E), dark grey calcareous sandstone, with *Marginatia burlingtonensis* and *Asyrinxia nipponotrigonalis*.

The Odairayama fauna

The brachiopod fauna described herein includes six species in six genera: *Tomiproductus elegantulus* (Tolmatchoff, 1924), *Marginatia burlingtonensis* (Hall, 1858), *Rhipidomella michelini* (Léveillé, 1835), *Cleiothyridina harkeri* Carter, 1987, *Kitakamithyris hikoroitiensis* Minato, 1951 and *Asyrinxia nipponotrigonalis* (Minato, 1951). The stratigraphic distribution of the brachiopod species of the fauna is summarized in Fig. 3.

Of the brachiopods listed above, *Tomiproductus elegantulus* is known from the lower Tournaisian to upper Visean (Sarytcheva et al., 1963; Nalivkin and Fotieva, 1973), *Marginatia burlingtonensis* from the upper Tournaisian to upper Visean (Weller, 1914; Tazawa, 2018c), *Rhipidomella michelini* from the upper Tournaisian to lower Bashkirian (Sarytcheva and Sokolskaya, 1952; Litvinovich et al., 1969; Tazawa, 2018c), *Cleiothyridina harkeri* from the upper Tournaisian to lower Visean (Abramov, 1970; Carter, 1987), *Kitakamithyris hikoroitiensis* from the upper Famennian to lower Visean (Tazawa, 2018b), and *Asyrinxia nipponotrigonalis* from the lower–upper Visean (Tazawa, 2018a). In summary, the age of the Odairayama fauna is identified as early Visean.

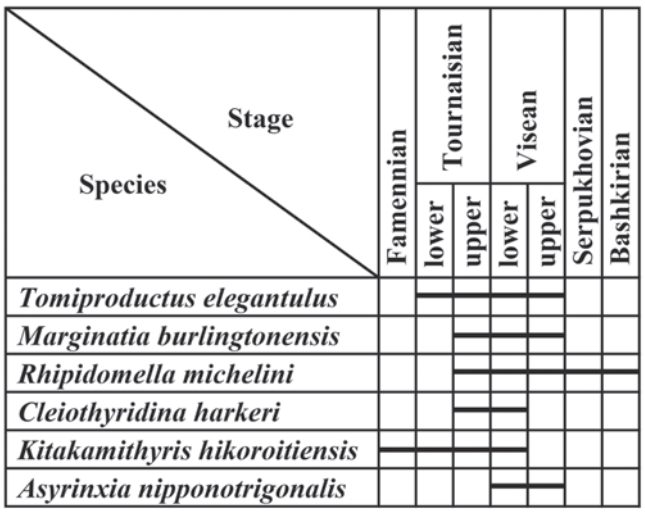

Fig. 3. Stratigraphic distributions of brachiopod species of the Odairayama fauna.

Discussion

Regarding the age of the Arisu Formation, Minato et al. (1953) proposed that unit Ⅲ (= middle and upper parts) of the Arisu Formation correlates with the upper Tournaisian of Europe and the Osagean of the USA, based on the abundant occurrence of *Syringothyris* in the D_0 Zone (lower part of unit Ⅲ). Minato and Kato (1979) later regarded the age of the Arisu Formation as late Tournaisian on the basis of brachiopods (*Syringothyris* spp., *Spirifer kozuboensis* and "*Athyris*" *lamellosa*), a crinoid (*Platycrinus asiaticus*) and a blastoid (*Nymphaeoblastus anossofi*) from the D_0 Zone. Tazawa (1985) considered that the upper part of the Arisu Formation correlates in lithology with the upper part of the lower Hikoroichi Formation of the Hikoroichi area (about 7 km east of the Yokota area); the latter is assigned to early Visean in age on the basis of the occurrence of a brachiopod (*Linoprotonia* sp). In the present study, the age of the middle part of the Arisu Formation is concluded to be early Visean, although the ages of the lower and upper parts of the Arisu Formation are uncertain.

Systematic descriptions

Order Productida Sarytcheva and Sokolskaya, 1959
Suborder Productidina Waagen, 1883
Superfamily Productoidea Gray, 1840
Family Buxtoniidae Muir-Wood and Cooper, 1960
Subfamily Buxtoniinae Muir-Wood and Cooper, 1960
Genus *Tomiproductus* Sarytcheva in Sarytcheva, Sololskaya, Besnossova and Maksimova, 1963

Type species.—*Productus elegantulus* Tolmatchoff, 1924.

Tomiproductus elegantulus (Tolmatchoff, 1924)
Fig. 4A

Productus elegantulus Tolmatchoff, 1924, p. 244, 579, pl. 14, figs. 5–7.
Tomiproductus elegantulus (Tolmatchoff). Sarytcheva in Sarytcheva et al., 1963, p. 202, pl. 31, figs. 1–11; pl. 32, figs. 1–7, text-figs. 88, 89; Nalivkin and Fotieva, 1973, p. 42, pl. 8, figs. 12, 13; Kalashnikov, 1974, p. 55, pl. 13, fig. 6; Bublichenko, 1976, p. 54, pl. 3, fig. 9; pl. 5, figs. 1, 2.

Material.—Two specimens from localities IYK1 and IYK2, internal moulds of two ventral valves, NU-B2262, 2263.

Remarks.—These specimens are referred to *Tomiproductus elegantulus* (Tolmatchoff, 1924), redescribed by Sarytcheva in Sarytcheva et al. (1963, p. 202, pl. 31, figs. 1–11; pl. 32, figs. 1–7, text-figs, 88, 89) from the lower–upper Tournaisian of the Kuznetsk Basin, central Russia, in the small size (length 20 mm, width 22 mm in the larger specimen, NU-B2262), strongly inflated ventral valve with a long trail, numerous fine costellae on entire surface of the ventral valve (numbering 10–12 in 5 mm on ventral trail) and weak concentric rugae on the ventral disc. *Tomiproductus minimus* (Demanet, 1921), redescribed by Nalivkin (1979, p. 91, pl. 13, fig. 26; pl. 31, figs. 1–11) from the upper Tournaisian–middle Visean of the northern Urals, is also a small-sized *Tomiproductus*, but it differs from *T. elegantulus* in having stronger rugae on the ventral trail. *Tomiproductus kollari* Carter (1990, p. 224, figs. 3.1–3.14), from the middle–upper Keokuk Limestone of Missouri, USA, differs from *T. elegantulus* in the larger size and coarser rugae on the ventral trail.

Distribution.—Lower Tournaisian–upper Visean: northeastern Japan (Yokota in the South Kitakami Belt), northern Russia (Pechora Basin), central Russia (western Urals and Kuznetsk Basin) and Kazakhstan (Altay Mountains).

Subfamily Marginatiinae Waterhouse, 2002

Genus *Marginatia* Muir-Wood and Cooper, 1960

Type species.—*Productus fernglenensis* Weller, 1909.

Marginatia burlingtonensis (Hall, 1858)

Figs. 4C, D

Productus flemingi var. *burlingtonensis* Hall, 1858, p. 598, pl. 12, fig. 3.

Productus burlingtonensis Hall. Weller, 1914, p. 104, pl. 9, figs. 1–10; Frech, 1916, p. 239, pl. 6, fig. 1; Tolmatchoff, 1924, p. 237, 575, pl. 14, figs. 8–11; Girty, 1929, p. 85, pl. 9, figs. 20–24.

Productus (*Productus*) *burlingtonensis* Hall. Nalivkin, 1937, p. 66, pl. 7, figs. 7–11.

Productus sp. Minato, 1951, p. 366, pl. 1, fig. 4.

Productus (*Dictyoclostus*) *burlingtonensis* Hall. Simorin, 1956, p. 136, pl. 9, figs. 1–3.

Marginatia burlingtonensis (Hall). Sarytcheva in Sarytcheva et al., 1963, p. 191, pl. 28, figs. 5–8, text-figs. 81, 82; Grechishnikova, 1966, p. 116, pl. 8, figs. 11–13; Litvinovich in Litvinovich et al., 1969, p. 213, pl. 35, figs. 2–4; Nalivkin and Fotieva, 1973, p. 39, pl. 8, fig. 1; Bublichenko, 1976, p. 50, pl. 2, fig. 12; pl. 4, fig. 6; pl. 5, figs. 4–6; pl. 6, fig. 9; Galitskaya, 1977, p. 83, pl. 22, figs. 6–10; Nalivkin, 1979, p. 94, pl. 32, figs. 1–10; pl. 34, figs. 3, 4; Lee et al., 1980, p. 368, pl. 148, fig. 10; Jin, 1985, p. 77, pl. 1, figs. 20–22; Carter, 1987, p. 39, pl. 9, figs. 1–8; Shi et al., 2005, p. 44, figs. 5D, I–K, M; Tazawa, 2006, p. 132, figs. 6.1–6.8; Tazawa, 2017, p. 335, figs. 6.3–6.5; Tazawa, 2018c, p. 44, fig. 23A–D.

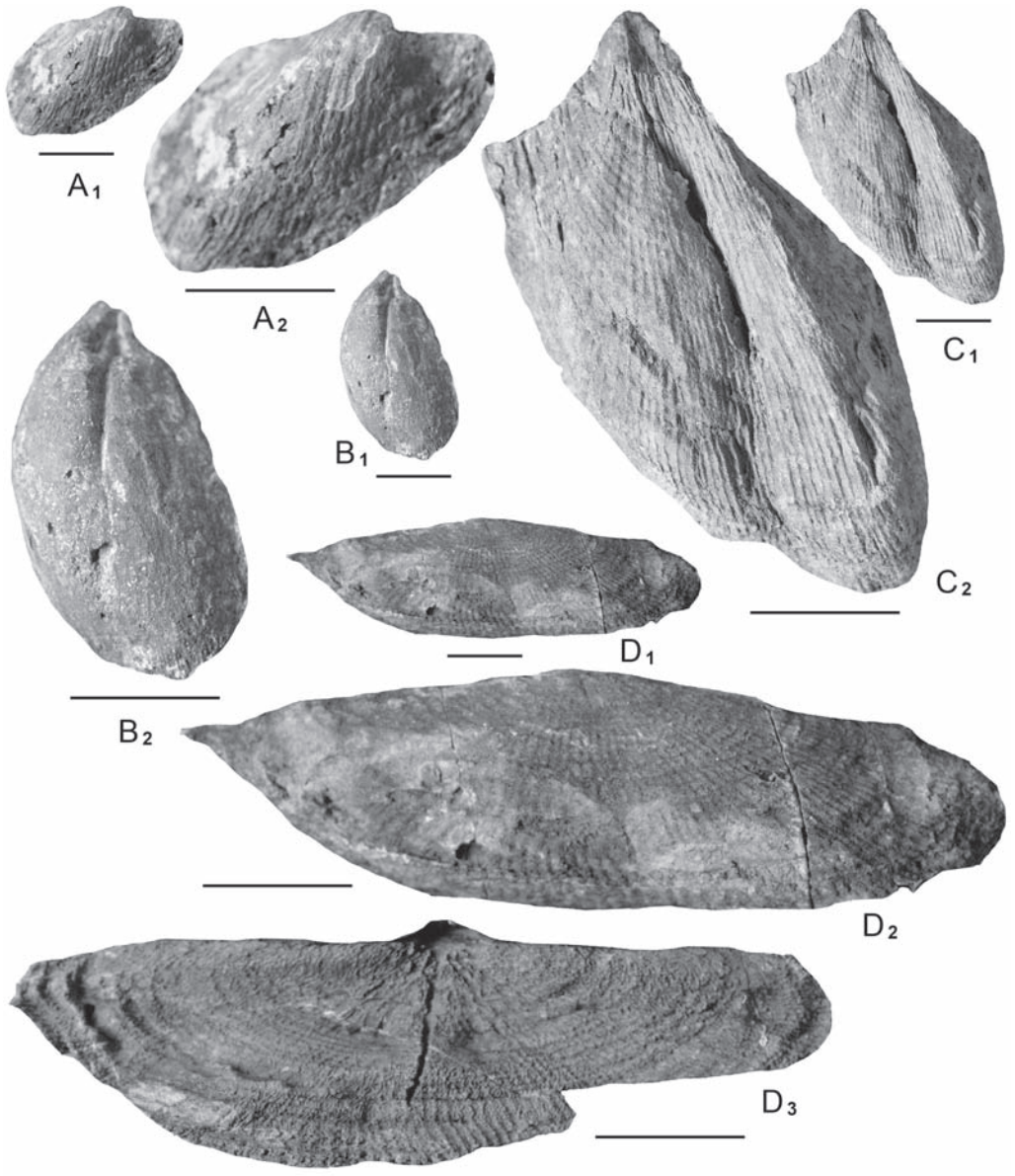

Fig. 4. Brachiopods of the Odairayama fauna (1). **A,** *Tomiproductus elegantulus* (Tolmatchoff), internal mould (A_1, A_2) of ventral valve, NU-B2262; **B,** *Rhipidomella michelini* (Léveillé), internal mould (B_1, B_2) of dorsal valve, NU-B2256; **C, D,** *Marginatia burlingtonensis* (Hall); internal mould (C_1, C_2) of ventral valve, NU-B2258; external mould (D_1, D_2) and internal mould (D_3) of dorsal valve, NU-B2260. Scale bars are 1 cm.

Dictyoclostus sp. Hase and Yokoyama, 1975, pl. 18, fig. 1.

Marginatia sp. Tazawa, 1985, p. 459, figs. 2.3–2.7; Tazawa, 1989, p. 60, pl. 1, fig. 1; Tazawa, 2002, figs. 7.1, 7.2.

Material.—Four specimens from localities IYK2 and IYK3: (1) internal moulds of two ventral valves, NU-B2258, 2259; (2) external and internal moulds of a dorsal valve, NU-B2260; and (3) external mould of a dorsal valve, NU-B2261.

Remarks.—These specimens are more or less squashed, but can be referred to *Marginatia burlingtonensis* (Hall, 1858), redescribed by Weller (1914, p. 104, pl. 9, figs. 1–10) from the Burlington Limestone of the Mississippi Valley, USA, on the basis of the medium-sized (length 42 mm, width 24 mm in the best preserved ventral valve specimen, NU-B2258; length 22 mm, width 62 mm in the largest dorsal valve specimen, NU-B2261) and strongly geniculated both ventral and dorsal valves, with regular and strong reticulate ornament on the visceral disc of the dorsal valve. *Marginatia patersonensis* Roberts (1965, p. 63, pl. 10, figs. 1–5), from the lower and upper Visean of New South Wales, eastern Australia, differs from the present species in having finer costae and larger number of spines on the ventral valve. The type species, *Marginatia fernglenensis* Weller (1909, p. 299, pl. 12, figs. 14–17) from the Fern Glen Formation of Missouri, differs from *M. burlingtonensis* in having shallower ventral sulcus.

Distribution.—Upper Tournaisian–upper Visean: northeastern Japan (Hikoroichi and Yokota in the South Kitakami Belt), southwestern Japan (Hina in the Akiyoshi Belt), USA (Illinois, Iowa and Arkansas), western Canada (Alberta), Turkey (Taurus Mountains), central Russia (southern Urals and Kuznetsk Basin), Kazakhstan, Kyrgyzstan and northeastern China (Liaoning).

Order Orthida Schuchert and Cooper, 1932
Suborder Dalmanellidina Moore, 1952
Superfamily Dalmanelloidea Schuchert, 1913
Family Rhipidomellidae Schuchert, 1913
Subfamily Rhipidomellinae Schuchert, 1913
Genus *Rhipidomella* Oehlert, 1890

Type species.—*Terebratula michelini* Léveillé, 1835.

Rhipidomella michelini (Léveillé, 1835)
Fig. 4B

Terebratula michelini Léveillé, 1835, p. 39, pl. 2, figs. 14–17.

Orthis michelini (Léveillé). Davidson, 1861, p. 132, pl. 30, figs. 6–12.

Dalmanella michelini (Léveillé). Frech, 1900, p. 201, pl. 16, fig. 15.

Rhipidomella michelini (Léveillé). Rotai, 1931, p. 44, pl. 1, fig. 3; Demanet, 1934, p. 37, pl. 2, figs. 1–9; Sarytcheva in Sarytcheva and Sokolskaya, 1952, p. 26, pl. 1, fig. 7; Litvinovich, 1962, p. 177, pl. 1, fig. 1; Zang in Yang et al., 1962, p. 19, pl. 1, figs. 1–7; Ustritsky and Tschernjak, 1963, p. 68, pl. 1, figs. 11, 12; Yang, 1964, p. 58, pl. 1, fig. 1; Brunton, 1968, p. 17, pl. 3, figs. 1–25, text-fig. 5; Litvinovich in Litvinovich et al., 1969, p. 127, pl. 1, figs. 9, 10; Bublichenko, 1971, p. 29, pl. 2, figs. 9–12; Alexandrov and Solomina, 1973, p. 87, pl. 21, fig. 1; Kalashnikov, 1974, p. 21, pl. 3, figs. 7–9; Volgin and Kushnar, 1975, p. 21, pl. 1, figs. 1, 2; Lee and Gu, 1976, p. 231, pl. 131, figs. 1–6; Martinez Chacon, 1979, p. 63, pl. 3, figs. 12–15; pl. 4, figs. 1–15, text-figs. 6, 7; Lee et al., 1980, p. 330, pl. 145, fig. 4; Ding and Qi, 1983, p. 250, pl. 88, fig. 13; Zakowa, 1989, p. 115, pl. 3, fig. 5; pl. 7, fig. 7; Harper and Jeffrey, 1996, fig. 3a; Legrand-Blain in Legrand-Blain et al., 1996, p. 180, pl. 28, figs. 21, 22; Jiang, 1997, pl. 1, fig. 3; Bassett and Bryant, 2006, p. 502, pl. 1, figs. 1–4; pl. 6, figs. 11–17; Sun and Baliński, 2008, p. 519, fig. 26; Tazawa, 2018c, p. 52, figs. 26A–C, 30G.

Rhipidomella sp. Tazawa and Katayama, 1979, p. 170, pl. 11, figs. 1–7; Mori and Tazawa, 1980, text-figs. 3.4–3.6; Tazawa, 1984, p. 305, pl. 61, figs. 5–7.

Material.—One specimen from locality IYK1, internal mould of a dorsal valve, NU-B2256.

Remarks.—This specimen resembles the shells, described by Tazawa (2018c, p. 52, figs. 26A–C, 30G) as *Rhipidomella michelini* (Léveillé, 1835) from the middle and upper parts of the Hikoroichi Formation in the Hikoroichi area, South Kitakami Belt, in size, outline and internal structure of the dorsal valve. *Rhipidomella michelini* (Léveillé, 1835) is characterized by having a short hinge line and the widest part of shell at slightly anterior to midlength. *Rhipidomella altaica* Tolmatchoff (1924, p. 213, 569, pl. 13, figs. 5–7, 9, 10), from the Tournaisian of the Kuznetsk Basin, central Russia, differs from *R. michelini* in having longer hinge and the widest part at midlength of the shell.

Distribution.—Upper Tournaisian–lower Bashkirian: northeastern Japan (Hikoroichi, Shimoarisu and Yokota in the South Kitakami Belt), northern Russia (Taimyr Peninsula and Pechora Basin), UK (England, Wales and northern Ireland), Ireland, Poland, Belgium, France (French Pyrenees), Spain (Cantabrian Mountains), western Russia (Moscow Basin and Donetz Basin), Iran, central Russia (southern Urals), Kazakhstan, Uzbekistan, northwestern China (Xinjiang, Qinghai, Gansu and Ningxia), northern China (Inner Mongolia), northeastern China (Liaoning) and southwestern China (Guizhou and Yunnan).

Order Athyridida Boucot, Johnson and Staton, 1964

Suborder Athyrididina Boucot, Johnson and Staton, 1964

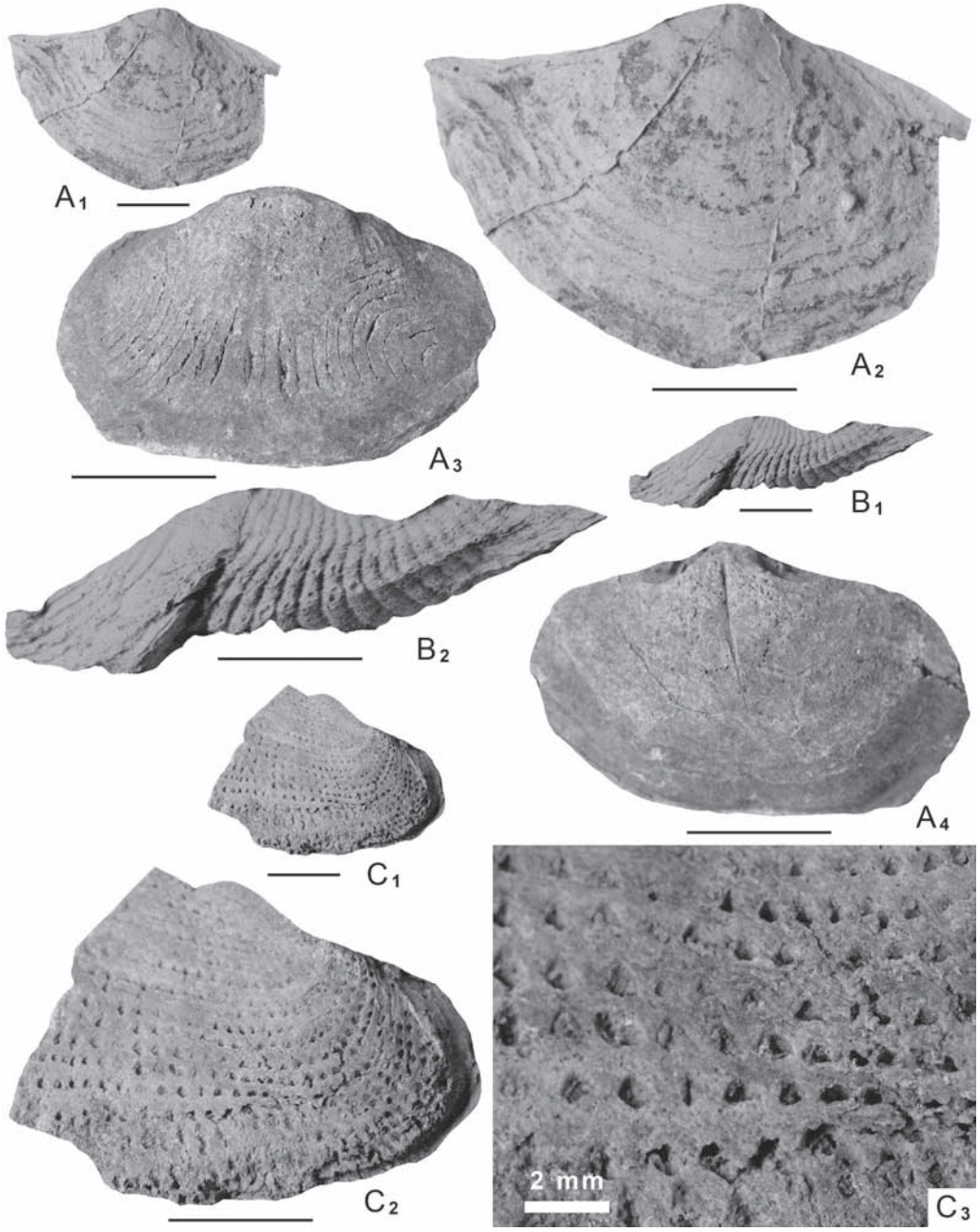

Fig. 5. Brachiopods of the Odairayama fauna (2). **A,** *Cleiothyridina harkeri* Carter, external latex cast (A_1, A_2) and internal mould (A_4) of dorsal valve, and internal mould (A_3) of ventral valve of conjoined shell, NU-B2265; **B,** *Asyrinxia nipponotrigonalis* (Minato), external latex cast (B_1, B_2) of dorsal valve, NU-B2264; **C,** *Kitakamithyris hikoroitiensis* Minato, external mould (C_1, C_2) of valve (ventral or dorsal uncertain), and enlarged one (C_3) showing biramose spine bases, NU-B2257. Scale bars are 1 cm, except for C_3.

Superfamily Athyridoidea Davidson, 1881
Family Athyrididae Davidson, 1881
Subfamily Cleiothyridininae Alvarez, Rong and Boucot, 1998
Genus *Cleiothyridina* Buckman, 1906

Type species.—*Atrypa pectinifera* Sowerby, 1840.

Cleiothyridina harkeri Carter, 1987
Fig. 5A

Cleiothyridina obmaxima (McChesney)? Nelson, 1961, pl. 4, figs. 5, 6; pl. 7, fig. 14; Abramov and Grigorjeva, 1986, pl. 15, figs. 17, 18.
Cleiothyridina obmaxima (McChesney). Abramov, 1970, p. 157, pl. 38, figs. 1–3.
Cleiothyridina harkeri Carter, 1987, p. 60, pl. 19, figs. 24–27.

Material.—One specimen from locality IYK2, internal mould of a conjoined shell, with external mould of the dorsal valve, NU-B2265.

Remarks.—This specimen can be referred to *Cleiothyridina harkeri* Carter, 1987, described by Carter (1987, p. 60, pl. 19, figs. 24–27) from the upper part of the Banff Formation of western Alberta, Canada, by the large, transverse shell (length about 25 mm, width about 36 mm), weakly uniplicate anterior commissure with shallow ventral sulcus and low dorsal fold, and external ornament consisting of numerous dense growth lamellae. *Cleiothyridina obmaxima* (McChesney), redescribed by Weller (1914, p. 475, pl. 79, figs. 1–11) from the Keokuk and Burlington formations of the Mississippi Valley, is also a large, transverse *Cleiothyridina,* but the American species differs from *C. harkeri* in having well developed sulcus and fold.

Distribution.—Upper Tournaisian–lower Visean: northeastern Japan (Yokota in the South Kitakami Belt), western Canada (Alberta) and northern Russia (Verkhoyansk Range).

Order Spiriferida Waagen, 1883
Suborder Delthyridina Ivanova, 1972
Superfamily Reticularioidea Waagen, 1883
Family Elythidae Fredericks, 1924
Subfamily Elythinae Fredericks, 1924
Genus *Kitakamithyris* Minato, 1951

Type species.—*Torynifer* (*Kitakamithyris*) *tyoanjiensis* Minato, 1951.

Kitakamithyris hikoroitiensis Minato, 1951
Fig. 5C

Torynifer (*Kitakamithyris*) *hikoroitiensis* Minato, 1951, p. 375, pl. 1, fig. 1.
Kitakamithyris hikoroitiensis Minato, 1952, p. 171, pl. 7, fig. 3; pl. 8, fig. 6; Minato et al., 1979a, pl. 16, fig. 1; Tazawa, 2018b, p 141, figs. 10E, 11B; Tazawa, 2018c, p. 72, figs. 20B, C, 21B, 29A, B.
Kitakamithyris semicircularis Minato, 1952, p. 171, pl. 7, fig. 6; pl. 8, fig. 5; pl. 10, fig. 3; Minato et al., 1979a, pl. 15, fig. 1.

Material.—One specimen from locality IYK1, external mould of a valve (ventral or dorsal uncertain), NU-B2257.

Remarks.—This specimen can be referred to *Kitakamithyris hikoroitiensis* Minato (1951), redescribed by Tazawa (2018b, p. 141, figs. 10E, 11B) from the upper part of the Choanji Formation (upper Famennian) at Choanji, by size, shape and external ornament of the shell, particularly in having large and sporadically arranged biramose spine bases (numbering 4–5 in 5 mm) on the valve. *Kitakamithyris semicircularis* Minato (1952, p. 171, pl. 7, fig. 6; pl. 8, fig. 5; pl. 10, fig. 3), from the Choanji and Arisu formations of the South Kitakami Belt, is deemed a junior synonym of *K. hikoroitiensis*. The type species, *Kitakamithyris tyoanjiensis* Minato, 1951, is readily distinguished from the present species by the smaller and densely arranged spine bases on the both valves.

Distribution.—Upper Devonian (upper Famennian)–lower Visean: northeastern Japan (Choanji, Hikoroichi, Yokota and Shimoarisu in the South Kitakami Belt).

Order Spiriferinida Ivanova, 1972
Suborder Spiriferinidina Ivanova, 1972
Superfamily Syringothyridoidea Fredericks, 1926
Family Syringothyrididae Fredericks, 1926
Subfamily Permasyrinxinae Waterhouse, 1986
Genus *Asyrinxia* Campbell, 1957

Type species.—*Spirifera lata* M'Coy, 1847.

Asyrinxia nipponotrigonalis (Minato, 1951)
Fig. 5B

Fusella nipponotrigonalis Minato, 1951, p. 372, pl. 2, fig. 5; Minato, 1952, p. 160, pl. 5, fig. 1; pl. 6, fig. 6; pl. 11, fig. 3; Minato et al., 1979a, pl. 22, fig. 4.

Fusella nipponotrigonalis var. *minor* Minato, 1952, p. 160, pl. 6, fig. 3.
Asyrinxia sp. Tazawa, 1981, p. 74, pl. 5, fig. 14.
Asyrinxia nipponotrigonalis (Minato). Tazawa, 2018a, p. 4, figs. 3.1, 3.2.

Material.—One specimen from locality IYK3, external mould of a dorsal valve, NU-B2264.

Remarks.—The single dorsal valve specimen from Yokota is medium in size (length 16 mm, width about 50 mm), transverse outline with alate cardinal extremities, moderately and unevenly convex in lateral profile, having a high smooth fold, and ornamented with numerous rounded simple costae (numbering 5–6 in 10 mm at anterior margin), some strong concentric rugae, and very fine concentric lamellae on the lateral slopes. This specimen resembles well the specimen (UHR16227), described by Minato (1952, p. 160, pl. 6, fig. 3) as *Fusella nipponotrigonalis* var. *minor* Minato, 1952 from the Jumonji Stage (= middle part of the Arisu Formation) and the Maide Stage (= middle part of the Odaira Formation) of the Yokota area, South Kitakami Belt, in size, shape and external ornament of the dorsal valve. *Fusella nipponotrigonalis* var. *minor* is deemed to be a synonym of *Fusella nipponotrigonalis* Minato (1951, p. 372, pl. 2, fig. 5), from the Jumonji Stage of the Shimoarisu and Yokota areas, South Kitakami Belt; and the latter is assigned to the genus *Asyrinxia* by Tazawa (2018a, p. 4).

Distribution.—Lower–upper Visean: northeastern Japan (Shimoarisu, Yokota and Nisawa in the South Kitakami Belt).

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