Early Carboniferous (late Visean) brachiopods from the Onimaru Formation in the Nagaiwa–Onimaru area, South Kitakami Belt, northeastern Japan

Jun-ichi Tazawa* and Muneo Taira**

Abstract

A brachiopod fauna (the Onimaru fauna), consisting of six species in five genera, is described from the Onimaru Formation in the Nagaiwa–Onimaru area, South Kitakami Belt, northeastern Japan. The age of the fauna is identified as the late Visean. Palaeobiogeographically, the Onimaru fauna has a close affinity with the lower Carboniferous faunas of southwestern Japan (Akiyoshi Belt), northern Russia (northern Urals), England, Kazakhstan and northwestern China (Xinjiang and Qinghai). The South Kitakami region was probably the eastern extension of the North China Province, and located near and to the east of the North China Block in the late Visean.

Key words: Brachiopoda, North China block, Onimaru Formation, South Kitakami Belt, Visean.

Introduction

The Onimaru Formation, which occurs in the eastern and central areas of the South Kitakami Belt, northeastern Japan, consists mainly of the upper Visean dark grey to black limestones with abundant corals such as *Kueichouphyllum*, *Siphonodendron*, and *Dibunophyllum*. The stratigraphy of the Onimaru Formation was studied by Minato (1941), Minato et al. (1953, 1979b), Onuki (1969) and Niikawa (1983a, 1983b). Numerous studies have described fossils from the Onimaru Formation, which include foraminifers (Yabe, 1942;

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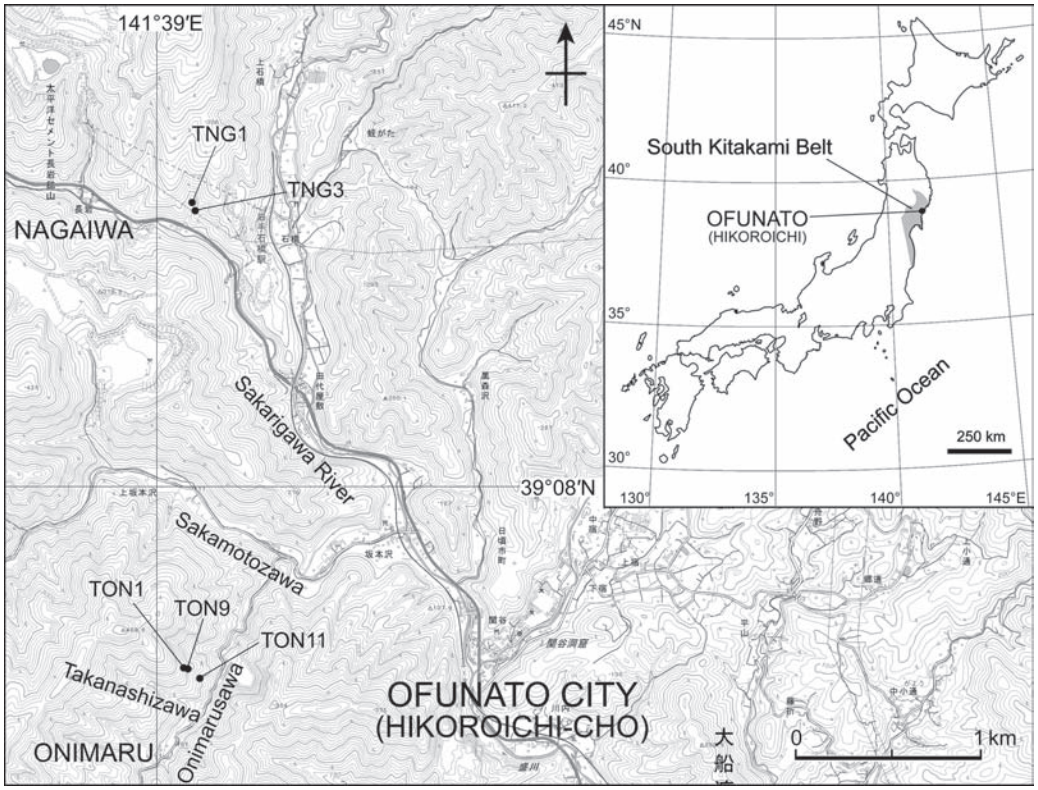

Fig. 1. Map showing the fossil localities TNG1, TNG3, TON1, TON9 and TON11 in the Nagaiwa–Onimaru area, South Kitakami Belt, northeastern Japan (using a digital topographic map of the Geospatial Information Authority of Japan).

Okimura, 1965), corals (Yabe and Hayasaka, 1915; Yabe and Sugiyama, 1939, 1940; Yabe and Minato, 1946; Minato, 1955; Kato, 1959; Minato and Rowett, 1967a, 1967b; Niikawa, 1997), brachiopods (Tazawa and Miyake, 2002), ammonoids (Ehiro and Araki, 1996), trilobites (Araki and Koizumi, 1968; Kobayashi and Hamada, 1978a, 1978b, 1980), and calcareous algae (Endo, 1951, 1952). However, most of brachiopods have not been described, except for one species, *Gigantoproductus* cf. *okensis* Kalashnikov, from the upper part of the Onimaru Formation at Okusakamotozawa in the Nagaiwa–Onimaru area (Tazawa and Miyake, 2002).

In the present study we describe a brachiopod fauna (the Onimaru fauna), comprising six species in five genera from the upper and uppermost parts of the Onimaru Formation of the type locality, the Nagaiwa–Onimaru area (Nagaiwa and Onimaru, Hikoroichi-cho, Ofunato City, Iwate Prefecture), South Kitakami Belt, northeastern Japan (Figs. 1, 2), and discuss the age and the palaeobiogeography of the fauna. The brachiopod specimens described herein are registered and stored in the Ofunato City Museum, Ofunato, Iwate Prefecture, Japan (prefix OCMG, numbers 2044–2050).

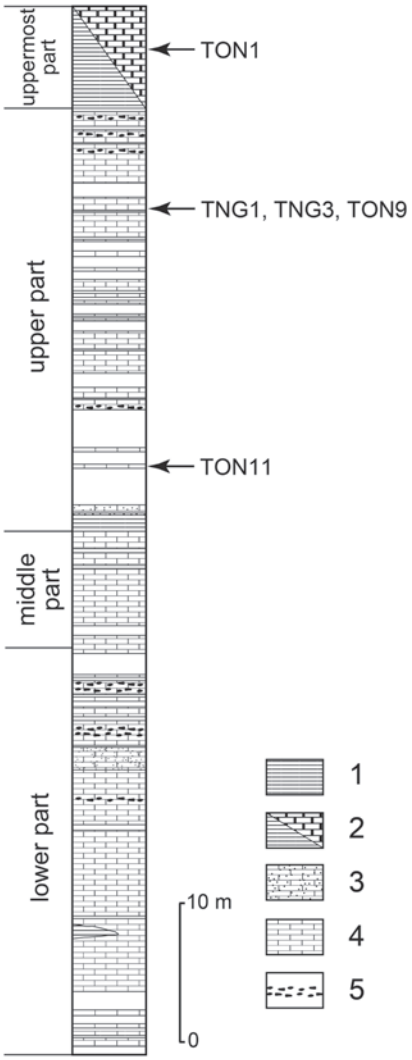

Fig. 2. Generalized columnar section of the Onimaru Formation in the Nagaiwa–Onimaru area, showing the fossil horizons TNG1, TNG3, TON1, TON9 and TON11 (modified and adapted from Niikawa, 1983a). 1, shale; 2, alternating shale and impure limestone; 3, sandy limestone; 4, limestone; 5, chert nodule.

Stratigraphy and material

According to Niikawa (1983a), the Onimaru Formation in the Nagaiwa–Onimaru area has a total thickness of about 73 m, and is divided stratigraphically into four parts; lower (28 m of dark grey limestone with thin layers of shale and sandstone, containing many corals, and characterized by chert nodules in the upper horizon); middle (8 m of dark grey limestone characterized by dense occurrence of the foraminifer *Saccamminopsis*); upper (30 m of dark grey limestone including chert nodules in the lower and upper horizon, and many corals in the upper horizon); and uppermost (7 m of intercalated limestone and shale, with a few coral

fossils). The brachiopod fossils were collected by M. Taira from five localities (TNG1, TNG3, TON1, TON9 and TON11) in the Nagaiwa–Onimaru area. The topographic and stratigraphic locations and the fossil contents of the localities are as follows.

TNG1: dark grey limestone (float) at a small tributary between Nagaiwa and Ishibashi (39° 08′ 50″ N, 141° 39′ 08″ E), about the same horizon as TON9, with *Latiproductus edelburgensis*.

TNG3: dark grey limestone (float) at a small tributary between Nagaiwa and Ishibashi (39° 08′ 49″ N, 141° 39′ 09″ E), about the same horizon as TON9, with *Gigantoproductus* sp.

TON1: outcrop of dark grey limestone on the eastern slope of a 459 m hill, 550 m NNE of Onimaru (39° 07′ 28″ N, 141° 39′ 06″ E), 4 m above the base of the uppermost part of the Onimaru Formation, with *Martinia* sp. and *Actinoconchus planosulcatus*.

TON9: outcrop of grey limestone on the eastern slope of a 459 m hill (39° 07′ 28″ N, 141° 39′ 07″ E), 7 m below the top of the upper part of the Onimaru Formation, with *Lamellosathyris qaidamensis*.

TON11: outcrop of dark grey limestone on the eastern slope of a 459 m hill (39° 07′ 26″ N, 141° 39′ 10″ E), 5 m above the base of the upper part of the Onimaru Formation, with *Gigantoproductus talotensis*.

The Onimaru fauna

The brachiopod fauna described herein includes six species in five genera: *Gigantoproductus talotensis* Kalashnikov, 1974, *Gigantoproductus* sp., *Latiproductus edelburgensis* (Phillips, 1836), *Actinoconchus planosulcatus* (Phillips, 1836), *Lamellosathyris qaidamensis* Chen, Shi and Zhan, 2003 and *Martinia* sp.

Age

The stratigraphic distributions of the brachiopod species are summarized in Fig. 3. Of the brachiopod species listed above, *Gigantoproductus talotensis* is known from the upper Visean (Kalashnikov, 1974; Tazawa and Miyake, 2002), *Latiproductus edelburgensis* from the upper Visean to Serpukhovian (Sarytcheva and Sokolskaya, 1952; Galitskaya, 1977), *Actinoconchus planosulcatus* from the lower and upper Visean (Brunton, 1980; Chen and Archbold, 2000), and *Lamellosathyris qaidamensis* from the upper Tournaisian to upper Visean (Chen et al., 2003). At the generic level, *Gigantoproductus* has a range of the lower Visean–Serpukhovian (Sarytcheva and Sokolskaya, 1952; Brunton et al., 2000; Tazawa, 2018), and *Martinia* is a long-ranging genus known from the lower Tournaisian to Changhsingian (Carter and Gourvennec, 2006). To summarize, the age of the Onimaru fauna is identified as late Visean. This conclusion is consistent with the previous work of Minato (1955), Minato

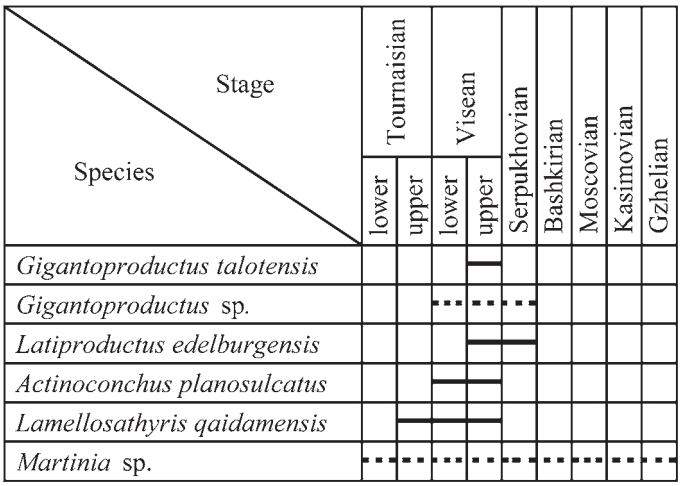

Fig. 3. Stratigraphic distribution of brachiopod species of the Onimaru fauna. Broken line shows range of the genus.

and Kato (1979) and Niikawa (1983b), who considered the age of the Onimaru Formation to be late Visean on the basis of coral fauna.

Palaeobiogeography

The geographic distributions of the brachiopod species of the Onimaru fauna are described in the next chapter, "Systematic descriptions", and summarized in Fig. 4 and Fig. 5. Of the six species of the fauna, three also occur in northwestern China (Xinjiang), and two in southwestern Japan (Akiyoshi Belt), northern Russia (northern Urals), the UK (England), Kazakhstan and northwestern China (Qinghai). These data suggest that the Onimaru fauna has a close affinity with the lower Carboniferous brachiopod faunas of southwestern Japan (Akiyoshi Belt), the northern Urals, England, Kazakhstan and northwestern China (Xinjiang and Qinghai). This conclusion is consistent with that of Tazawa (2017, 2018), who considered the South Kitakami region to probably be the eastern extension of the North China Province (Yang, 1983), and to have been located near and to the east of the North China Block in the late Visean as can be seen in Tazawa (2018, fig. 15).

Systematic descriptions

Order Productida Sarytcheva and Sokolskaya, 1959
Suborder Productidina Waagen, 1883
Superfamily Linoproductoidea Stehli, 1954
Family Linoproductidae Stehli, 1954

Species \ Region	Japan		USA				N. Russia	UK			W. Russia		Iran				NW China			NE China	CS China	
	1. South Kitakami Belt	2. Akiyoshi Belt	3. Ohio	4. Indiana	5. Missouri	6. Oklahoma	7. Northern Urals	8. England	9. Poland	10. Algeria	11. Moscow Basin	12. Donetz Basin	13. Elburz Mountains	14. Kazakhstan	15. Uzbekistan	16. Kyrgyzstan	17. Xinjiang	18. Qinghai	19. Gansu	20. Jilin	21. Hubei	22. Hunan
Gigantoproductus talotensis	+						+															
Gigantoproductus sp.	+																					
Latiproductus edelburgensis	+	+					+	+	+	+	+	+		+		+	+	+	+	+	+	+
Actinoconchus planosulcatus	+	+						+							+		+					
Lamellosathyris qaidamensis	+		+	+	+	+							+	+			+	+				
Martinia sp.	+																					

Fig. 4. Geographic distribution of brachiopod species of the Onimaru fauna.

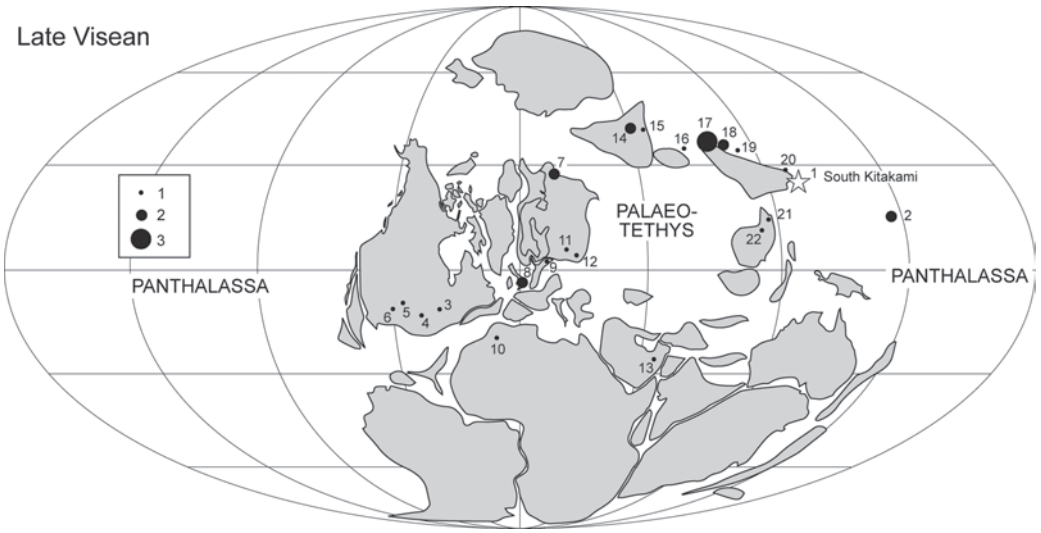

Fig. 5. Late Visean reconstruction map of the world (adapted Qiao and Shen, 2014), showing the geographic distribution of brachiopod species of the Onimaru fauna excluding two uncertain species (*Gigantoproductus* sp. and *Martinia* sp.) Solid circles indicate numbers of brachiopod species listed in the Onimaru fauna. Station numbers are same as in Fig. 4.

Subfamily Gigantoproductinae Muir-Wood and Cooper, 1960
Genus *Gigantoproductus* Prentice, 1950

Type species.—*Productus giganteus* Sowerby, 1822.

Gigantoproductus talotensis Kalashnikov, 1974
Fig. 6A

Gigantoproductus gigantoides talotensis Kalashnikov, 1974, p. 89, pl. 33, figs. 1, 2.
Gigantoproductus cf. *okensis* (Sarytcheva). Tazawa and Miyake, 2002, p. 3, figs. 2, 3.

Material.—One specimen from locality TON11, a ventral valve, OCMG2045.

Description.—Shell medium in size for genus, subquadrate in outline, with greatest width at hinge; length about 80 mm, width about 80 mm. Ventral valve moderately convex in both lateral and anterior profiles, most convex at umbonal region; ears large and triangular in shape, but not clearly demarcated from venter; sulcus absent, trail long. External surface of ventral valve ornamented with numerous, slightly flexuous costae, numbering 11–12 in 10 mm at about midlength. Rugae absent; fluting (by Pattison, 1981, p. 2) obscure, very shallow and irregular; spine bases not preserved.

Remarks.—The single specimen from Onimaru is lacking nearly half of the lateral side of the ventral valve, but not deformed. This specimen can be referred to *Gigantoproductus talotensis* Kalashnikov, 1974, from the upper Visean of the Pechorian Urals (northern Urals), northern Russia, in size, shape and external ornament of the ventral valve, particularly, in having prominent ears. *Gigantoproductus* cf. *okensis* (Sarytcheva, 1928), described by Tazawa and Miyake (2002, p. 3, figs. 2, 3) from the Onimaru Formation of Okusakamotozawa in the Hikoroichi area, South Kitakami Belt, is conspecific with the present species. *Gigantoproductus* cf. *crassiventer* (Prentice, 1949), described by Tazawa and Ibaraki (2009, p. 13, figs. 6.1, 6.2) from the upper part of the lower Hikoroichi Formation (HK2 Unit of Tazawa, 2018; lower Visean) of the Hikoroichi area, South Kitakami Belt, differs from *G. talotensis* in the smaller size and in having stronger fluting on anterior half of the ventral valve.

Distribution.—Upper Visean: northeastern Japan (South Kitakami Belt) and northern Russia (northern Urals).

Gigantoproductus sp.
Fig. 6B

Material.—One specimen from locality TNG3, a ventral valve, OCMG2046.

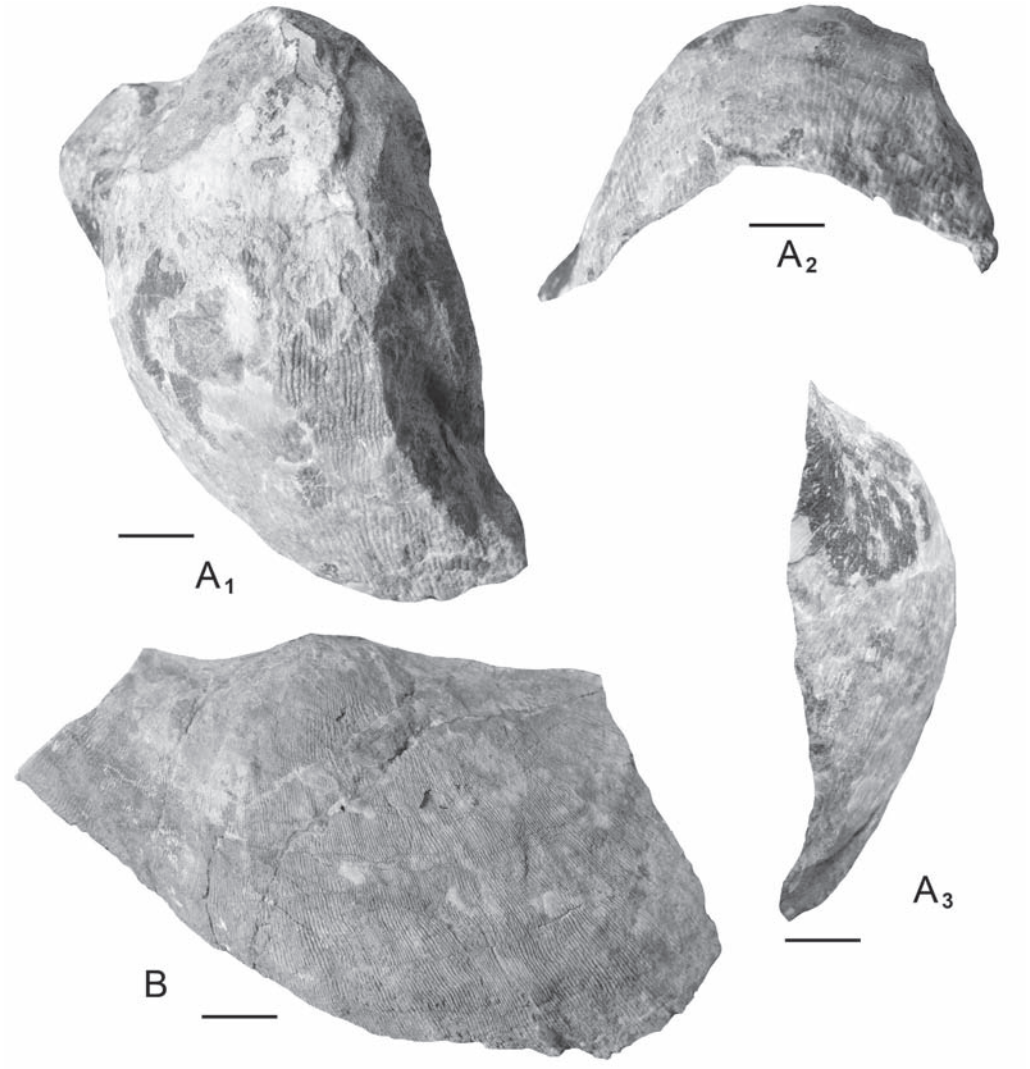

Fig. 6. Brachiopods of the Onimaru fauna (1). **A,** *Gigantoproductus talotensis* Kalashnikov, ventral (A_1), anterior (A_2) and lateral (A_3) views of ventral valve, OCMG2045; **B**, *Gigantoproductus* sp., ventral view of ventral valve, OCMG, 2046. Scale bars are 1 cm.

Remarks.—The single ventral valve specimen from the Nagaiwa–Onimaru area is safely assigned to the genus *Gigantoproductus* by the large, transverse (length about 65 mm, width about 100 mm) and moderately convex ventral valve, and the external ornament consisting of numerous fine costellae (numbering 24–25 in 10 mm at about midlength) and very shallow, irregular fluting on anterior half of the valve. In general shape and external ornamentation of the ventral valve, the Kitakami species resembles *Gigantoproductus maximus* (non M' Coy, 1844), described by Nalivkin and Fotieva (1973, p. 49, pl. 12, figs. 1, 2)

from the upper Visean of the western Urals, central Russia. The present species is probably a new species, but the material available is not sufficient for the establishment.

Genus *Latiproductus* Sarytcheva and Legrand-Blain, 1977

Type species.—*Productus latissimus* Sowerby, 1822.

Latiproductus edelburgensis (Phillips, 1836)
Fig. 7

Producta edelburgensis Phillips, 1836, p. 214, pl. 7, fig. 5.
Productus edelburgensis Phillips. Garwood, 1916, pl. 17, fig. 6.
Productus giganteus var. *edelburgensis* Phillips. Davidson, 1861, p. 143, pl. 40, fig. 2; Gröber, 1908, p. 230, pl. 27, figs. 1, 2; Hayasaka, 1924, p. 28, pl. 5, figs. 3–6.
Productus giganteus mut. *edelburgensis* Phillips. Gröber, 1909, p. 372, pl. 1, fig. 11; pl. 2, figs. 3, 4.
Productus (*Gigantoproductus*) *edelburgensis* Phillips. Gladchenko, 1955, p. 19, pl. 10, fig. 1.
Gigantoproductus edelburgensis (Phillips). Sarytcheva in Sarytcheva and Sokolskaya, 1952, p. 131, pl. 35, fig. 180; Prentice, 1956, p. 234, pl. 20, figs. 1, 2; pl. 22, figs. 1, 2; Ding in Yang et al., 1962, p. 71, pl. 27, fig. 4; pl. 28, fig. 1; Litvinovich, 1962, p. 206, pl. 6, figs. 1, 2; pl. 7, fig. 1; Litvinovich in Litvinovich et al., 1969, p. 179, pl. 19, fig. 2; pl. 21, fig. 1. Kalashnikov, 1974, p. 94, pl. 41, fig. 1; Galitskaya, 1977, p. 147, pl. 61, fig. 2; pl. 62, fig. 1; pl. 63, figs. 1, 2; Yang et al., 1977, p. 368, pl. 147, fig. 1; Lee et al., 1980, p. 386, pl. 149, fig. 4; Aisenverg and Poletaev, 1983, pl. 45, fig. 2; Wang, 1984, p. 197, pl. 79, fig. 1; Yang, 1984, p. 225, pl. 36, fig. 1; Yang and Gao, 1996, p. 217, pl. 32, figs. 1, 2; Tan, 1987, p. 122, pl. 17, fig. 7; Gu, 1992, p. 239, pl. 65, fig. 3; Chen and Shi, 2003, p. 155, pl. 7, fig. 16.
Productus-Gigantoproductus-edelburgensis Phillips. Pareyn, 1961, p. 202, pl. 24, figs. 4, 5.
Gigantoproductus cf. *edelburgensis* (Phillips). Legrand-Blain, 1973, p. 103, pl. 2, figs. 1–3, text-fig. 3a.
Gigantoproductus aff. *submaximus* (Bolkhovitinova). Yanagida, 1979, p. 111, fig. 2.
Gigantoproductus aff. *edelburgensis* (Phillips). Yanagida, 1979, p. 112, fig. 3.
Latiproductus? *edelburgensis* (Phillips). Zakowa, 1986, p. 65, pl. 6, fig. 1.
Latiproductus edelburgensis (Phillips). Ibaraki et al., 2014, p. 71, figs. 3.1–3.4.

Material.—One specimen from locality TNG1, a ventral valve, OCMG2044.

Remarks.—This specimen is represented by an abraded ventral valve, but can be referred to *Latiproductus edelburgensis* (Phillips, 1836), redescribed by Sarytcheva in Sarytcheva and Sokolskaya (1952, p. 131, pl. 35, fig. 180) from the Serpukhovian of the

Fig. 7. Brachiopods of the Onimaru fauna (2). *Latiproductus edelburgensis* (Phillips), ventral view of ventral valve, OCMG2044. Scale bar is 1 cm.

Moscow Basin, western Russia, by the large, transverse and moderately convex ventral valve (length more than 67 mm, width about 165 mm), without sulcus, and ornamented by numerous costae numbering 9–10 in 10 mm at about midlength of the valve. The type species, *Latiproductus latissimus* (Sowerby, 1822), redescribed by Sarytcheva and Legrand-Blain (1977, p. 76, pl. 7, figs. 5–7; pl. 8, figs. 1–5) from the Serpukhovian of the Moscow Basin, differs from *L. edelburgensis* in the smaller, more transverse ventral valve, ornamented with finer costae. The shell described by Wu et al. (1974, pl. 4, fig. 11) as *Gigantoproductus edelburgensis* (Phillips) from the Serpukhovian of western Guizhou, southwestern China, is deemed to be *Latiproductus latissimus* (Sowerby).

Distribution.—Upper Visean–Serpukhovian: northeastern Japan (South Kitakami Belt), southwestern Japan (Akiyoshi Belt), northern Russia (northern Urals), UK (England), Poland, Algeria, western Russia (Moscow Basin and Donetz Basin), Kazakhstan, Kyrgyzstan, northwestern China (Xinjiang, Qinghai and Gansu), northeastern China (Jilin) and central-southern China (Hubei and Hunan).

Order Athyridida Boucot, Johnson and Staton, 1964
Suborder Athyrididina Boucot, Johnson and Staton, 1964
Superfamiy Athyridoidea Davidson, 1881
Family Athyrididae Davidson, 1881
Subfamily Athyridinae Davidson, 1881
Genus *Actinoconchus* M'Coy, 1844

Type species.—*Actinoconchus paradoxus* M'Coy, 1844.

Actinoconchus planosulcatus (Phillips, 1836)
Fig. 8A

Spirifer planosulcata Phillips, 1836, p. 220, pl. 10, fig. 15.
Athyris planosulcata (Phillips). Davidson, 1859, p. 80, pl. 16, fig. 2 only.
Athyris (*Actinoconchus*) *planosulcata* (Phillips). Yanishevsky, 1918, p. 108, pl. 4, fig. 12.
Actinoconchus planosulcata (Phillips). Yanagida, 1962, p. 110, pl. 18, figs. 1–5, text-fig. 16.
Actinoconchus planosulcatus (Phillips). Brunton, 1980, p. 224, figs. 13, 14; Chen and Archbold, 2000, p. 191, figs. 5.5, 31, 32.

Material.—A conjoined shell from locality TON1, with external mould of the ventral valve, OCMG2047.

Remarks.—This specimen is referred to *Actinoconchus planosulcatus* (Phillips, 1836), redescribed by Brunton (1980, p. 224, figs. 13, 14) from the upper Visean of Yorkshire, England, in the small, transversely pentagonal shell (length 23 mm, width 30 mm), with shallow median sulci on both ventral and dorsal valves. *Actinoconchus expansus* (Phillips, 1836), redescribed by Brunton (1980, p. 222, fig. 10) from the lower Visean of Yorkshire, England, differs from *A. planosulcatus* in lacking median sulci (sulcus) on the ventral valve. The shell, described by Minato (1952, p. 174, pl. 8, fig. 4; pl. 10, fig. 4) as *Actinoconchus planosulcata* (Phillips) from the Hikoroiti Series (= Choanji Formation, Tazawa and Niikawa, 2018) of Tyoanji (Choanji), South Kitakami Belt, is readily distinguished from the present species by the much larger dimensions.

Distribution.—Lower–upper Visean: northeastern Japan (South Kitakami Belt), southwestern Japan (Akiyoshi Belt), UK (England), Uzbekistan (Fergana) and northwestern China (Xinjiang)

Genus *Lamellosathyris* Jin and Fang, 1983

Type species.—*Spirifer lamellosus* Léveillé, 1835.

Lamellosathyris qaidamensis Chen, Shi and Zhan, 2003
Fig. 8D

Athyris lamellosa (Léveillé). Hall and Clarke, 1895, p. 46, figs. 16–20; Weller, 1914, p. 465, pl. 78, figs. 1–5, 15–20; Zhang et al., 1983, p. 375, pl. 124, figs. 1, 2.
Actinoconchus cf. *lamellosa* (Léveillé). Minato, 1951, p. 380, pl. 1, fig. 6.

Actinoconchus lamellosa (Léveillé). Minato, 1952, p. 173, pl. 11, fig. 6.
Cleiothyridina lamellosa (Léveillé). Yang, 1964, p. 144, pl. 22, figs. 1, 2.
Athyris lamellosus (Léveillé). Litvinovich in Litvinovich et al., 1969, p. 281, pl. 69, fig. 6.
Athyris? *lamellosa* (Léveillé). Gaetani, 1968, p. 708, pl. 51, figs. 1–3, text-fig. 9.
Actinoconchus lamellosus (Léveillé). Minato et al., 1979a, pl. 19, fig. 1.
Lamellosathyris lamellosa (Léveillé). Tazawa, 1989, p. 61, pl. 1, fig. 3; Carter, 1999, p. 121, figs. 13, 14; Bahrammanesh et al., 2011, p. 158, figs. 7aa—gg, 11a—c.
Lamellosathyris qaidamensis Chen, Shi and Zhan, 2003, p. 849, figs. 4, 5.1–5.6, 5.8, 5.9, 5.11, 5.12, 5.16, 5.17, 6; Tazawa, 2018, p. 60, figs. 26M, N, 27A.

Material.—One specimen from locality TON9, a conjoined shell, OCMG2050.

Description.—Shell large in size for genus, transversely subelliptical in outline; cardinal extremities rounded; hinge much shorter than greatest width at midlength; length 43 mm, width 45 mm. Ventral valve moderately convex in lateral profile; sulcus narrow and shallow on anterior portion of valve, with rounded bottom. Dorsal valve more convex than ventral valve, with greatest convexity at posterior to midlength; fold low and narrow on anterior portion of valve. External surface of both valves ornamented with regular, strong concentric lamellae, numbering 2–3 in 10 mm length on dorsal valve; very fine concentric growth lines over valve.

Remarks.—This specimen is represented by an abraded, imperfect conjoined shell, lacking posterior portion of the ventral valve. But it can be referred to *Lamellosathyris qaidamensis* Chen, Shi and Zhan, 2003, from the upper Tournaisian–lower Visean of the Qaidam Basin, Qinghai, northwestern China, on account of the large size, dorsibiconvex profile and strong broad concentric lamellae on the both ventral and dorsal valves. The type species, *Lamellosathyris lamellosa* (Léveillé, 1835), redescribed by Brunton (1980, p. 225, figs. 15–17) from the upper Tournaisian of Tournai, Belgium, differs from *L. qaidamensis* in the smaller size and in having more numerous and narrower concentric lamellae on the both valves. Shells of *Lamellosathyris* species from the lower Carboniferous of the South Kitakami Belt, *Actinoconchus* cf. *lamellosa* (Léveillé, 1835), described by Minato (1951, p. 380, pl. 1, fig. 6) from the Jumonji Stage (= middle part of the Arisu Formation, Tazawa and Iryu, 2019) of the Shimoarisu area and *Actinoconchus lamellosa* (Léveillé, 1835) described by Minato (1952, p. 173, pl. 11, fig. 6) from the Jumonji Stage of the Shimoarisu and Yokota areas, are conspecific with *L. qaidamensis*.

Distribution.—Upper Tournaisian–upper Visean: northeastern Japan (South Kitakami Belt), USA (Ohio, Indiana, Missouri and Oklahoma), Iran (Elburz Mountains), Kazakhstan and northwestern China (Xinjiang and Qinghai).

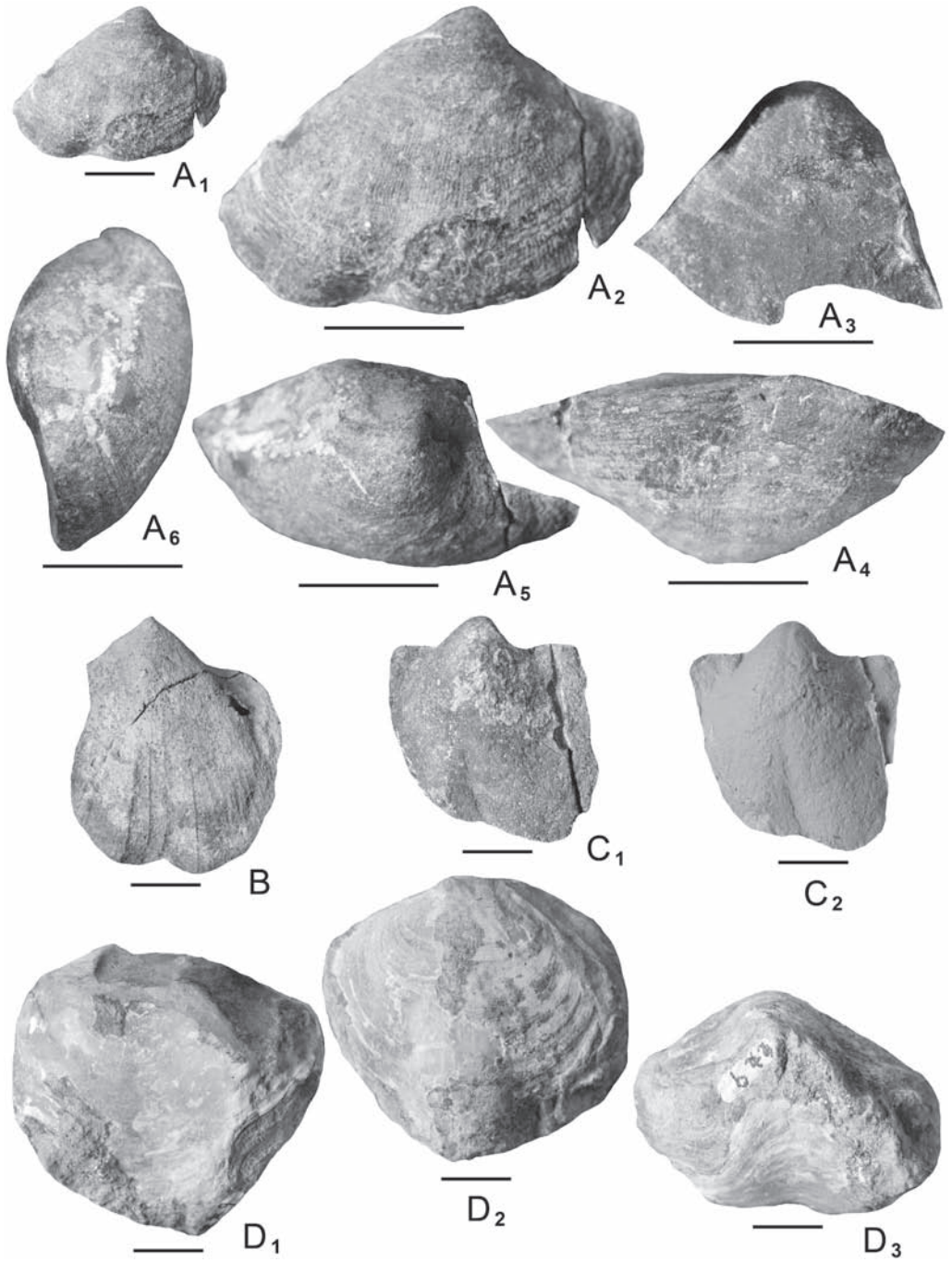

Fig. 8. Brachiopods of the Onimaru fauna (3). **A,** *Actinoconchus planosulcatus* (Phillips), ventral (A_1, A_2), dorsal (A_3), anterior (A_4), posterior (A_5) and lateral (A_6) views of conjoined shell, OCMG2047; **B, C,** *Martinia* sp.; B, internal mould of ventral valve, OCMG2049; C, internal mould (C_1) and external latex cast (C_2) of ventral valve, OCMG2048; **D,** *Lamellosathyris qaidamensis* Chen, Shi and Zhan, ventral (D_1), dorsal (D_2) and anterior (D_3) views of conjoined shell, OCMG2050. Scale bars are 1 cm.

Order Spiriferida Waagen, 1883
Suborder Spiriferidina Waagen, 1883
Superfamily Martinioidea Waagen, 1883
Family Martiniidae Waagen, 1883
Subfamily Martiniinae Waagen, 1883
Genus *Martinia* M'Coy, 1844

Type species.—*Spirifer glaber* Sowerby, 1820.

Martinia sp.
Fig. 8B, C

Material.—Two specimens from locality TON1: (1) external and internal moulds of a ventral valve, OCMG2048; and (2) internal mould of a ventral valve, OCMG2049.

Description.—Shell medium in size for genus, slightly longer pentagonal in outline; cardinal extremities rounded; hinge slightly shorter than greatest width at about midlength; length 39 mm, width about 35 mm in the larger specimen (OCMG2049); length 35 mm, width 32 mm in the smaller specimen (OCMG2048). Ventral valve moderately convex in lateral profile, most convex in umbonal region; ears large; sulcus narrow and shallow on anterior half of valve. External surface of ventral valve almost smooth, with some irregular concentric growth lines. Interior of ventral valve not well preserved except for radial vascular markings.

Remarks.—These specimens can be assigned to the genus *Martinia* by the almost smooth ventral valve and lacking internal structure of the ventral valve except for radial vascular markings. *Martinia pentagonalis* Jin and Hu (1978, p. 121, pl. 4, figs. 25, 26, 29–32), from the Kuhfeng Formation of Anhui, eastern China, somewhat resembles the Onimaru species in pentagonal outline of the ventral valve, but differs in its smaller size. *Martinia karawanica* Volgin (1959, p. 121, pl. 6, figs. 8–10) from the upper Carboniferous of Fergana, Uzbekistan, differs from the Onimaru species in the transverse outline. The type species, *Martinia glabra* (Sowerby, 1820), redescribed by Muir-Wood (1951, p. 111, pl. 3, fig. 2), from the upper Visean of Derbyshire, England, is readily distinguished from the present species in the much larger, transverse shell with smaller ears. The Onimaru species may be a new species, but the material is too poor for the establishment.

Conclusions

In this study, brachiopods of six species in five genera are described from the upper and uppermost parts of the Onimaru Formation in the Nagaiwa–Onimaru area, South Kitakami

Belt, northeastern Japan. The species are as follows: *Gigantoproductus talotensis* Kalashnikov, *Gigantoproductus* sp., *Latiproductus edelburgensis* (Phillips), *Actinoconcus planosulcatus* (Phillips), *Lamellosathyris qaidamensis* Chen, Shi and Zhan and *Martinia* sp. In conclusion, a late Visean age is assigned to the Onimaru fauna. In terms of palaeobiogeography, the Onimaru fauna possesses a close affinity with the lower Carboniferous brachiopod faunas of southwestern Japan (Akiyoshi Belt), the northern Urals, England, Kazakhstan and northwestern China (Xinjiang and Qinghai). The South Kitakami region was probably the eastern extension of the North China Province, and located near and to the east of the North China Block in the late Visean.

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