

Carboniferous brachiopod *Latiproductus edelburgensis* (Phillips, 1836) from Akiyoshi and Omi, Japan

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Abstract

A productid brachiopod species, *Latiproductus edelburgensis* (Phillips), is described from the upper Visean to lower Serpukhovian of the Akiyoshi Limestone, Akiyoshi, southwest Japan and the Omi Limestone, Omi, central Japan. The occurrence of *L. edelburgensis* indicates a late Visean to early Serpukhovian age for the *Mediocris mediocris* Zone of the Akiyoshi Limestone and the *Eostaffella-Millerella* Zone of the Omi Limestone. The stratigraphic and geographic distributions of *L. edelburgensis* are restricted to the Lower Carboniferous (upper Visean to lower Serpukhovian) of Europe, central and eastern Asia, northern Africa and western Panthalassa, and completely absent in North and South America and Australia.

Key words: Akiyoshi, Brachiopoda, *Latiproductus edelburgensis*, lower Carboniferous, Omi.

Introduction

Gigantoproductoids are large-sized brachiopods known as a leading fossil of Early Carboniferous (late Visean–early Serpukhovian) from Europe, Algeria, Russia, China and North America. In Japan, several gigantoproductoid species were previously described from the Omi Limestone in Omi, Itoigawa City, central Japan (Hayasaka, 1924), the Akiyoshi Limestone in Akiyoshi Plateau, southwest Japan (Yanagida, 1979), the Koyama Limestone in Oga, Takahashi City, southwest Japan (Ibaraki et al., 2014), the Ichinotani Formation in the Fukuji area, Hida Mountains (Tazawa and Kato, 1986; Ibaraki et al., 2009), the Tsuchikurazawa

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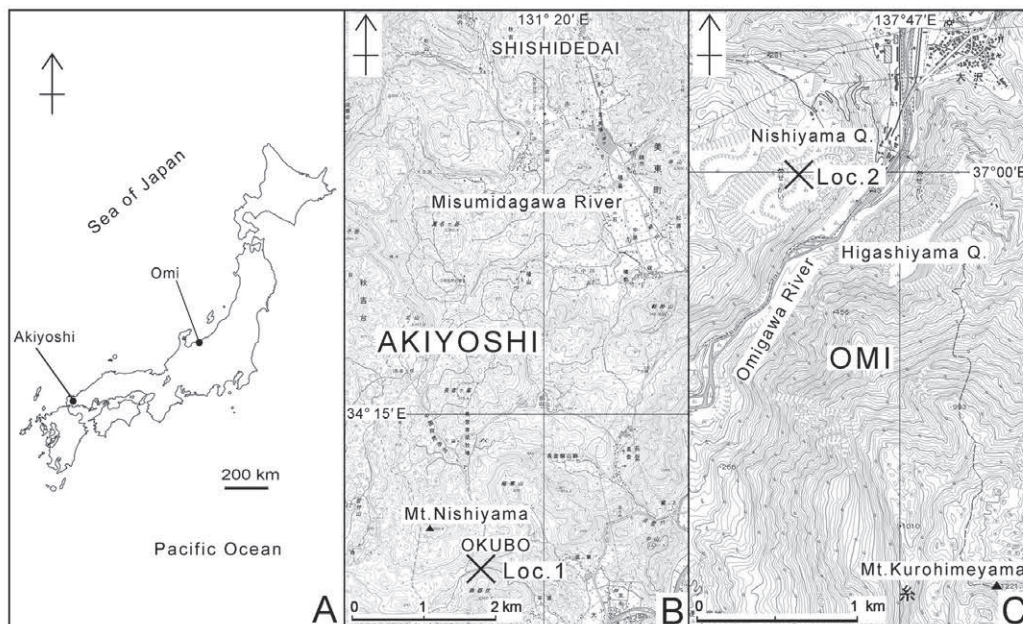


Fig. 1. Map showing the fossil localities, Loc. 1 (Okubo), Loc. 2 (Nishiyama Quarry), A: Akiyoshi, B: Omi, using the topographical map of “Akiyoshidaihokubu”, “Akiyoshidai” and “Itoigawa” scale 1:25,000 published by the Geographical Survey Institute of Japan.

Limestone in Kotaki, Itoigawa City, central Japan (Tazawa, 2004; Ibaraki et al., 2008, 2010) and the Onimaru Formation in the Nagaiwa-Onimaru area and the Hikoroichi Formation in the Hikoroichi area, southern Kitakami Mountains, northeast Japan (Tazawa and Miyake, 2002; Tazawa and Ibaraki, 2009; Tazawa, 2018; Tazawa and Taira, 2020).

In this paper, we examine four specimens of gigantoproductoids from the *Mediocris mediocris* Zone of the Akiyoshi Limestone in Shishidedai and Okubo, Akiyoshi Plateau, southwest Japan and the *Eostaffella-Millerella* Zone of the Omi Limestone in Nishiyama Quarry, Omi, Itoigawa City, central Japan (Fig. 1).

Material

The Akiyoshi specimens were collected by late Professor Juichi Yanagida of Kyushu University. Most of the Omi specimens were collected by Emeritus Professor Jun-ichi Tazawa of Niigata University. Based on the present systematic descriptions, all of the specimens are referred to *Latiproductus edelburgensis* (Phillips, 1836), originally described from the Lower Carboniferous of Bolland, Lancashire, England, the UK.

The specimens described herein are registered and housed in the Fossa Magna Museum



Fig. 2. Geographical distribution of *Latiproductus edelburgensis* (Phillips) in the late Viséan (adapted Scotese, 2004). 1: Algeria, 2: Lancashire, 3: Yorkshire, 4: Pennine Mountains, 5: Silesia, 6: Holy Cross Mountains, 7: Moscow Basin, 8: northern Timan, 9: Pechora, 10: central Ural, 11: central Kazakhstan, 12: northern Kirgizia, 13: Tien-Shan, 14: Xizang, 15: Qinghai, 16: Jilin, 17: Sichuan, 18: Jiangxi, 19: Hubei, 20: Hunan, 21: Guizhou, 22: Akiyoshi, 23: Omi, 24: Oga, 25: Nagaiwa-Onimaru.

(specimen numbers prefixed with FMM) and the Kitakyushu Museum of Natural History and Human History (specimen numbers prefixed with KMNHIVP).

Stratigraphic and geographic distributions of *Latiproductus edelburgensis*

Latiproductus edelburgensis has been described from the upper Viséan–Serpukhovian of Algeria (1; Legrand-Brain, 1973, 1980; Pareyn, 1961). Lancashire, England (2; Phillips, 1836), Yorkshire, England (3; Davidson, 1958–1963; Prentice, 1956), Pennine Mountains, England (4; Pattison, 1981), Silesia, Germany (5; Paeckelmann, 1931), Holy Cross Mountains, Poland (6; Zakowa, 1986), Moscow Basin, western Russia (7; Sarytcheva and Sokolskaya, 1952), northern Timan, western Russia (8; Aisenberg and Poletaev, 1970), Pechora, western Russia (9; Kalashnikov, 1974), central Urals, western Russia (10; Einor, 1957), central Kazakhstan (11; Litovinovich, Aksenova and Razina, 1969), northern Kirgizia (12; Gladchenko, 1955; Galitzkaja, 1977), Tien-Shan, Northwest China (13; Gröber, P., 1909; Krenkel, 1913), Xizang, Southwest China (14; Jin et al., 1985), Qinghai, Northwest China (15; Yang et al., 1962), Jilin, Northeast China (16; Lee et al., 1980), Sichuan, Southwest China (17; Yang and Jiang, 1987), Jiangxi, South China, (18; Wang et al., 1982), Hubei, South China (19; Wang, 1984), Hunan, South China (20; Tan, 1987; Liu et al., 1982), Guizhou, South China (21; Chao, 1927), Akiyoshi, southwest Japan (22; Yanagida, 1989), Omi, central Japan (23; This paper), Oga, southwest Japan (24; Ibaraki et al., 2014), Nagaiwa-Onimaru, South Kitakami Mountains, northeast Japan (25; Tazawa and

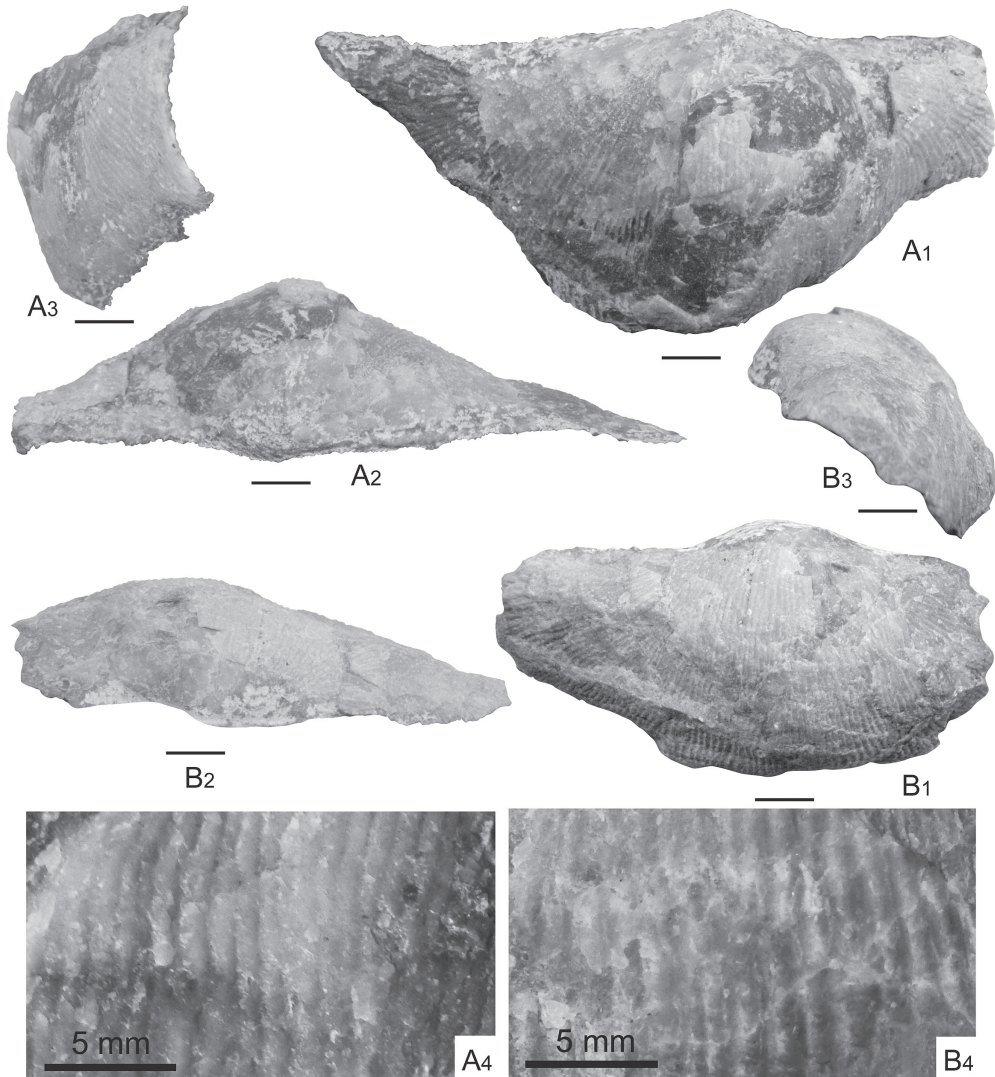


Fig. 3. A₁ – A₄: ventral, posterior, lateral views and enlarged radial costae of conjoined valve, KMNHiv710001. B₁ – B₄: ventral, posterior, lateral views and enlarged radial costae of dorsal valve, KMNHiv710002. Scale bars are 1 cm, except of A₄ and B₄.

Taira, 2020) (Fig. 2).

From the above data, the range of *Latiproductus edelburgensis* is assigned to late Viséan–Serpukhovian, which is the same as the summary by Brunton et al. (2000). Qiao and Shen (2015) also concluded as above. Palaeobiogeographically, it is noteworthy that *L. edelburgensis* has been mostly found from equatorial to mid latitude areas of Asia and Europe, but completely absent in North America, South America and Australia. This result is consistent with one of the conclusions in Qiao and Shen (2014). The lower Carboniferous

limestones of Omi and Akiyoshi were probably reef-seamount of the Panthalassa in the mid-latitude area of the Northern Hemisphere during late Viséan–Serpukhovian. This conclusion is consistent with that of Tazawa et al. (2005), in which they noted that the Akiyoshi-Omi reef-seamounts were probably located at the lower to middle northern palaeolatitude on the Panthalassa during the early Carboniferous (late Viséan).

Systematic descriptions

(by Y. Ibaraki)

Order Procuctida Sarycheva and Sokolskaya, 1959
 Suborder Productidina Waagen, 1883
 Superfamily Linoproductoidea Stehli, 1954
 Family Linoproductidae Stehli, 1954
 Subfamily Gigantoproductinae Muir-Wood and Cooper, 1960
 Tribe Semiplanini Sarycheva, 1960
 Genus *Latiproductus* Sarycheva and Legrand-Blain, 1977

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

Latiproductus edelburgensis (Phillips, 1836)

Figs. 3–4

Producta edelburgensis Phillips, 1836, p. 214, pl. 7, fig. 5.

Productus giganteus mut. *edelburgensis* (Phillips). Glöber, 1909, p. 372, pl. 1, fig. 11; pl. 2, figs. 3–4.

Productus giganteus var. *edelburgensis* (Phillips). Hayasaka, 1924, p. 143, pl. 54, figs. 1, 2.

Striatifera edelburgensis (Phillips). Chao, 1927, p. 107, pl. 10, figs. 4, 5; pl. 12, fig. 6.

Gigantella edelburgensis var. *glöbereri* Sarycheva, 1928, p. 51, pl. 4, fig. 5.

Productus (*Gigantella*)? *edelburgensis* (Phillips). Paeckelmann, 1931, p. 260, pl. 29, figs. 1a–1c.

Productus (*Gigantella*) *edelburgensis*? Ozaki, 1939, p. 244, pl. 38, fig. 2.

Productus (*Gigantella*) *edelburgensis*? var. *shajenwaensis* Ozaki, 1939, p. 242, pl. 37, fig. 4; pl. 38, fig. 1; pl. 39, fig. 2.

Gigantoproductus edelburgensis (Phillips). Sarycheva in Sarycheva and Sokolskaya, 1952, p. 131, pl. 35, fig. 180; Prentice, 1956, p. 234, pl. 20, figs. 1a–c, 2; Galitskaya, 1977, p. 147, pl. 61, figs. 2a–2b; pl. 62, fig. 1; pl. 63, figs. 1–2.

Productus (*Gigantoproductus*) *edelburgensis* (Phillips). Gladchenko, 1955, p. 19, pl. 10, figs. 1a–1c.

Productus (*Gigantoproductus*) *edelburgensis* var. *schaitankaensis* Einor, 1957, p. 151, pl. 3, fig. 3.

Productus-Gigantoproductus-edelburgensis (Phillips). Pareyn, 1961, p. 202, pl. 24, figs. 4, 5.

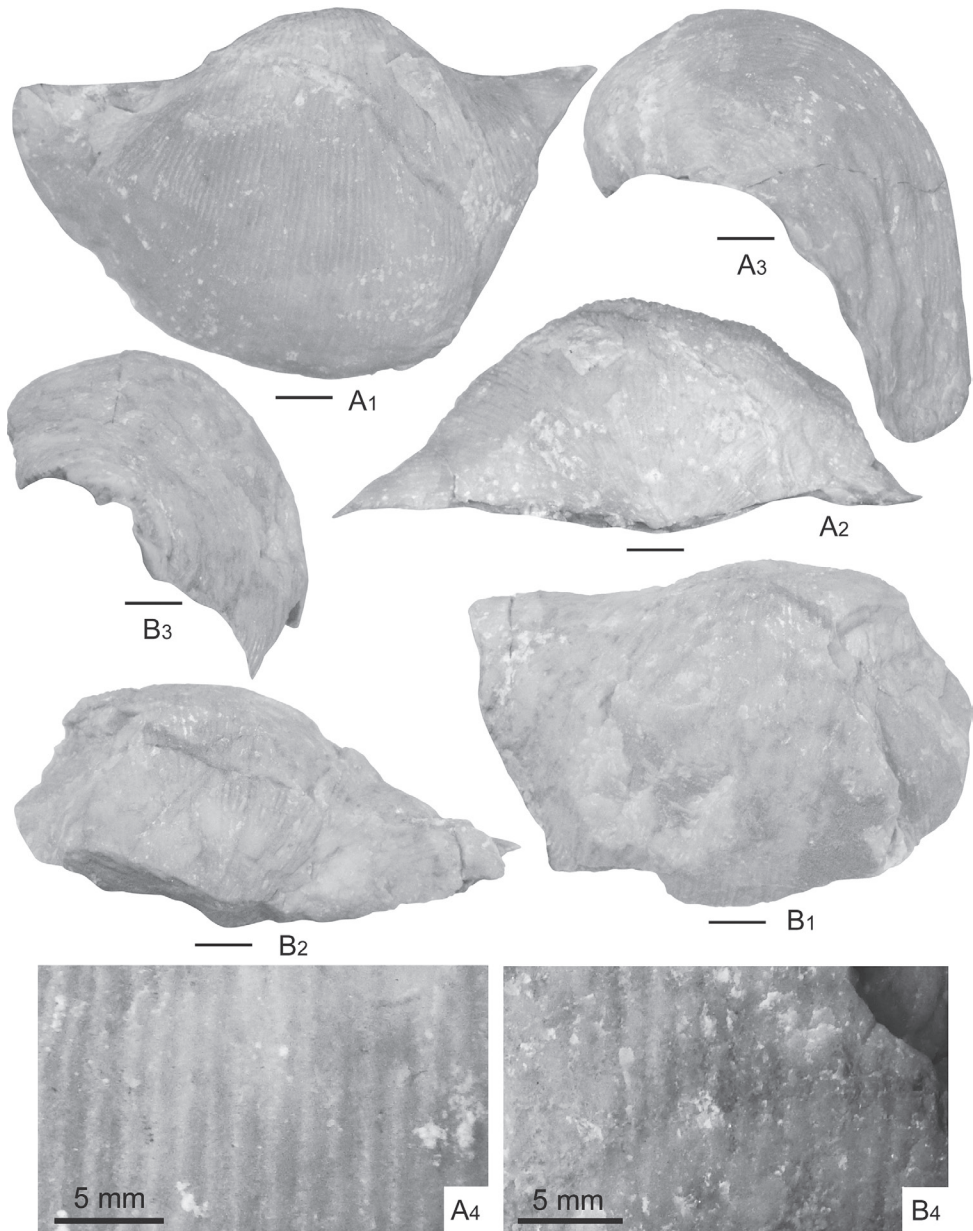


Fig. 4. A₁ – A₄: ventral, posterior, lateral views and enlarged radial costae of ventral valve, FMM2023. B₁ – B₄: ventral, posterior, lateral views and enlarged radial costae of ventral valve, FMM2024. Scale bars are 1 cm, except of A₄ and B₄.

Productus (Gigantoproductus) edelburgensis var. *beleutensis* Litvinovich, 1962, p. 207, pl. 7, fig. 2.

Gigantoproductus cf. *edelburgensis* (Phillips). Legrand-Blain, 1973, p. 91, pl. 2, figs. 1a–1b.

Gigantoproductus edelburgensis edelburgensis (Phillips). Semichatova, 1975, p. 173, pl. 77, fig. 1.

Gigantoproductus edelburgensis schaitakaensis (Einor). Semichatova, 1975, p. 173, pl. 77, fig. 2.

Gigantoproductus edelburgensis? var. *shajenwaensis* (Ozaki). Yang et al., 1977, p. 368, pl. 146, fig. 4.

Gigantoproductus aff. *edelburgensis* (Phillips). Yanagida, 1979, p. 112, fig. 3.

Gigantoproductus aff. *submaximus* (Bolikhovitinova). Yanagida, 1979, p. 111, fig. 2.

Gigantoproductus edelburgensis var. *shajenwaensis* (Ozaki). Liu et al., 1982, p. 189; pl. 135, fig. 5.

Latiproductus (?) *edelburgensis sahariensis* forme a Legrand-Blain, 1980, p. 42, pl. 3, figs. 3; text-figs. 13, 15.

Latiproductus (?) *edelburgensis sahariensis* forme c Legrand-Blain, 1980, p. 46, pl. 5, figs. 1, 2; text-figs. 13, 16.

Latiproductus (?) *edelburgensis subsahariensis*. Legrand-Blain, 1980, p. 47, pl. 1, fig. 6; pl. 3, fig. 4; text-figs. 14, 17.

Latiproductus edelburgensis (Phillips). Zakowa, 1986, p. 65, pl. 6, fig. 1; Ibaraki et al., 2014, p. 17, fig. 3; Tazawa and Taira, 2020, p. 21, fig. 7.

Material.—(1) An imperfect conjoined valve, KMNHIv710001 from Loc. 1; (2) two ventral valves, FMM2023, 2024 from Loc. 2; (3) a dorsal valve, KMNHIv710002 from Loc. 1.

Description.—Shell medium size for genus, transversely semicircular in outline, with greatest width at hinge; length 60 mm, width 110 mm in the largest specimen (FMM2023); length 50 mm, width about 90 mm in the smallest specimen (FMM2024). Ventral valve moderately convex in lateral profile, strongly geniculated at 40–50 mm from umbo; flanks gently inclined; umbo small, rounded and inflated; ears large, triangular and moderately demarcated from flanks; sulcus absent. External surface of ventral valve ornamented with numerous costae but no rugae; costae regular in anterior part, but irregular in trail, numbering 8–10 per 10 mm at about midvalve, and costae sometimes bifurcated or inserted in anterior regions; intercostal sulci as wide as costae; several radial fluting crossing costae on trail; numerous fine growth lines on valve; spines or spine bases not preserved on the surface of valves. Dorsal valve slightly concave, geniculated at 40–50 mm from umbo; incurve of midvalve weaker than that of ventral valve; external surface of dorsal disc ornamented with numerous costae; costae regular, numbering 8–9 per 10 mm at about midvalve; costae sometimes bifurcated or inserted in anterior regions; no rugae; numerous fine growth lines over the inner surface; interior of both valves not observed.

Remarks.—The specimens are assigned to *Latiproductus edelburgensis* (Phillips, 1836), originally described from the Lower Carboniferous of Bolland, Lancashire, England, from account of size, shape, and external ornament of ventral valve, particularly in its size, shape of umbo. *Latiproductus latissimus* (Sowerby, 1822), described and figured by Pattison (1981) differs from *L. edelburgensis* in its smaller size and flattened ears, existence of a sulcus, finer costae, absence of intercostal sulci on ventral valve and thicker shell. *Gigantoproductus submaximus* (Bolikhovitinova, 1932) resembles *L. edelburgensis* in shape of ventral valve and

the presence of several rugae on trail, but differs in its larger size, finer costae on ventral valve. A specimen described as *Gigantoproductus* aff. *submaximus* (Bolkhovitnova) by Yanagida (1979) is reassigned to *Latiproductus edelburgensis*, owing to the following reasons: 1) The specimen of Yanagida (1979) lacks a long trail with fluting flexuously costae in the ventral valve, which are characteristics of *L. edelburgensis* as shown in well-preserved specimen (Galitskaya, 1977: fig. 1, pl. 63) and 2) the ventral valve of *G. submaximus* is much larger and having finer costae than those of *L. edelburgensis*.

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