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Pararigbyella and *Dicystoconcha* (Lyttoniidina, Brachiopoda) from the middle Permian (Wordian) of Japan

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Abstract. Permianellids are a specialized fossil group of Brachiopoda characterized by a complicated forking lobe system. In this paper, we report two permianellid species (*Pararigbyella doulingensis* Shen and Zhang, 2008 and *Dicystoconcha lapparenti* Termier and Termier in Termier *et al*., 1974), from the middle Guadalupian (Wordian, middle Permian) of the Kamiyasse-Imo area, South Kitakami Belt, Northeast Japan, of which *Pararigbyella doulingensis* is the first record in Japan. A global review of all occurrences of the two genera suggests that *Pararigbyella* is restricted to the Cathaysian Province, while *Dicystoconcha* is mainly distributed in the Paleotethyan region and the two transitional zones between the Boreal or Gondwanan and Paleotethyan realms.

Key words: *Dicystoconcha*, *Pararigbyella*, Permian, South Kitakami Belt, Wordian

Introduction

This paper presents the first description of two unusual Permian lyttoniid brachiopods, *Pararigbyella* and *Dicystoconcha*, from Japan, i.e., *Pararigbyella doulingensis* Shen and Zhang, 2008 and *Dicystoconcha lapparenti* Termier and Termier in Termier *et al*., 1974, from the middle Guadalupian (Wordian, middle Permian) of the Kamiyasse-Imo area, South Kitakami Belt, northeast Japan.

The material was collected from sandstone and argillaceous limestone of the lower Kamiyasse Formation (Wordian) at localities KF217 and KF218, upper Imosawa Valley, Kamiyasse-Imo area in South Kitakami Belt (Figures 1, 2). The Kamiyasse Formation (designated by Misaki and Ehiro, 2004) consists mostly of sandstone and shale, associated with limestone and conglomerate, and is 288 m thick. The age of the lower Kamiyasse Formation is considered to be Wordian on the basis of ammonoids (Ehiro and Misaki, 2005), and early Midian on the basis of fusulinids (Kobayashi *et al*., 2009).

Pararigbyella has been recorded from the uppermost part of the Douling Formation (basal Wuchiapingian) in Hunan, central South China. Its allied genus *Rigbyella* Stehli, 1956 has been reported from the Lamar Limestone (Capitanian) of the Bell Canyon Formation in West Texas, USA. *Dicystoconcha* has been recorded from the unnamed Murgabian (middle Guadalupian) limestones in Wardak, central Afghanistan (Termier and Termier in Termier *et al*., 1974), which palaeobiogeographically belongs to the southern transitional Cimmerian Province during the middle Guadalupian (Shi *et al*., 1995), the Lengwu Formation (Capitanian) in Zhejiang, Southeast China (Liang, 1990), the Chihsia Formation in Hubei, central South China (Yang, 1984), the upper Douling Formation (Capitanian) in Guangdong, South China (Mou and Liu, 1989), the Tongziyan Formation (Capitanian) in Fujian, East China (Zhu, 1990) and the Chandalaz Formation (Capitanian) in South Primorye, Russian Far East (Licharew and Kotlyar, 1978). Thus, *Pararigbyella* is restricted to the Cathaysian Province (Shen *et al*., 2009); and *Dicystoconcha* is mainly distributed in the Paleotethyan region and the two transitional zones between the Boreal or Gondwanan and Paleotethyan realms (Shi *et al*., 1995). The middle Guadalupian (Wordian) brachiopod fauna of the South Kitakami Belt is characterized by a mixture of both Boreal and Paleotethyan elements (Tazawa, 1991, 2002, 2007). Therefore, the specimens of *Pararigbyella* and *Dicystoconcha* from the Kamiyasse-Imo area are newly additional Paleotethyan elements of the South Kitakami fauna.

The brachiopod specimens described herein are registered and housed in the Department of Geology, Niigata University (NU-B), and the Rikuzentakata City Museum,

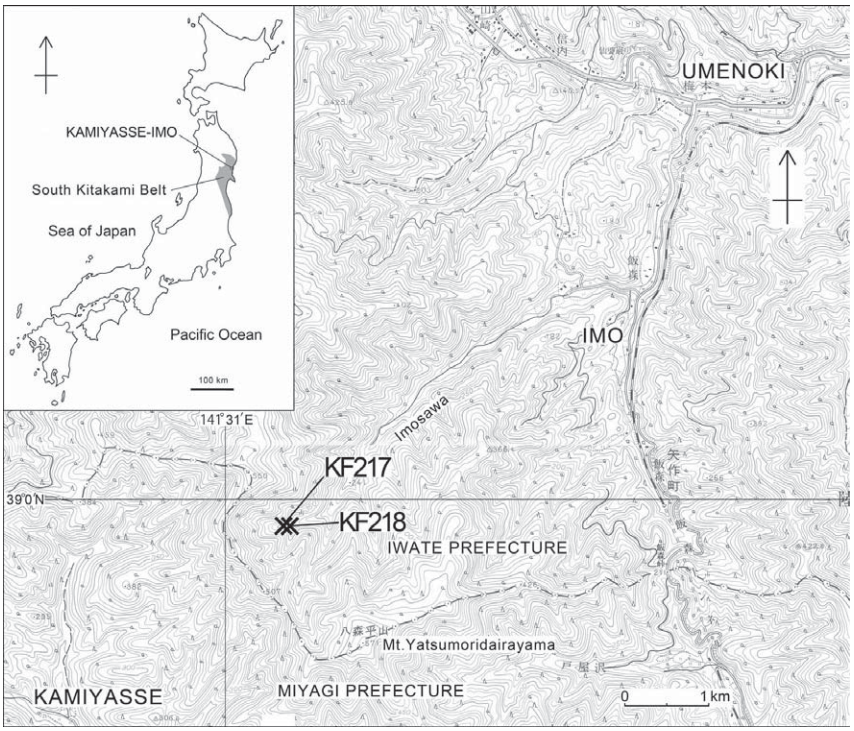

Figure 1. Map showing the fossil localities KF217 and KF218 in the Kamiyasse-Imo area (using the topographical maps of "Imaizumi" and "Shishiori" scale 1:25,000 published by the Geospatial Information Authority of Japan).

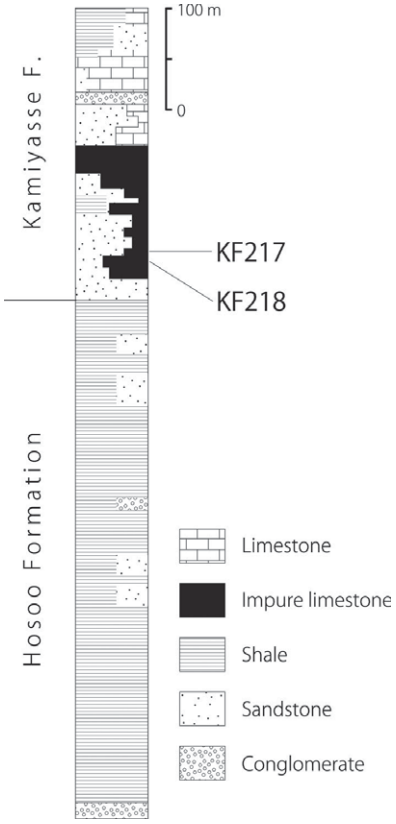

Figure 2. Columnar section of the middle Permian of the Kamiyasse-Imo area, showing the fossil horizons KF217 and KF218 (modified and adapted from Tazawa, 1973, 1976).

Rikuzentakata, Iwate Prefecture (RCM-F).

Systematic descriptions

Order Productida Sarytcheva and Sokolskaya, 1959
Suborder Lyttoniidina Williams, Harper and Grant, 2000
Superfamily Lyttonioidea Waagen, 1883
Family Lyttoniidae Waagen, 1883
Subfamily Lyttoniinae Waagen, 1883
Genus ***Pararigbyella*** Shen and Zhang, 2008

Type species.—*Pararigbyella quodrilobata* Shen and Zhang, 2008, p. 933, figs. 5.1–5.11.

Discussion.—Williams *et al.* in Brunton *et al*. (2000) proposed a new family Rigbyellidae to accommodate two genera (*Rigbyella* and *Paralyttonia*) in view of their lobe system nearly parallel to the median axis. However, the general outline of the ventral valve of these two genera is very similar to other members of Lyttoniidae Waagen, 1883. The septum and its corresponding lobe systems of the dorsal valve in Lyttoniidae are highly variable in direction, from vertical (e.g. *Leptodus*), to oblique (e.g. *Oldhamina*, *Sceletonia*) to parallel to the median axis (e.g. *Rigbyella*, *Pararigbyella*). Therefore, we consider *Pararigbyella* is a member of Lyttoniidae Waagen, 1883.

Pararigbyella differs from *Rigbyella* Stehli, 1956 in its complicated forking lobes, more elongate outline and much more distinct median septum. The elongate triangular outline of *Pararigbyella* indicates that it is different from the cup-like shape of *Rigbyella* with a very strong cicatrix on the beak. *Pararigbyella* is similar to *Paralyttonia* Wanner in Wanner and Sieverts, 1935 in its septal system but differs in having more complicated lobes and a distinct median septum. *Pararigbyella* is also somewhat similar to permianellids (*Permianella* He and Zhu, 1979 and allied genera) in view of their symmetrically bifurcated lobes. But the permianellids have two lobes only, often deeply incised both valves, and a thin knife-edged median septum or a central median platform in the

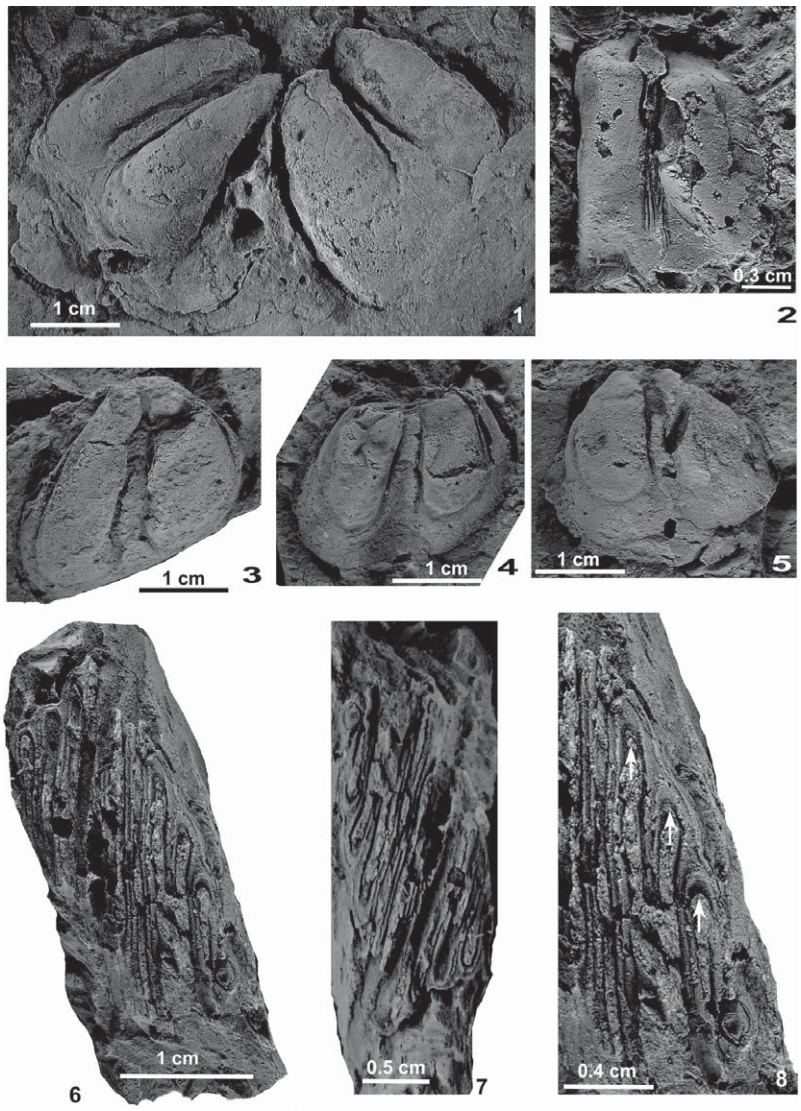

Figure 3. **1–5,** *Dicystoconcha lapparenti* Termier and Termier in Termier *et al*., 1974; 1, internal molds of two ventral valves, RCM-F-10001 (right), RCM-F-10002 (left); 2–5, four internal molds of ventral valves, immature specimens, RCM-F-10005 (2), RCM-F-10003, RCM-F-10004 (4), and RCM-F-10006 (5); **6–8,** *Pararigbyella doulingensis* Shen and Zhang, 2008; 6–7, ventral view of an internal mold of a ventral valve; 8, enlargement of the right side of a ventral valve showing the bifurcation of lobes (white arrows), NU-B1756.

ventral valve.

Pararigbyella doulingensis Shen and Zhang, 2008

Figures 3.6–3.8

Pararigbyella doulingensis Shen and Zhang, 2008, p. 933, figs. 5.12–5.14.

Material.—One specimen, internal mold of a ventral valve, NU-B1756, collected from argillaceous limestone of the lower Kamiyasse Formation at locality KF218, Kamiyasse-Imo area.

Description.—Shell large size for genus, elongate triangular in outline, with the greatest width at anterior margin; length 35 mm, width about 26 mm in the specimen NU-B1756. Ventral valve gently convex; median septum distinct, bounded by two sinuses in posterior one-third; a pair of lateral septa symmetrically developed from one-third of shell length; crests of all septa rounded; sinuses narrower than septa, bifurcated three to four times anteriorly and forming about ten sinuses.

Discussion.—The present specimen is not very well preserved. However, its size, outline, bifurcated lobes and distinct median septum are generally comparable

with those of *Pararigbyella doulingensis* Shen and Zhang, 2008, from the uppermost Douling Formation (lowest Wuchiapingian) in Chenxian, Hunan, central South China. The Kitakami specimen bifurcates three to four times to form more sinuses than those from Hunan. However, we consider that this reflects different growth stages, and being an intraspecific variation.

The type species, *Pararigbyella quadrilobata* Shen and Zhang (2008, p. 933, figs. 5.5–5.11), from the uppermost part of the Douling Formation (lowest Wuchiapingian) in Hunan, is readily distinguished from the present species by its much smaller dimensions and fewer sinuses.

Distribution.—Wordian–basal Wuchiapingian; northeast Japan (South Kitakami Belt) and central South China (Hunan).

Superfamily Permianelloidea He and Zhu, 1979
Family Permianellidae He and Zhu, 1979
Genus ***Dicystoconcha*** Termier and Termier in Termier *et al*., 1974

Type species.—*Dicystoconcha lapparenti* Termier and Termier in Termier *et al*., 1974.

Discussion.—*Dicystoconcha* Termier and Termier in Termier *et al*., 1974 differs from its allied genera *Permianella* He and Zhu, 1979 and *Laterispina* Wang and Jin, 1991 in its short and rounded outline, shallaw anterior incision, no distinct lateral brim and two septa on the central platform in the ventral valve. Both *Permianella* and *Laterispina* possess a strong median septum on the central platform, which can be readily distinguished from *Dicystoconcha* (see Shen and Tazawa, 1997). Frech (1901, p. 503) proposed the genus *Loczyella* with *Loczyella nankingensis* Frech, 1901, from the Chihsia Formation (upper Cisuralian) in Nanjing as the type species. However, this genus was established based on a poorly preserved incomplete specimen. It is nearly impossible to compare with any other genera except that it looks like a lytoniid. A *Loczyella* species has been subsequently described by Licharew (1930, p. 436, figs. 1, 2) as *Loczyella? parvula* Licharew, 1930, from the lower Permian of the Caucasus Mountians, but the Caucasus species has been assigned to *Permianella grunti* by Shen and Shi (1997, p. 273). If the specimen under the name *Loczyella nankingensis* from the Chihsia Formation in Nanjing (Frech, 1901) is confirmed as a permianellid in a future study, *Dicystoconcha* would be a junior synonym of *Loczyella*. A *Loczyella* species was also reported from the Lengwu Formation in Zhejiang, Southeast China (Liang, 1990, p. 216, pl. 39, fig. 9), but it is highly likely a species of *Dicystoconcha*.

Dicystoconcha lapparenti Termier and Termier in Termier *et al.*, 1974

Figures 3.1–3.5

Dicystoconcha lapparenti Termier and Termier in Termier *et al*., 1974, p. 123, pl. 22, figs. 1–2, text-fig. 22.
Guangjiayuanella guangjiayanensis Yang, 1984, p. 211, pl. 31, figs. 11–16, text-fig. 5–9.
Guangdongina xiamaoensis Mou and Liu, 1989, p. 458, pl. 1, figs. 1–9; pl. 2, figs. 1–7, text-fig. 5.
Guangdongina leguminiformis Mou and Liu, 1989, p. 458, pl. 3, figs. 4–8.
Guangdongina perforans Mou and Liu, 1989, p. 459, pl. 2, fig. 8; pl. 3, figs. 1–3.
Guangdongina sp. Mou and Liu, 1989, p. 460, pl. 2, fig. 9.
Fabulasteges planata Liang, 1990, p. 381, pl. 42, figs. 3–4.

Material.—Six specimens, internal molds of six ventral valves (RCM-F-10001-10006), collected from the sandstone in the lower Kamiyasse Formation at locality KF217, Kamiyasse-Imo area.

Description.—Shell small, consisting of two lobes, slightly triangular or ovate in outline, with maximum width near anterior margin; no distinct hinge line on posterior end probably attaching other objects; lateral margins generally rounded and divergent anteriorly in immature specimens, but becoming less divergent in large specimens; length 25 mm, width 27 mm in the largest specimen (RCM-F-10001); length 19 mm, width 22 mm in an average-sized specimen (RCM-F-10003). Ventral valve with a deep sulcus and anterior incision dividing the shell into two equal lobes; sulcus originating from beak, slightly broader anteriorly, anterior incision very shallow, irregular marginal brim may be present; ventral surface with 1–2 strong concentric growth lines. Ventral interior with a distinct central platform, but septum not observed. Dorsal valve not preserved.

Discussion.—The Kitakami specimens are not well preserved in the internal structures of both valves, but they can be referred to *Dicystoconcha lapparenti* Termier and Termier in Termier *et al.*, 1974, described from the middle Guadalupian of Wardak, central Afghanistan, in the ovate outline, shallow anterior incision, deep ventral sulcus and the strong concentric growth lines on the ventral valve.

The following six forms from the Permian of Southeast to South China are considered to be junior synonyms of the present species: *Guangjiayuanella guangjiayuanensis* Yang, 1984 from the basal part of the Chihsia Formation in the Yangtze Gorge area in Hubei and Hunan; four species of *Guangdongina*, described by Mou and Liu (1989) from the upper Douling Formation of Guangzhou, Guangdong Province, i.e., *G. xiamaoensis, G. leguminiformis*, *G. permforans* and *G.* sp.; and *Fabulasteges planata* (Liang, 1990), from the Lengwu Formation of

Zhejiang Province.

Distribution.—Artinskian-Capitanian; central Afghanistan, Northeast Japan (South Kitakami Belt), North China (Inner Mongolia), central South China (Hubei, Hunan and Guangdong).

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References

Brunton, C. H. C., Lazarev, S. S., Grant, E. R. and Jin, Y. G., 2000: Productidina. *In*, Williams, A., Brunton, C. H. C., Carlson, S. J., *et al. eds.*, *Treatise on Invertebrate Paleontology*, *Part H*, *Brachiopoda (Revised)*, *Vol. 3*, *Linguliformea*, *Craniiformea*, *and Rhynchonelliformea (Part)*, p. 424–609. Geological Society of America, Boulder and The University of Kansas Press, Lawrence.

Ehiro, M. and Misaki, A., 2005: Middle Permian ammonoids from the Kamiyasse-Imo district in the Southern Kitakami Massif, Northeast Japan. *Paleontological Research*, vol. 9, p. 1–14.

Frech, F., 1901: Die Dyas. *In*, *Lethaea Geognostica*. *I. Teil*, *Lethaea Paleozoica*, *Bd*. *2*, p. 453–578. E. Nagele, Stuttgart.

He, X. L. and Zhu, M. L., 1979: A new form of brachiopods and its systematical classification. *Journal of China Institute of Mining Technology*, no. 4, p. 131–140.

Kobayashi, F., Shiino, Y. and Suzuki, Y., 2009: Middle Permian (Midian) foraminifers of the Kamiyasse Formation in the Southern Kitakami Terrane, NE Japan. *Paleontological Research*, vol. 13, p. 79–99.

Liang, W. P., 1990: *Lengwu Formation of Permian and its brachiopod fauna in Zhejiang Province*, 522 p. Geological Memoirs 10, Ministry of Geology and Mineral Resources, People's Republic of China, Geological Publishing House, Beijing. (*in Chinese with English summary*)

Licharew, B. K., 1930: On two new representatives of the family Productidae from the Lower Permian of North Caucasus. *Doklady Akademii Nauk SSSR*, *Seriya A*, vol. 16, p. 436–440. (*in Russian*)

Licharew, B. K. and Kotlyar, G. V., 1978: Permian brachiopods of South Primorye. *In*, Popeko, L. I. *ed.*, *Upper Palaeozoic of Northeast Asia*, p. 63–75. DVNTS, Akademiya Nauk SSSR, Vladivostok. (*in Russian*)

Misaki, A. and Ehiro, M., 2004: Stratigraphy and geologic age of the Permian in the Kamiyasse-Imo district, Southern Kitakami Massif, Northeast Japan. Journal of the Geological Society of Japan, vol. 110, p. 129–145. (*in Japanese with English abstract*)

Mou, C. J. and Liu, C. L., 1989: A new type of brachiopods-*Guangdongina* and its ecological environment. *Acta Palaeontologica Sinica*, vol. 28, p. 455–462. (*in Chinese with English abstract*)

Sarytcheva, T. G. and Sokolskaja, A. N., 1959: On the classification of the pseudopunctate brachiopods. *Doklady Akademii Nauk SSSR*, vol. 125, p. 181–184. (*in Russian*)

Shen, S. Z. and Shi, G. R., 1997: *Permianella* (Brachiopoda) from the Upper Permian of Transcaucasia. *Science Reports of Niigata University*, *Series E*, no. 12, p. 19–27.

Shen, S. Z. and Tazawa, J., 1997: Two permianellids (Brachiopoda) from the Middle Permian of the southern Kitakami Mountains, northeast Japan. *Paleontological Research*, vol. 1, p. 285–290.

Shen, S. Z., Xie, J. F., Zhang, H. and Shi, G. R., 2009: Roadian-Wordian (Guadalupian, Middle Permian) global palaeobiogeography of brachiopods. *Global and Planetary Change*, vol. 65, p. 166–181.

Shen, S. Z. and Zhang, Y. C., 2008: Earliest Wuchiapingian (Lopingian, Late Permian) brachiopods in southern Hunan, south China: Implications for the pre-Lopingian crisis and onset of lopingian recovery/radiation. *Journal of Paleontology*, vol. 82, p. 924–937.

Shi, G. R., Archbold, N. W. and Zhan, L. P., 1995: Distribution and characteristics of mixed (transitional) mid-Permian (Late Artinskian-Ufimian) marine faunas in Asia and their palaeogeographical implications. *Palaeogeography*, *Palaeoclimatology*, *Palaeoecology*, vol. 114, p. 241–271.

Stehli, F. G., 1956: Notes on oldhaminid brachiopods. *Journal of Paleontology*, vol. 30, p. 305–313.

Tazawa, J., 1973: Geology of the Kamiyasse area, Southern Kitakami Mountains. *Journal of the Geological Society of Japan*, vol. 79, p. 677–686. (*in Japanese with English abstract*)

Tazawa, J., 1976: The Permian of Kesennuma, Kitakami Mountains: A preliminary report. *Earth Science (Chikyu Kagaku)*, vol. 30, p. 175–185.

Tazawa, J., 1991: Middle Permian brachiopod biogeography of Japan and adjacent regions in East Asia. *In*, Ishii, K. I., Liu, X. M., Ichikawa, K. and Huang, B. *eds.*, *Pre-Jurassic Geology of Inner Mongolia*, *China*, p. 213–230. Matsuya Insatsu, Osaka.

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

Tazawa, J., 2007: Middle Permian brachiopod faunas of Japan and their significance for understanding the Paleozoic-Mesozoic tectonics of the Japanese Islands. *In*, Wong, Th. E. *ed.*, *Proceedings of the 15th International Congress on Carboniferous and Permian Stratigraphy*, *Utrecht*, *the Netherlands*, *10-16 August 2003*, p. 565–573. Royal Netherlands Academy of Arts and Sciences, Amsterdam.

Termier, G., Termier, H., Lapparent, A. F. de and Marin, P., 1974: Monographie du Permo-Carbonifère de Wardak (Afghanistan central). *Documents des Laboratoires de Géologie*, *Lyon*, *Hors Série 2*, p. 1–167.

Waagen, W., 1883: Salt Range Fossils. I. *Productus*-Limestone fossils. *Geological Survey of India*, *Memoirs*, *Palaeontologia Indica*, *Series 13*, vol. 4, p. 391–546.

Wang, H. Y. and Jin, Y. G., 1991: On permianellids (Brachiopoda). *Acta Palaeontologica Sinica*, vol. 30, p. 481–501. (*in Chinese with English abstract*)

Wanner, J. and Sieverts, H., 1935: Zur Kenntnis der permischen Brachiopoden von Timor. *Neues Jahrbuch für Mineralogie*, *Geologie und Paläontologie*, *Abteilung B*, vol. 74, p. 201–281.

Williams, A., Harper, D. A. T. and Grant, R. E., 2000: Lyttoniidina. *In*, Williams, A., Brunton, C. H. C., Carlson, S. J., *et al. eds*., *Treatise on Invertebrate Paleontology*, *Part H*, *Brachiopoda (Revised)*, *Vol. 3*, *Linguliformea*, *Craniiformea*, *and Rhynchonelliformea (Part)*, p. 424–919. Geological Society of America, Boulder and University of Kansas, Lawrence.

Yang, D. L., 1984: Brachiopoda. *In*, Feng, S. N., Xu, S. Y., Lin, J. X. and Yang, D. L. *eds.*, *Biostratigraphy of the Yangtze Gorge Area*, *3- Late Paleozoic Era*. p. 203–239. Geological Publishing House, Beijing. (*in Chinese with English summary*)

Zhu, T., 1990: *The Permian Coal-Bearing Strata and Palaeobiocoenosis of Fujian*, 127 p. Geological Publishing House, Beijing. (*in Chinese*)