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PLATYSTROPHIA (ORTHIDA, BRACHIOPODA) FROM THE ARENIG AND LOWERMOST LLANVIRN OF NORTHWESTERN RUSSIA

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Abstract. Six species of the genus *Platystrophia* (Plectorthidae, Orthida) are described from the Arenig and lowermost Llanvirn of the Baltic–Ladoga Klint, northwestern Russia. One taxon represents an earlier known species, one a new species, and four forms are described in open nomenclature. The oldest species of the genus in the Ordovician of Baltoscandia are *Platystrophia* sp. a Rubel, 1961 and *Platystrophia*? sp. 1 (in this paper) from the Volkhov Stage (upper part of the *Baltoniodus triangularis–B. navis* conodont Zone) of the St. Petersburg region. The lack of granulation on the shell makes the generic attribution of both species tentative.

The distribution of the genus *Platystrophia* in the upper Arenig–lower Llanvirn of Russia, Wales, North America, South America, and China is discussed. The earliest known species of the genus is *Platystrophia* sp. from the *Niquivilia* brachiopod Zone (lower part of the *B. triangularis–B. navis* Zone) of the Argentine Precordillera. This species has no granulation on the well-preserved shell; therefore its generic position should be confirmed by further study.

Key words: Brachiopoda, *Platystrophia*, Ordovician, Arenig, Llanvirn, Russia.

INTRODUCTION

The genus *Platystrophia* King, 1850 includes one of the most distinctive and widespread brachiopods in the Ordovician of Baltoscandia, which makes its first appearance in the late Arenig (Volkhov Stage) and ranges up into the Wenlock (Jaagarahu Stage). The main task of the present paper is to revise the earliest Arenig–Llanvirn species of *Platystrophia* from the Lower Palaeozoic outcrop area along the eastern part of the Baltic–Ladoga Klint (Fig. 1).

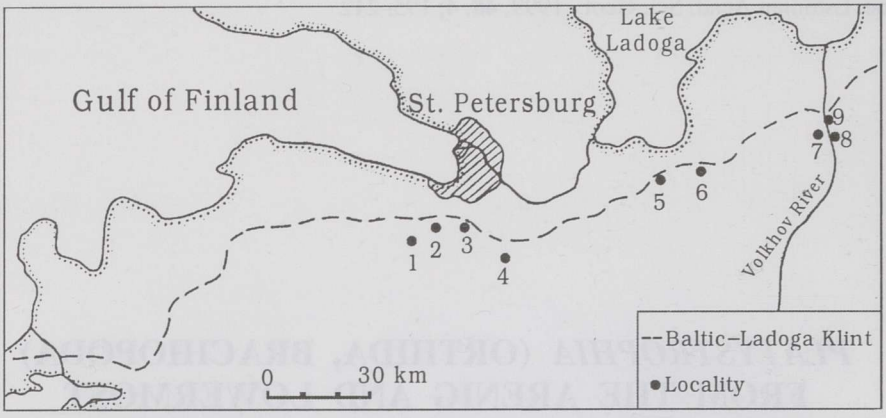


Fig. 1. Map of the study area. 1, Kipen village; 2, Kirchoff Mountain; 3, Pulkovka River; 4, Popovka River; 5, Putilovo quarry; 6, Lava River; 7, Izvoz village; 8, Simankovo village; 9, Babino quarry.

In the St. Petersburg region, in terms of regional stratigraphical units from the Volkhov to Kunda stages of the Oeland Series, the studied interval is mostly represented by glauconitic (Volkhov Formation) and oolitic (Obukhovo Formation) limestones. It has been discussed in a number of recent publications (Dronov & Fedorov, 1995; Dronov et al., 1996, 1998). The lithostratigraphic subdivisions of the Volkhov and Kunda stages described in these publications are used here to characterize the stratigraphic distribution of the earliest Baltic *Platystrophia* (Fig. 2).

The figured specimens under the collection number 12974 are deposited in the Central Scientific-Research Geological Exploration Museum named after F. N. Chernyshev (CNIGR), St. Petersburg, where also A. von Volborth's collection No. 13017 is housed. Two specimens (one of them figured) of *Platystrophia costata* from the collection of C. H. Pander (MMI 373) are housed in the Museum of the Mining Institute, St. Petersburg.

DISTRIBUTION OF THE EARLIEST *PLATYSTROPHIA*

The earliest finds of *Platystrophia* come from the upper Arenig–lower Llanvirn of northwest Russia, Wales, North America, South America, and China (Fig. 3). *Platystrophia* sp. a Rubel, 1961 and *Platystrophia*? sp. 1 (in this paper) from the Volkhov Stage of the St. Petersburg region are tied to the upper part of the *Baltoniodus triangularis–B. navis* conodont Zone (for zones see Fortey et al., 1995; Dronov et al., 1998). This is the earliest known occurrence of *Platystrophia* in Baltoscandia. These species, as well as two unnamed species described here

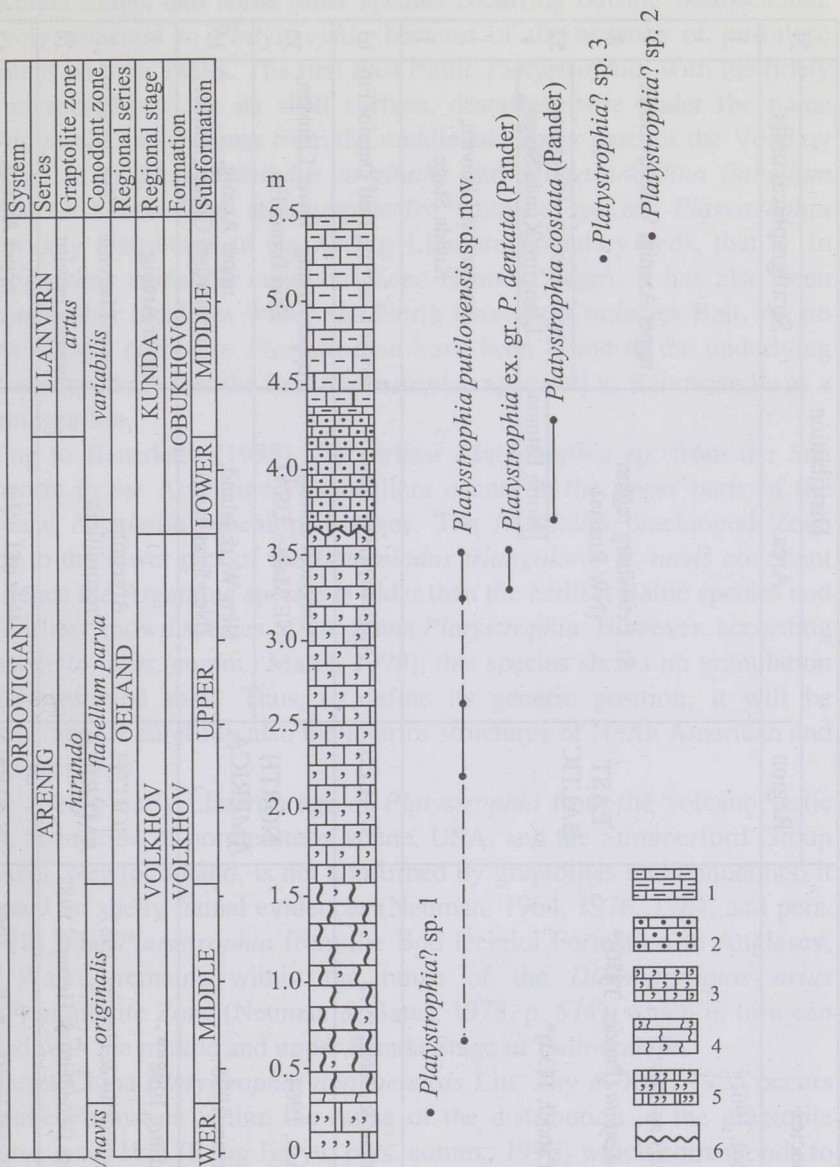


Fig. 2. Distribution of *Platystrophia* in the Volkhov and Kunda stages in the eastern Baltic–Ladoga Klint (generalized section of the Volkhov and Obukhovo formations based on the data of Dronov & Fedorov, 1995; Dronov at al., 1996). Key: 1, "orthoceratite" limestone; 2, "lower oolite layer"; 3–5, glauconite limestone; 6, unconformity.

Species	Distribution			N
	Region	Area	Stratigraphical units	
Platystrophia sp. a Rubel, 1961	EAST BALTIC	St. Petersburg region (NW Russia)	upper Arenig, Volkhov Stage	1
Platystrophia? sp. 1*				1
Platystrophia putilovensis sp. nov.*				51
Platystrophia ex. gr. *P. dentata* (Pander, 1830)*				3
Platystrophia costata (Pander, 1830)*			upper Arenig–lowermost Llanvirn, Kunda Stage	52
		North Estonia		1
Platystrophia? sp. 2*			lowermost Llanvirn, Kunda Stage	1
Platystrophia? sp. 3*				1
Platystrophia? sp. Neuman & Bates, 1978	WALES	Anglesey (NW Wales)	lower Llanvirn, Bod Deiniol Fm.	13
Platystrophia sp. Neuman, 1964	NORTH AMERICA	Penobscot county (NE Maine, USA)	upper Arenig–lower Llanvirn, Shin Brook Fm.	32
Platystrophia? sp. Neuman, 1976		New Work Island, (Newfoundland)	upper Arenig, Summerford Group (unit B)	15
Platystrophia sp. Benedetto, 1998**	SOUTH AMERICA	Argentine Precordillera	upper Arenig	?
Platystrophia minuta Benedetto & Herrera, 1987			lower Llanvirn San Juan Fm.	5
Platystrophia fasciculata Benedetto & Herrera, 1987			lower Llanvirn	24
Platystrophia dongbeiensis Liu, Zhy & Xue, 1985	NE CHINA	West of Luohe (Heilohgjiang Province)	upper Arenig, Dazhi and Xiqiuhe Fms.	13

Fig. 3. Late Arenig–early Llanvirn species of the genus *Platystrophia.* * species described in this paper; ** undescribed species; N, number of specimens.

from the Kunda Stage, and some other species occurring outside Baltoscandia, are tentatively assigned to *Platystrophia* because of the absence of pustulose microornament on their shells. The first East Baltic *Platystrophia*, with the finely pustulose microornament on its shell surface, described here under the name *Platystrophia putilovensis*, comes from the middle and upper parts of the Volkhov Stage, that is, from the *Paroistodus originalis* and *Microzarkodina flabellum parva* conodont zones. The stratigraphically younger species *Platystrophia costata* is widely distributed in the Arenig–Llanvirn boundary beds, that is, in the *Eoplacognathus variabilis* conodont Zone (Kunda Stage). It has also been found in some other localities within the North Estonian Confacies Belt. As no brachiopods closely related to *Platystrophia* have been found in the underlying deposits, it is very likely that the first *Platystrophia* appeared in Baltoscandia as a result of immigration.

According to Benedetto (1998), the earliest *Platystrophia* sp. from the San Juan Formation in the Argentine Precordillera occurs in the upper parts of the *Monorthis* and *Niquivilia* brachiopod zones. The *Niquivilia* brachiopod Zone corresponds to the lower part of the *Baltoniodus triangularis–B. navis* conodont Zone, and hence the Argentine species is older than the earliest Baltic species and can be the earliest known species of the genus *Platystrophia*. However, according to J. L. Benedetto (pers. comm., March 1999), this species shows no granulation on the well-preserved shell. Thus, to define its generic position, it will be necessary to compare carefully also the interior structures of North American and East Baltic specimens.

The late Arenig–early Llanvirn age of *Platystrophia* from the volcanoclastic Shin Brook Formation of northeastern Maine, USA, and the Summerford Group in Virgin Arm, Newfoundland, is not confirmed by graptolites and conodonts; it is solely based on shelly faunal evidences (Neuman, 1964, 1976, 1984, and pers. comm., 1998). The *Platystrophia* from the Bod Deiniol Formation in Anglesey, northwest Wales, remains within the range of the *Didymograptus artus* (= "*bifidus*") graptolite Zone (Neuman & Bates, 1978, p. 574), which in turn can be correlated with the middle and upper Kunda Stage of Baltoscandia.

In northeast China *Platystrophia dongbeiensis* Liu, Zhy & Xue, 1985 occurs in the Xiqiuhe Formation within the range of the distribution of the graptolite *Phyllograptus anna* Hall (Rong Jia-yu, pers. comm., 1998) which corresponds to the latest Arenig–early Llanvirn. This stratigraphic level may be correlated with the Kunda Stage of the Baltoscandian sequence.

The place of origin and subsequent migration routes of *Platystrophia* during the pre-Arenig remain unclear. However, it is remarkable that outside East Baltic all known early Ordovician occurrences of the genus are reported from microplates, separated from major land massifs in the early Ordovician (e.g. Avalonian Plate), or suspect terranes with complicated early Palaeozoic geological history.

SYSTEMATIC DESCRIPTIONS

Family PLECTORTHIDAE SCHUCHERT, 1929

Subfamily PLATYSTROPHIINAE SCHUCHERT, 1929

Genus *Platystrophia* King, 1850

Type species. *Terebratulites biforatus* von Schlotheim, 1820, from the Ordovician of the Baltic area (exact locality and horizon uncertain).

Platystrophia costata (Pander, 1830)

Plate I, figures 1–14; Figure 4; Table 1

1830 *Porambonites costatus* n. sp.; Pander, p. 96, pl. XI, fig. 3.
1837 *Spirifer chama* Eichwald; Buch, p. 34.
1840 *Spirifer chama* Eichwald; Buch, p. 180.
1841 *Spirifer chama* Eichwald, p. 31.
1845 *Spirifer biforatus* var. *chama* Eichwald (*pars*); Verneuil, p. 139, f. minor *non* f. major pl. V, fig. 1.
non 1861 *Platystrophia costata* Pander; Eichwald, p. 233.
1961 *Platystrophia* sp. c Rubel, p. 155, pl. I, fig. 7; pl. II, figs. 1–5.
1961 *Platystrophia costata* (Pander); Rubel, p. 156, pl. I, fig. 8.

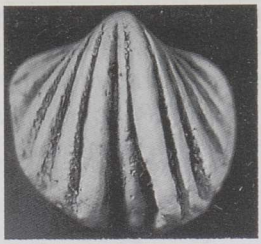
Neotype. Selected here: complete shell MMI 1/373, collection of C. H. Pander of 1845, Pulkovka River, St. Petersburg region (horizon is not specified, probably from the Kunda Stage, Obukhovo Formation).

Pander (1830) did not select the holotype. The collection used in that paper was lost by the beginning of the 20th century. However, two complete shells of *Platystrophia* from Pander's collection of 1845, MMI 373, were identified by him as *Spirifer biforatus* var. *chama* from the Pulkovka River, St. Petersburg region. This identification is considered to be synonymous to *Porambonites costata*

Explanation of Plate I

Figs. 1–10. *Platystrophia costata* (Pander). 1–5, MMI 1/373; ventral, dorsal, lateral, anterior, and posterior views of conjoined valves; Pulkovo village; coll. by C. H. Pander, 1845. 6, CNIGR Museum 5/12974; anterior view of conjoined valves. 7–9, CNIGR Museum 4/12974; ventral, lateral, and posterior views of conjoined valves; Lava River; Kunda Stage. 10, CNIGR Museum 7/12974; interior of dorsal valve; Putilovo quarry; Kunda Stage; coll. by the author.

Figs. 11–14. *Platystrophia* cf. *P. costata* (Pander). CNIGR Museum 6/12974; ventral, dorsal, anterior, and posterior views of conjoined valves; Putilovo quarry; Kunda Stage; coll. by the author. Figs. 1–9, 11–14 ×3; fig. 10 ×5.



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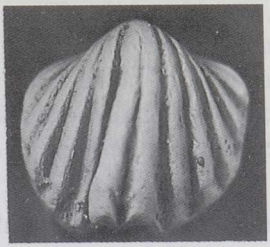

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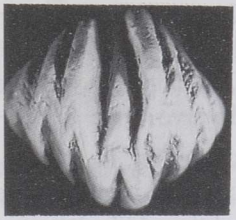

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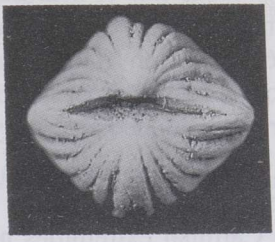

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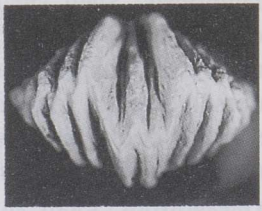

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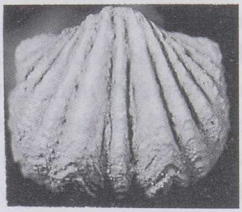

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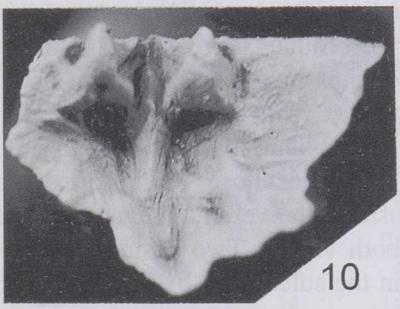

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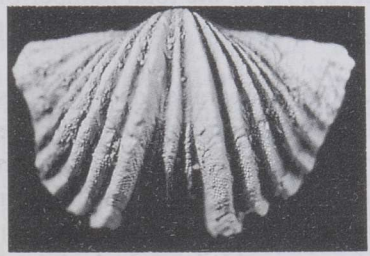

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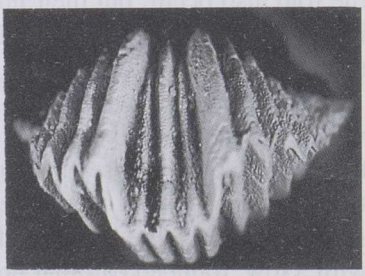

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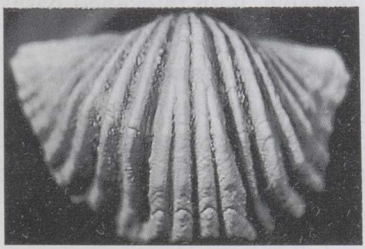

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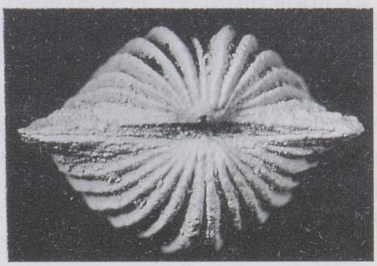

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Pander by Verneuil (1845, pp. 139, 140). These specimens, indeed, strongly resemble *Platystrophia costata*, as described and illustrated by Pander, in their external morphology and character of radial ornament. Because of their locality, the Pulkovka River, they can be regarded as the topotypes of *Porambonites costatus*. One of them is selected as the neotype of *Platystrophia costata* (Pander) in this paper.

Material. 35 complete shells, 9 ventral and 8 dorsal valves.

Diagnosis. Shell small for the genus, subequally biconvex, subrectangular in outline, with maximum width at hinge line or near mid-valve; cardinal extremities nearly right-angled; radial ornament with 1 costa in ventral sulcus, 2 costae in dorsal median fold, and 5–6 costae on flanks; brachiophore bases massive, subrhomboidal in cross-section; cardinal process ridge-like, situated on a wide notothyrial platform; median ridge extended anteriorly to mid-valve.

Description. Shell subequally biconvex, transverse, subrectangular in outline, up to 11 mm long and up to 14.5 mm wide, with the maximum width at the hinge line or near mid-valve. Cardinal extremities nearly right-angled. Anterior commissure uniplicate. Ventral valve strongly and evenly convex, with somewhat swollen, strongly curved beak and low, apsacline interarea slightly curved in cross-section. Delthyrium open, triangular, narrow. Sulcus narrow, originating in the umbonal area, with steep lateral slopes. Margins of sulcus diverge at about 20–24°. Dorsal valve moderately and evenly convex, with low, orthocline interarea, slightly curved. Beak incurved, slightly swollen. Narrow median fold originates in the umbonal area. Shell surface finely pustulose. Radial ornament composed mainly of angular costae, with 1 costa in the ventral sulcus, 2 in the dorsal fold, and 5–6 costae on the flanks of both valves. Two costae originate occasionally near mid-length by intercalation in the sulcus and by bifurcation in the fold. Finely pustulose specimens with 3 costae in the sulcus and 4 costae in the fold also occur, but their number does not exceed 20% of the total number of individuals in the collection (Pl. I, figs. 11–14). Growth lines present in most specimens.

Ventral interior with small teeth supported by stout subparallel dental plates which extend to the anterior to confine the ellipsoidal muscle field on the thickened platform (pseudospondylium). The crural fossettes are very shallow on the inner face of the teeth. Details of the muscle scars are not known. Interior surface of the valve crenulated in the anterior half of the valve. Dorsal interior with a low, rounded cardinal process extends for about two-thirds of the length of a wide notothyrial platform. Brachiophores high, massive, with thickened bases, subrhomboidal in cross-section. Dental sockets moderately deep and wide. Adductor muscle field quadripartite. Posterior adductor scars strongly impressed, suboval in outline. Anterior adductor scars elongate ellipsoidal in outline. Median ridge extends anteriorly to mid-valve; it is low posteriorly and becomes thin and high between anterior adductor scars. Interior surface of the valve crenulated in the anterior half of the valve.

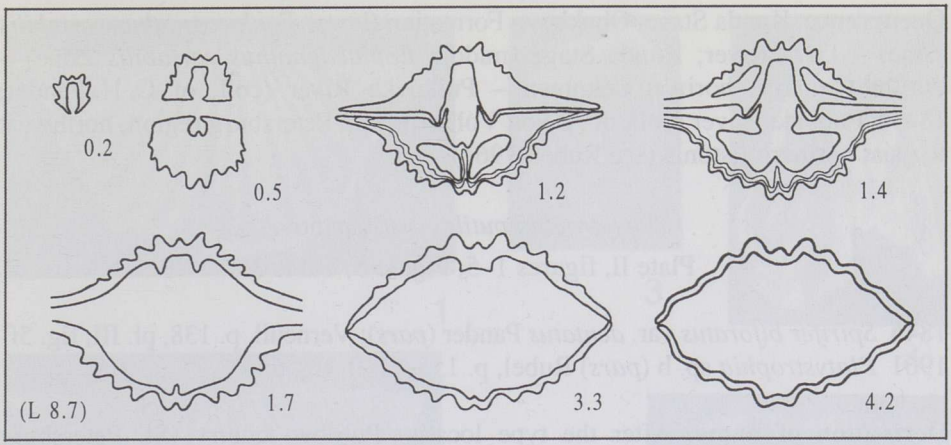

Fig. 4. Serial sections of *Platystrophia costata* (Pander) based on specimen 31/12974. L = sagittal length. Measurements in mm. ×2.5.

Table 1. *Platystrophia costata* (Pander), average dimensions (in mm) of 13 complete shells. L = sagittal length, W = width, T = thickness, X = mean, S = standard deviation, MIN = minimum value, MAX = maximum value, N = number of specimens

	L	W	T	L/W	T/L
N	13	13	12	13	12
X	9.7	11.8	9.3	83%	96%
S	0.97	0.97	1.63	7.3	12.9
MIN	7.6	9	6	69%	77%
MAX	11	14.5	11.8	95%	114%

Discussion. *Platystrophia costata* resembles *Platystrophia pseudocostata* Bondarev (1968) from the Yugorskii Stage, early Caradoc of Vaigach Island, in its rounded rectangular shell outline, transverse profile of both valves, and number of costae in the sulcus, fold, and flanks. *Platystrophia costata* may be distinguished from the latter species by having strongly incurved swollen beaks in both valves, narrow ventral sulcus and dorsal median fold, smaller and rounded costae, as well as low, rounded cardinal process in the dorsal valve.

The radial ornament on some specimens is characterized by bifurcation of costae in the dorsal median fold; intercalation of two costae in the ventral sulcus (see Pl. I, figs. 11–14) is rather unusual for the Baltoscandian species of *Platystrophia*. Such pattern specifies the North American representatives of the genus which have been referred to a so-called tricostate group of species (Cummings, 1903; McEwan, 1919). The bifurcation occurs also in some specimens of unicostate *Platystrophia anomala* Hiller (1980) from the Dolhir Formation of North Wales (Ashgill).

Occurrence. Kunda Stage, Obukhovo Formation (lower *Eoplacognathus variabilis* Zone) – Lava River; Kunda Stage (middle *Eoplacognathus variabilis* Zone) – Putilovo quarry; horizon unknown – Pulkovka River (coll. of C. H. Pander, 1845); Popovka River (coll. of A. von Volborth); St. Petersburg region, northwest Russia; northern Estonia (see Rubel, 1961).

Platystrophia putilovensis sp. nov.

Plate II, figures 1–5; Figure 5; Table 2

1845 *Spirifer biforatus* var. *dentatus* Pander (*pars*); Verneuil, p. 138, pl. III, fig. 5f.
1961 *Platystrophia* sp. b (*pars*) Rubel, p. 155, pl. II, fig. 6.

Derivation of name. After the type locality Putilovo quarry (St. Petersburg region).

Holotype. Complete shell, CNIGR 9/12974, from the Volkhov Stage, Volkhov Formation (*Paroistodus originalis* Zone), Putilovo quarry, St. Petersburg region, coll. by the author; Pl. II, figs. 1–3.

Material. 3 complete shells, 22 ventral and 26 dorsal valves.

Diagnosis. Shell small for genus, subequally biconvex, trapezoidal in outline, with maximum width at hinge line; cardinal extremities acute; radial ornament with 2 costae in ventral sulcus, 3 costae in dorsal median fold, and 6–7 costae on flanks; brachiophore bases triangular in cross-section; cardinal process simple, ridge-like; dorsal median ridge high, about two-thirds of valve length.

Description. Shell subequally biconvex, trapezoidal in outline, with maximum width along the hinge line, up to 10.8 mm long and up to 19 mm wide. Cardinal

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Explanation of Plate II

Figs. 1–5. *Platystrophia putilovensis* sp. nov. 1–3, CNIGR Museum 9/12974, holotype; ventral, dorsal, and lateral views of conjoined valves; Putilovo quarry; Volkhov Stage. 4, CNIGR Museum 27/12974; interior of ventral valve; Putilovo quarry; Volkhov Stage. 5, CNIGR Museum 10/12974; interior of dorsal valve; Putilovo quarry; Volkhov Stage; coll. by the author.

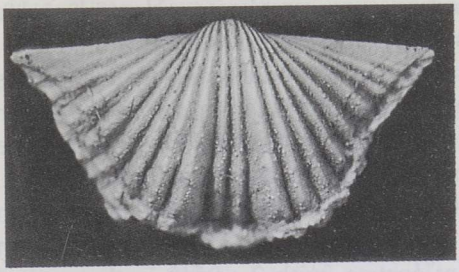
Figs. 6–9. *Platystrophia* ex. gr. *P. dentata* (Pander). 6–8, CNIGR Museum 20/12974; ventral, dorsal, and posterior views of conjoined valves; Putilovo quarry; Volkhov Stage; coll. by the author. 9, CNIGR Museum 19/12974; interior of dorsal valve; Volkhov River; Kunda Stage; coll. by S. S. Terentiev.

Figs. 10, 11. *Platystrophia*? sp. 1. CNIGR Museum 29/12974; exterior and interior of ventral valve; Putilovo quarry; Volkhov Stage; coll. by A. V. Dronov.

Fig. 12. *Platystrophia*? sp. 2. CNIGR Museum 21/12974; exterior of ventral valve; Kipen village; Kunda Stage; coll. by S. S. Terentiev.

Figs. 13, 14. *Platystrophia*? sp. 3. CNIGR Museum 22/12974; ventral and dorsal views of conjoined valves; Kirchoff Mountain, Kunda Stage; coll. by S. S. Terentiev.

Figs. 1–3, 5–8, 10–14 ×3; fig. 4 ×5; fig. 9 ×2.



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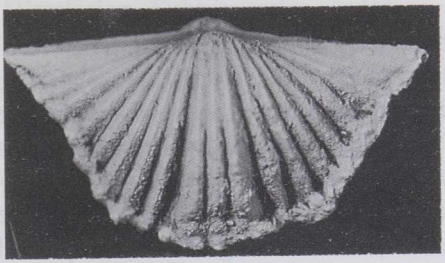

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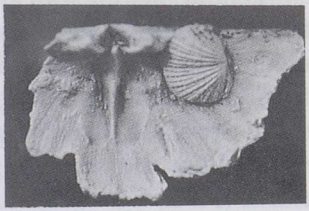

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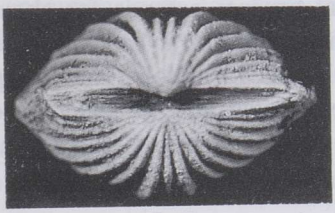

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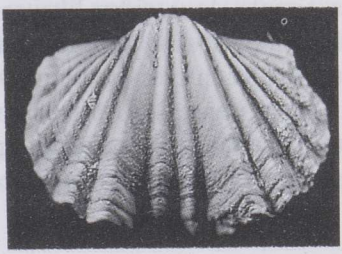

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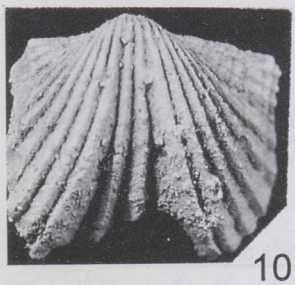

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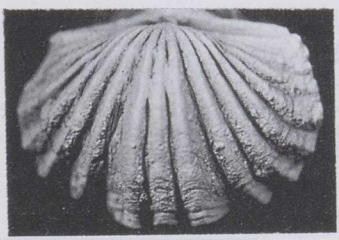

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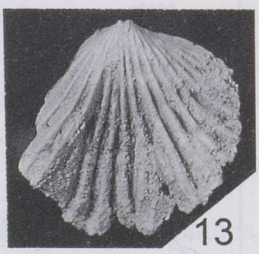

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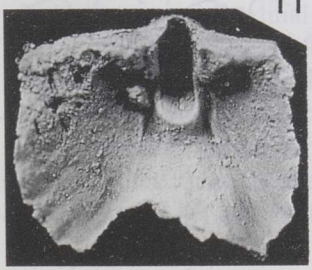

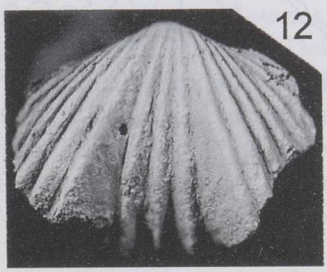

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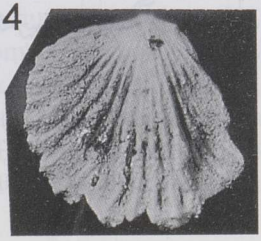

extremities strongly acute. Anterior commissure uniplicate. Ventral valve moderately and evenly convex, with a slightly curved, pointed beak and low, almost planar, apsacline interarea. Delthyrium open, triangular, wide. Sulcus moderately wide, deep, with steep lateral sides, originating about 1–2 mm anterior to the umbo. Margins of sulcus diverge at about 20–23°. Dorsal valve moderately and evenly convex, with low, almost planar, anacline interarea. Median fold relatively low, with steep lateral slopes, originating about 1–2 mm from the umbo. Pustulose microornament can be observed in interspaces between costae in most specimens. Radial ornament costate, with 2 costae in the ventral sulcus, 3 costae in the dorsal median fold, and 6–7 costae on the flanks of both valves. Growth lines present.

Ventral interior with small teeth and moderately thin dental plates. The crural fossettes are moderately deep on the inner face of the teeth. Muscle field elongate, suboval, situated on pseudospondylium. Anterior margin of the muscle field concentrically striated. Muscle scars not clearly defined. Two specimens show two short, closely spaced ridges crossing the anterior slope of the pseudospondylium and separating the anterior part of weakly impressed linear muscle tracks (Pl. II, fig. 4; Fig. 5A). Six specimens have a thickening of secondary shell on the anterior slope of the pseudospondylium (Fig. 5B). Dorsal interior with a simple, low, ridge-like cardinal process extends for about two-thirds of the length of a wide and deep notothyrial platform. Brachiophores short, with bases triangular in cross-section. Dental sockets shallow, like oval pits. Adductor scars weakly impressed, with elongate suboval anterior pair, bisected by a high and thin median ridge extending for about two-thirds of the valve length. Interior surface of the valve crenulated.

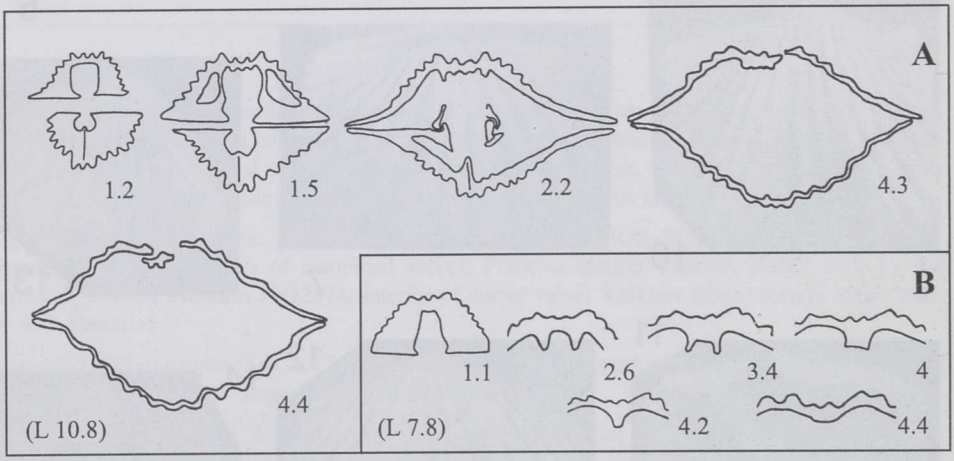

Fig. 5. *Platystrophia putilovensis* sp. nov. (A) Serial sections of complete shell 1/13017. (B) Serial sections of ventral valve 30/12974. L = sagittal length. Measurements in mm. All figures ×2.

Table 2. *Platystrophia putilovensis* sp. nov., average dimensions (in mm) of one complete shell and six dorsal valves. For abbreviations see Table 1

	L	W	T	L/W	T/L
N	7	7	2	7	2
X	8.8	16.7	7.75	53%	76%
S	1.23	1.14	2.47	7.6	17.5
MIN	7	15.8	6	44%	63%
MAX	10.8	19	9.5	68%	88%

Discussion. Subtriangular, widening anteriorly brachiophore bases are the most distinctive feature of this species. In this character and in trapezoidal shell outline the species is comparable with *Platystrophia minuta* Benedetto & Herrera (1987) from the early Llanvirn of Argentina, however, *Platystrophia putilovensis* differs in having less costae in the ventral sulcus and in the dorsal median fold, visible impressed anterior adductors, suboval outline of posterior adductors, and a shorter, wider cardinal process.

Platystrophia costata (see above) differs from *Platystrophia putilovensis* in having a strongly biconvex shell of rounded rectangular outline, predominance (up to 80%) of the specimens with one costa in the sulcus and two costae in the dorsal median fold, rhomboidal cross-section of the brachiophore base, and a relatively narrow delthyrium.

Occurrence. Volkhov Stage, Volkhov Formation (*Paroistodus originalis* Zone) – Putilovo quarry; Volkhov Stage (*Microzarkodina flabellum parva* Zone) – Izvoz village, Simankovo village, Babino quarry, Popovka River; St. Petersburg region, northwest Russia.

Platystrophia ex. gr. *P. dentata* (Pander, 1830)

Plate II, figures 6–9

1845 *Spirifer biforatus* var. *dentatus* Pander (*pars*); Verneuil, p. 138, pl. III, figs. 5a–e.

Material. 1 complete shell, 2 dorsal valves.

Description. Shell subequally biconvex, roundedly subrectangular in outline, with the maximum width at mid-length. Length up to 10.3 mm and maximum width 13.1 mm. Cardinal extremities obtuse. Anterior commissure uniplicate. Ventral valve with apsacline interarea, slightly curved. Delthyrium open, triangular, moderately wide. Sulcus deep, originating about 1 mm from the umbo. Margins of sulcus diverge at about 30–34°. Dorsal valve with low, orthocline interarea, slightly curved. Radial ornament composed of high angular costae, two of them in the sulcus, three in the fold, and six on the flanks. Fine pustulose micro-ornament well defined in the interspaces between costae. Growth lines developed.

Dorsal interior with a thin, blade-like cardinal process extends over the full length of the wide and highly raised notothyrial platform. Brachiophores low, with bases subtriangular in cross-section. Dental sockets shallow, like narrow slits. Median ridge low, extending to about mid-valve. Adductor muscle scars weakly impressed. Interior surface of valve faintly crenulated.

Discussion. Originally the name *Platystrophia dentata* (Pander, 1830, p. 96, pl. XI, fig. 4) was assigned to a specimen with two costae in the sulcus and three costae in the fold. Precise stratigraphic position of the very schematically illustrated specimen is unknown. Pander's localities are situated in the environs of St. Petersburg (Izhora, Popovka, Pulkovka rivers and other outcrops) where the rocks range stratigraphically from the Volkhov Stage to the Lasnamägi Stage. However, in subsequent publications the name *Platystrophia dentata* (Pander) was attributed to the shells having two costae in the sulcus and three costae in the fold, but being distributed from Llandeilo to Wenlock. No doubt they represent different species and therefore only one shell can be identified as *Platystrophia dentata*.

Exteriorly the specimens described herein closely resemble the shell illustrated by Verneuil (1845, p. 138, pl. III, figs. 5a–e), only slightly differing in having a somewhat narrower sulcus and greater height of interareas. However, these specimens differ from the typical specimens illustrated by Pander (1830) in having a rounded subrectangular shell outline, wider and deeper sulcus, and a high fold.

Platystrophia ex. gr. *P. dentata* has the same number of costae in the sulcus and fold as *Platystrophia* sp. Neuman (1964, p. 17, pl. 2, figs. 12–18) from the late Arenig–early Llanvirn, NE Maine, USA, and *Platystrophia dongbeiensis* Liu, Zhy & Xue (1985, p. 20, pl. 2, figs. 12–25) from the late Arenig of NE China, but differs in having more costae on the flanks and longer and wider interareas.

Platystrophia ex. gr. *P. dentata* differs from *Platystrophia putilovensis* sp. nov. in suboval shell outline, short hinge line, and in the interior of the dorsal valve it has a lower median ridge, longer cardinal process and deeper dental sockets.

Occurrence. Volkhov Stage, Volkhov Formation (*Microzarkodina flabellum parva* Zone) – Putilovo quarry, Simankovo village; St. Petersburg region, north-west Russia.

Platystrophia? sp. 1

Plate II, figures 10, 11

Material. 1 ventral valve.

Description. Ventral valve moderately and evenly convex, subquadrate in outline, with the maximum width at about mid-valve; length 10.5 mm, width

12+ mm. Cardinal extremities nearly right-angled. Interarea high, apsacline, curved. Delthyrium open, triangular, moderately wide. Sulcus originates in the umbonal area; it is narrow and shallow in the posterior third of the valve but strongly deepened and widened towards the anterior margin. Pustulose microornament not observed. Radial ornament contains 2 angular costae in the sulcus and 9 costae on the flanks. Growth lines present. Ventral interior with prominent teeth, subparallel dental plates, muscle field situated on pseudospondylium. The crural fossettes are very shallow on the inner face of the teeth. Muscle scars absent. Interior surface of the valve faintly crenulated in the anterior one-third of the valve.

Discussion. Externally *Platystrophia*? sp. 1 is similar to the ventral valve of *Platystrophia* sp. a Rubel (1961, p. 154, pl. I, figs. 4, 5) from the lower Volkhov Stage of the St. Petersburg region, but differs internally in the absence of a low median ridge between diductor scars posteriorly as well as in having faint crenulations in the anterior one-third of the valve. The unproved pustulose microornament and lack of the dorsal valve makes the generic attribution of both forms slightly tentative.

Occurrence. Volkhov Stage, Volkhov Formation (upper *Baltoniodus triangularis–B. navis* Zone) – Putilovo quarry; St. Petersburg region, northwest Russia.

Platystrophia? sp. 2

Plate II, figure 12

Material. 1 ventral valve.

Description. Ventral valve moderately convex, transverse, subrectangular in outline, with the maximum width at mid-valve; length 10 mm, width 14+ mm. Interarea about 0.6 mm high, nearly planar, apsacline, with open triangular, moderately wide delthyrium. Beak slightly erected. Sulcus deep and broad, with steep lateral sides. Margins of sulcus diverge at about 44°. Sulcus ends with the tongue 5 mm in length. Radial ornament costate, with 3 simple costae in the sulcus and 7 ones on the flanks. Ventral interior with short triangular teeth, subparallel dental plates, and a muscle field on the pseudospondylium. The crural fossettes developed on the inner side of teeth. Growth lines and granules absent.

Discussion. *Platystrophia*? sp. 2 has three costae in the sulcus like *Platystrophia lynx* Eichwald, as described by Alikhova (1951) from the Jõhvi Stage of the St. Petersburg region, but differs in having subrectangular transverse shell outline, a wider and deeper sulcus, and less costae on the flanks.

The described specimen differs from *Platystrophia*? sp. Neuman & Bates (1978, p. 589, pl. 68, figs. 17–24) from the early Llanvirn of northwest Wales in having smaller rounded costae and a deeper sulcus with the well-developed tongue.

Occurrence. Kunda Stage, Obukhovo Formation (upper *Eoplacognathus variabilis* Zone) – Kipen village; St. Petersburg region, northwest Russia.

Platystrophia? sp. 3

Plate II, figures 13, 14

Material. 1 complete shell.

Description. Length 9.6 mm, width 9.5+ mm. The poorly preserved shell has a 0.3 mm high, nearly planar, apsacline and short ventral interarea. Ventral sulcus and dorsal median fold originate at 1.5 mm from the umbo. Margins of sulcus diverge at about 42°. Radial ornament costate; 4 rounded costae are developed in the sulcus, 5 costae in the fold, and up to 8 costae on flanks. Growth lines and pustulose microornament not detected.

Discussion. This form is somewhat similar to *Spirifer lynx* Verneuil (1845, p. 136, pl. III, fig. 4b) from the Ordovician (exact locality and horizon uncertain) of the St. Petersburg region, but differs in having more costae in the sulcus and fold.

Occurrence. Kunda Stage, Obukhovo Formation (upper *Eoplacognathus variabilis* Zone) – Kirchoff Mountain; St. Petersburg region, northwest Russia.

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ARENIGI JA ALAM-LLANVIRNI *PLATYSTROPHIA* (ORTHIDA, BRACHIOPODA) LOODE-VENEMAAL

Mihhail ZUIKOV

On kirjeldatud brahhiopoodide perekonna *Platystrophia* vanimaid esindajaid Loode-Venemaa ordoviitsiumi läbilõigetes. Üks kuuest vaadeldavast taksonist esindab uut ja üks varem tuntud liiki ning nelja on kirjeldatud kui morfoloogiliselt erinevaid vorme, mis võivad kuuluda eri liikidesse. Vanimaks perekond *Platystrophia* esindajaks Baltoskandias on *Platystrophia* sp. a Rubel, 1961, mis esineb Leningradi oblastis Volhovi lademe alumises osas (konodonditsooni *Baltoniodus triangularis–B. navis* ülemises osas). Sellel liigil puudub aga *Platystrophia* perekonnale iseloomulik kaane välisskulptuuri element – granulatsioon. Samalt stratigraafiliselt tasandilt leitud eksemplar, millel on samuti ebatüüpiline kaane skulptuur, on arvatud sellesse perekonda tinglikult.

Venemaal, Walesis, Põhja-Ameerikas, Lõuna-Ameerikas ja Hiinas esinevate Ülem-Arenigi ja Alam-Llanvirni ealiste *Platystrophia* liikide leviku analüüs näitab, et vanim *Platystrophia* sp. võib pärineda Argentiinast (tsooni *Baltoniodus triangularis–B. navis* alumisest osast). Nii nagu Baltoskandias, on ka Argentiinas *Platystrophia* hulka kuuluvatel vanimatel eksemplaridel (kirjeldatud kui *Platystrophia* sp.) perekonnale ebatüüpiline skulptuur. Perekonna diagnostikas kasutatavad kaane välisskulptuuri tunnused vajavad lisauurimist.

PLATYSTROPHIA (ORTHIDA, BRACHIOPODA) ИЗ АРЕНИГА И НИЗОВ ЛЛАНВИРНА СЕВЕРО-ЗАПАДА РОССИИ

Михаил ЗУЙКОВ

Из аренига и низов лланвирна российской части Балтийско-Ладожского глинта описаны шесть представителей рода *Platystrophia* – два вида (один из которых новый) и четыре формы в открытой номенклатуре. Древнейшим представителем рода в ордовике Балтоскандии является *Platystrophia* sp. a, описанная Рубелем (1961) из низов волховского горизонта (верхняя часть конодонтовой зоны *Baltoniodus triangularis–B. navis*) Ленинградской области. Последняя, однако, не имеет грануляции на внешней поверхности раковины, и поэтому сходный экземпляр, обнаруженный в одновозрастных отложениях, в настоящей работе отнесен к роду условно.

Приведенные данные о распространении платистрофий в верхнем арениге–нижнем лланвирне России, Уэльса, Северной Америки, Южной Америки и Китая показывают, что самым древним представителем рода является *Platystrophia* sp. из аренига Аргентины (нижняя часть зоны *Baltoniodus triangularis–B. navis*). Несмотря на хорошую сохранность внешней поверхности раковины, данный вид не имеет грануляции, что делает его родовое определение дискуссионным.