

REVISION OF THE SILURIAN BRACHIOPOD *PENTAMERUS SAMOJEDICUS* KEYSERLING, 1846 FROM THE TIMAN RIDGE, RUSSIA

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Abstract. Revision of the pentamerid brachiopod *Pentamerus samojedicus* Keyserling, 1846 allows it to be assigned to the genus *Borealis* Boucot, Johnson & Rubel, 1971, and shows its much wider distribution than originally reported, from the Aeronian to Telychian in the Timan Ridge, Severnaya Zemlya, and the Baltic region. The gradational evolution from *Borealis borealis* to *P. oblongus*, as supposed and documented by Mørk using Norwegian material (*Palaeontology*, 1981, 24, 537–553), has a parallel branch through *B. samojedicus*, which occupies a transitional position in the Baltic sections.

Key words: brachiopods, pentamerids, Llandovery, Timan Ridge, Baltic.

INTRODUCTION

Keyserling (1846) discovered Silurian deposits from the Timan Ridge on the shore of the Arctic Ocean, and in the palaeontological part of his travel notes he described a new brachiopod species as *Pentamerus samojedicus*. Numerous shells of this pentamerid brachiopod were found by him in outcrops along the Vas'kina (Washkina) River on the Barmin Cape, where they formed a coquina. Somewhat later and not far from this locality, on the banks of the Chernaya River, Stuckenber (1874) described the same beds with abundant *P. samojedicus* (see Fig. 1).

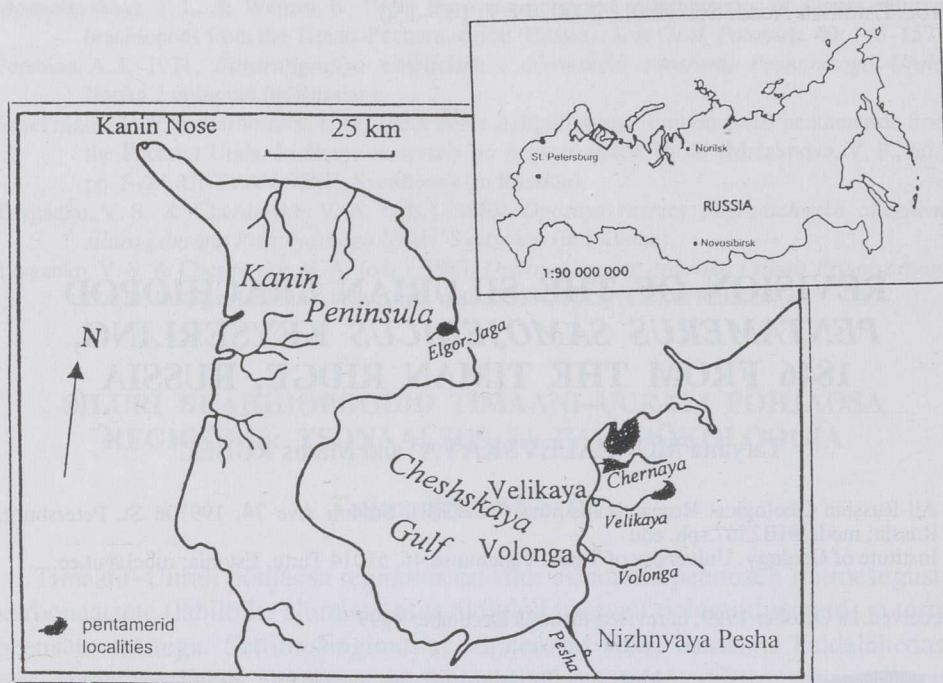


Fig. 1. Map showing the location of the Timan Ridge and pentamerid localities mentioned in the text.

Lebedeff (1892) compared *P. samojedicus* with the then-known Late Llandovery British and Baltic species of this genus and described additionally a new species *P. schmidtii* from the Silurian of Tunguska, Siberia. According to Lebedeff, the otherwise similar species *P. oblongus* and *P. esthonus* could be easily distinguished from each other by the relative heights of their ventral septum. The high ventral septum alone makes *P. samojedicus* closer to *P. esthonus* and *P. schmidtii* than to *P. oblongus*; the understanding of these taxa, especially *P. oblongus* and *P. esthonus*, was clearly different to Lebedeff from previous authors. Lebedeff noted also the wide base of the spondylium in *P. samojedicus*, which is narrow at least in *P. oblongus* and *P. esthonus*. After these early contributions, *P. samojedicus* was forgotten or overlooked for a long time.

In their systematic list of the Pentameridae, Boucot & Johnson (1979) assigned *P. samojedicus* to the genus *Borealis* Boucot, Johnson & Rubel, 1971 in the subfamily Virgianinae, although only questionably. But Sapelnikov & Beznosova (1980) examined (probably exteriors) the Timan species mostly from the Chernaya River and put *P. samojedicus* into synonymy with *P. oblongus*, i.e. to a species of the subfamily Pentamerinae (see also Sapelnikov 1985, p. 59). It is notable that in spite of the quite clear differences in the interiors of these subfamilies, the genera *Borealis* and *Pentamerus* were considered by Mørk

(1981) as members of the same phyletic lineage which was well documented at least in the Norwegian Llandovery.

The transition described by Mørk (1981) from *B. borealis* to *P. oblongus* through an intermediate *B. borealis osloensis* is comparable with the evolutionary lineages of other Silurian brachiopods like *Stricklandia* and *Eocoelia*, both used widely in chronostratigraphic correlations (Ziegler 1966; Baarli 1986; Baarli & Johnson 1988). Determination of the position of *P. samojedicus* in relation to Mørk's lineage may be useful for some chronostratigraphic implications and is also discussed below.

The collection studied by us includes 116 often deformed shells of different sizes. They were collected by V. P. Barkhatova in 1936, V. A. Filippov in 1937, L. S. Kossovoj in 1957, and V. A. Raznitsyn in 1966, from the Chernaya and Vas'kina River sections. All are in collection 13044 of Central Scientific-Research Geological Exploration Museum (CNIGRM), St. Petersburg, Russia. Additionally, the collection made by A. Keyserling (1846) has been studied in the Museum of the Institute of Mines, St. Petersburg.

Identification of *P. samojedicus* from Latvia was based on the specimens described as *P. oblongus* by Rybnikova (Gailite et al. 1967), housed in the Museum of Natural History of Latvia (MNHL), Riga. The Estonian specimens known until now as *P. cf. oblongus* are housed in the Institute of Geology of the Technical University of Tallinn (IG), Estonia.

SYSTEMATIC DESCRIPTION

Borealis samojedicus (Keyserling, 1846)

Plate I, figures 1–9; Plate II, figures 1–7

- 1846 *Pentamerus samojedicus* n. sp.; Keyserling, p. 235, pl. 9, figs. 2, 2a–h.
1892 *Pentamerus samojedicus* Keyserling; Lebedeff, p. 20.
1967 *Pentamerus oblongus* Sowerby; Gailite et al., p. 181, pl. 17, fig. 1.
1980 *Pentamerus oblongus* Sowerby; Sapelnikov & Beznosova, p. 10 (*pars*), pl. 5, figs. 1–5.
1985 *Pentamerus oblongus* Sowerby; Sapelnikov, pl. 19, figs. 3, 4.

Lectotype. Conjoined valves 136a, b/46, selected here from the Keyserling (1846) collection in the Museum of the Institute of Mines, St. Petersburg. Chernaya Reka Formation, Llandovery Series, Vas'kina River section, Timan Ridge, Russia.

Description. Shell large, ventribiconvex; outline elongate, subtriangular, with relatively sharpened ventral umbo and weak medial extension at the anterior margin. Lateral margins expand to maximum width in the anterior one-quarter. Median fold developed in the anterior part of both valves. Anterior commissure rectimarginate.

Exterior smooth, with inconspicuous radial furrows in the anterior part of the shell and sometimes one medial furrow in both valves. Concentric growth lines frequently developed, not sharp.

Spondylium long, curved, with a flat floor and evenly widening lateral sides (Fig. 2). Ventral septum extends for up to one-third of the shell length. Secondary deposits developed posteriorly.

Outer brachial plates short, up to one-quarter of the valve length, subparallel, distinct (Fig. 3). Inner plates as long as outer plates, ventrally divergent. Brachial processes rod- to plate-like, distinct, longer than brachial plates, located between the latter plates.

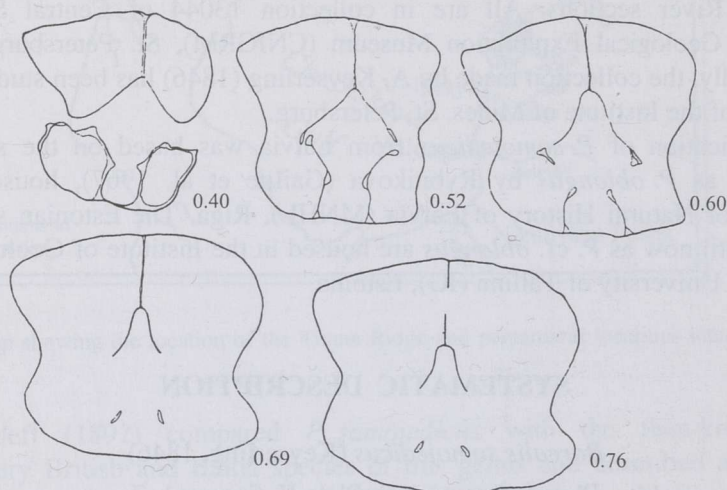


Fig. 2. Serial sections from the umbonal part of shell CNIGRM 5/13044 of *Borealis samojedicus* from the Chernaya Reka Formation, Aeronian of the Timan Ridge. Distances between sections are in millimetres, $\times 1.5$.

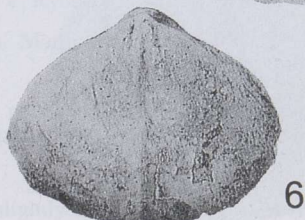
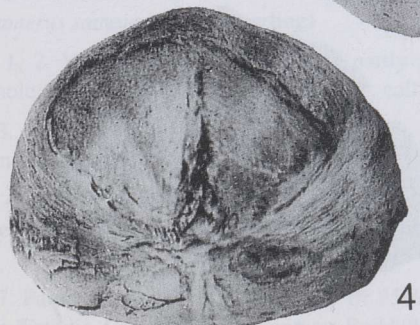
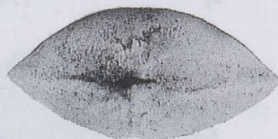
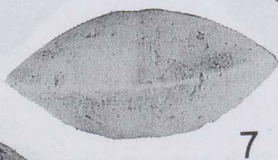
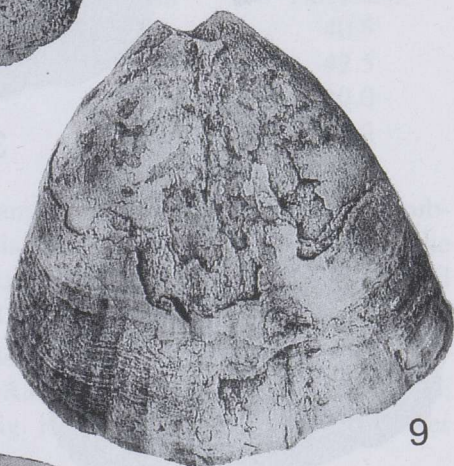
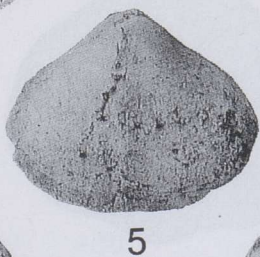
Explanation of Plate I

Pentamerus samojedicus (Keyserling)

Figs. 1–4. Ventral, dorsal, lateral, and posterior views of partly preserved shell CNIGRM 1/13044. Timan Ridge, Chernaya River, Middle Llandovery, Chernaya Reka Formation, coll. by V. P. Barkhatova, $\times 1$.

Figs. 5–8. Ventral, dorsal, anterior, and posterior views of young shell CNIGRM 4/13044. Timan Ridge, Vas'kina River, Chernaya Reka Formation, coll. by L. S. Kossovoj, $\times 2$.

Fig. 9. Ventral view of partly preserved shell CNIGRM 2/13044. Timan Ridge, Chernaya River, Middle Llandovery, Chernaya Reka Formation, coll. by V. P. Barkhatova, $\times 1$.

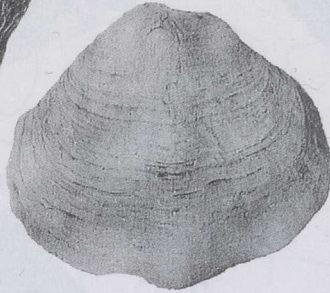




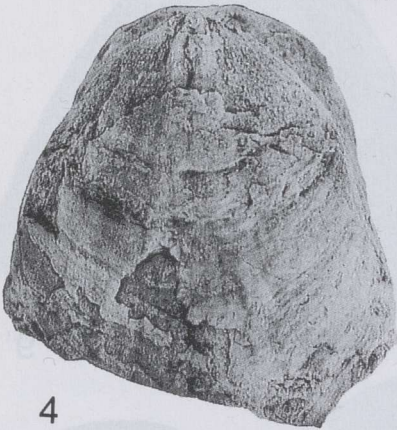
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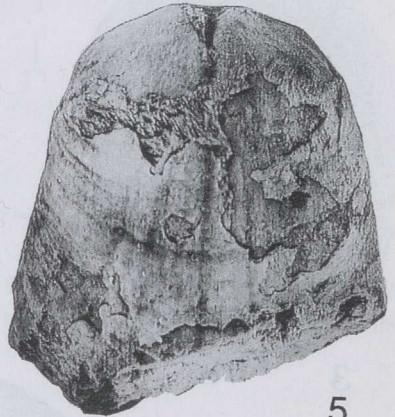
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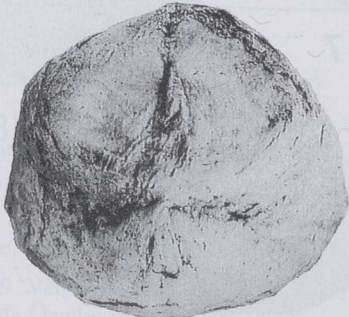
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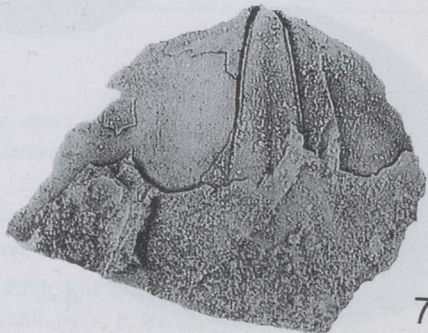
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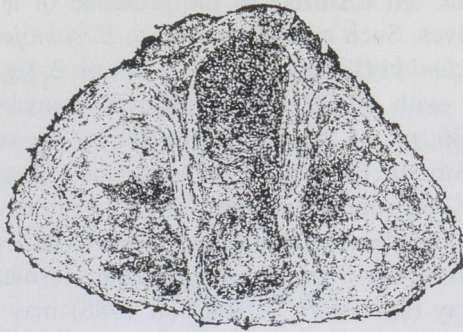


Fig. 3. Peel from the umbonal part of dorsal valve CNIGRM 5/13044 of *Borealis samojedicus* from the Chernaya Reka Formation, Aeronian of the Timan Ridge.

Dimensions in mm.

Specimens in CNIGRM	Length	Width	Thickness
1/13044	~59.0	53.6	40.5
2/13044	~56.5	9.3	42.5
3/13044	~50.5	46.5	40.0
4/13044	14.1	17.6	8.3

Variability. The outline of the shells ranges from rounded to clearly sub-triangular forms. Development of the median fold is variable, especially on the ventral valve. The specimens of coquinas, probably derived from crowded populations, exhibit more laterally flattened shells and narrow spondyliums.

Discussion. It is quite clear that *B. samojedicus* has the same interior morphology as the type of the genus, *B. borealis* (see Rubel 1970, p. 17; pl. V, figs. 8–14; pl. VI; pl. VII; pl. X, fig. 19; pl. XXIII, fig. 16) from the Juuru Stage, Lower

Explanation of Plate II

Pentamerus samojedicus (Keyserling)

Figs. 1, 2. Ventral and lateral views of partly preserved shell MNHL Br 30/53. Latvia, Druvas borehole, depth 287.4 m, Upper Llandovery, coll. by M. V. Rybnikova, $\times 0.7$.

Fig. 3. Exterior of dorsal valve IG Br 1867. Estonia, Martna borehole, depth 23.42–23.46 m, Aeronian, Raikküla Stage, $\times 0.7$.

Figs. 4–6. Dorsal, ventral, and posterior views of partly preserved shell CNIGRM 3/13044. Timan Ridge, Chernaya River, Middle Llandovery, Chernaya Reka Formation, coll. by V. P. Barkhatova, $\times 1$.

Fig. 7. Partly preserved dorsal valve IG Br 3599 with slightly divergent and relatively short outer plates, Estonia, Laeva borehole, topmost Raikküla Stage, $\times 2$.

Llandovery of Estonia, but it differs in the presence of a fold, which can be developed in both valves. Such a trilobed shell in *B. samojedicus* makes it more comparable with *B. schmidtii* (Lebedeff 1892, p. 23; pl. 2, fig. 9), as well as being probably conspecific with *P. oblongus* sensu Nikiforova (see Nikiforova & Andreeva 1961, p. 136; pl. 24, figs. 1–3), both from the same localities of the Moyerocan Stage of Siberia. From the Siberian species, *B. samojedicus* differs in its more subtriangular, less rounded outline. At the same time, the high variability of *B. schmidtii* allows consideration that *B. borealis osloensis* (Mørk 1981, p. 544; pl. 84, figs. 9–11) from the Solvik and Rytteråker formations, Aeronian and Rhuddanian of Norway (see Baarli & Johnson 1988) may be conspecific with *B. schmidtii*, from which *B. samojedicus* differs, as noted above, in its wider subtriangular shell and medially flattened trilobation.

Distribution. Chernaya Reka Formation, Rhuddanian–early Aeronian of the Timan Ridge; Snezhninka Formation, Aeronian of Severnaya Zemlya; Aeronian to Telychian (?) of Estonia and Latvia.

PHYLOGENETIC AND CLASSIFICATORY IMPLICATIONS

The quite stable interiors (relatively short and weakly divergent to subparallel brachial plates, broad spondylium with flattened floor) relate the species compared above with *B. samojedicus*, as well as some other early smooth virganiids from China with a highly ventribiconvex shell (see Rong & Yang 1977). These features define the genus *Borealis* or, in other words, the absence or presence of folds (trilobation) is not diagnostic for this genus as originally supposed (Boucot et al. 1971). Phylogenetically, a *Borealis*-type spondylium and cardinalia preceded a narrow spondylium, and long plate-like brachial plates with a process between them as they were replaced in *Pentamerus* and related genera in the Late Llandovery.

Of the Rhuddanian (oldest) species of the genus *Borealis*, the Baltic *B. borealis* has no folds on its shell. At the same time, *B. cristiformis* (Modzalevskaya 1985) from the Lower Persej and Vodopad formations in the lowermost Rhuddanian of Novaya Zemlya and Severnaya Zemlya, respectively, has conspicuous folds on both valves. The latter species could be considered therefore as a possible ancestor to the clearly trilobed *B. schmidtii* from the Llandovery of Siberia, as well as conspecific with *B. borealis osloensis* from Norway (see above). The Norwegian material of the latter subspecies has been documented in relation to its transition to *P. oblongus* (Mørk 1981). But, as now appears, *B. borealis borealis* is the closest species (ancestor) to *B. samojedicus*, which in turn has a clear transitional succession (see Pl. 2, fig. 7) to *P. oblongus* in the Baltic Aeronian. There is thus a possible polyphyletic origin (reticulate evolution) in the Late Llandovery species *P. oblongus*.

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SILURI PENTAMERIIDNE BRAHHIOPOOD *PENTAMERUS SAMOJEDICUS* KEYSERLING, 1846 TIMAANI AHELIKUST (VENEMAA): REVISJON

Tatjana MODZALEVSKAJA ja Madis RUBEL

Brahhiopoodi *Pentamerus samojedicus* Keyserling, 1846 olemasoleva kollektsooni lisaurimine näitas tema kuulumist perekonda *Borealis* Boucot, Johnson & Rubel, 1971. Revideeritud liik identifitseeriti peale Timaani aheliku Aeroni ja varajase Telychi veel Severnaja Zemlja ning ka Eesti ja Läti Aeronis või isegi Telychis. Eesti ja Läti *Borealis samojedicus*'e leiud ei kinnita Mørki oletatud (Norra materjalil dokumenteeritud; Mørk 1981) arengurida *B. borealis*'e ja *P. oblongus*'e vahel, vaid näitavad hoopis *P. oblongus*'e võimalikku polüfüleetilist päritolu.

РЕВИЗИЯ СИЛУРИЙСКИХ БРАХИОПОД ВИДА *PENTAMERUS SAMOJEDICUS* KEYSERLING, 1846 С ТИМАНА, РОССИЯ

Татьяна МОДЗАЛЕВСКАЯ и Мадис РУБЕЛЬ

Проведена ревизия брахиопод *Pentamerus samojedicus* Keyserling, 1846, на основе которой они отнесены к роду *Borealis* Boucot, Johnson и Rubel, 1971. Установлен возрастной диапазон этого рода на Тимане, Северной Земле и в Балтийском регионе от эрона до телича, т.е. он оказался гораздо шире, чем предполагалось ранее. Предложенный на норвежском материале Мерком эволюционный ряд от *Borealis borealis* к *Pentamerus oblongus* имеет параллельную ветвь через *Borealis samojedicus*, который занимает промежуточное положение в Балтийских разрезах.