

New *Inoceramus*-like Bivalves of the Genus *Praekolymia* Biakov from the Lower Permian of the Western Verkhoyansk Region, Northeastern Asia

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Abstract—Historical development of Permian *Inoceramus*-like bivalves of the genus *Praekolymia* Biakov endemic to the Verkhoyansk–Okhotsk and Kolyma–Omolon provinces is briefly considered. Two new earliest representatives of the genus (*Praekolymia kaschirtzevi* sp. nov. and *P. barajensis* sp. nov.) from the Lower Permian of the western Verkhoyansk are described.

Keywords: *Inoceramus*-like bivalves, Lower Permian, northeastern Asia

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INTRODUCTION

Inoceramus-like bivalves of the genus *Praekolymia* Biakov is a typical element of the marine biota of northeastern Asia of the terminal Early–basal Middle Permian. Appearing in the Middle Khalalian Time (Middle Kungurian) in the western sector of the Verkhoyansk Basin, they rather rapidly penetrated into the other parts of the basin and also in the Omolon Basin.

Praekolymia emerged in connection with diversification of *Inoceramus*-like bivalves of northeastern Asia in the Kungurian Age, in particular, differentiation of equivalve forms, which probably passed to a semi-burrowing mode of life and, hence, transformed the musculature, lost the anterior muscle and umbonal septum (Biakov, 2008).

Apparently, *Praekolymia kaschirtzevi* sp. nov. and *P. barajensis* sp. nov., coming from the lower part of the “Tumara” Formation of the western Verkhoyansk Region and described here for the first time, were the most ancient *Praekolymia*. These are moderately large forms, with a poorly differentiated anterior ear and moderately developed concentric ornamentation, which is in general not specific for the genus. In addition, they (at least *P. barajensis*) are characterized by a very poorly pronounced inequivalve pattern, which is possible to treat as an archaic character, making them close to *Aphanaia*.

The species described here were recognized for the first time by V.V. Kuznetsov in 1973 in his PhD Theses as members of the genus *Kolymia*; however, the description has not been published. In addition, spe-

cies volumes and their stratigraphic ranges were treated by Kuznetsov somewhat differently. The present paper provides improved descriptions of the taxa in question.

Apparently, *Praekolymia archboldi* Biakov (Biakov, 2008) described from the upper part of the Tumara Horizon of the western Verkhoyansk Region (probably Beds with *Tumaroceras? kashirtzevi*), where it co-occurs with *Aphanaia budnikovi* Biakov and *A. cf. andrianovi* (Muromzeva et Kusnezov) (Biakov, 2010), is a somewhat younger species of *Praekolymia*. It comprises small, almost smooth forms, with a relatively small anterior ear. Approximately 380 m downward the section, the ammonoid *Tumaroceras yakutorum* Ruzhencev was found and, directly upward from the finds of *Praekolymia*, there was *Epijuresanites musalini* Popov (data of I.V. Budnikov and R.V. Kutygin, 2000). Probably, it was *Praekolymia archboldi* to give rise to all members of the genus *Kolymia* sensu stricto; it dominated bivalve communities of Verkhoyansk and Kolyma–Omolon provinces throughout the Rodian and Wordian.

Praekolymia archboldi most likely appeared in the Kolyma–Omolon system of basins simultaneously with *P. urbajtisae* Biakov, which is described by a relatively small oval triangular shell, with distinct wrinkled ornamentation. Kutygin (Kutygin and Ganelin, 2013) recorded here the ammonoid *Tumaroceras? kashirtzevi* Andrianov, which is characteristic of the Middle Kungurian of the Verkhoyansk Region. *Praekolymia urbajtisae* persisted up to the Middle Rodian Age (termi-



Fig. 1. Localities of new bivalve species of the genus *Praekolymia* in the western Verkhoyansk Region. Designations: (1) left bank of the Saganzha River, Ilgete River; (2) left bank of the Arkachan River, Endybal Mountain.

nal Russian–Omolon Time), survived a great Late Kungurian extinction (Biakov, 2012).

In addition to the above forms, in the Kungurian Age, the southern Verkhoyansk Region was inhabited by small rounded trapeziform *Praekolymia alitis* (Astafieva) with a rudimentary anterior ear (Astafieva, 1993) and, in the northern Verkhoyansk Region, there was *Praekolymia* sp., which is close to *P. kaschirtzevi* (original identification of specimens in the collection of M.V. Gertseva, Scientific Production Association “Aerogeologiya”).

The species described in this study come from the western Verkhoyansk Region (Fig. 1). All specimens are housed in the Shtukenberg Geological Museum of Kazanian (Volga) Federal University, Kazan (KFU), collection no. 551.

The following abbreviations are used below in descriptions: (H) shell height, (Vc) valve convexity, (MD) shell length along the main diagonal, (L) shell length, (LHL) hinge line length, (AA) apical angle, (OA) valve obliquity angle.

SYSTEMATIC PALEONTOLOGY

Family Kolymiidae Kusnezov, 1973

Subfamily Kolymiinae Kusnezov, 1973

Genus *Praekolymia* Biakov, 2008

Praekolymia: Biakov, 2008, p. 18; 2010, p. 170.

Type species. *Praekolymia archboldi* Biakov, 2008, Lower Permian, Kungurian Stage, Tumara Horizon; western Verkhoyansk Region.

Diagnosis. Shell relatively small or moderately long, equivalve or slightly inequivalve, almost smooth or with moderately developed concentric ornamentation. Well-developed anterior ear absent, but showing distinct trend to formation of this structure. Umbonal septum absent. Posterior ear developed to varying extent. Posterior muscle scar large, saddle-shaped; pallial line distinct; both similar in morphology to that of *Kolymia*. Prismatic layer relatively thin, up to 0.8 mm thick.

Species composition. In addition to the type species, *P. urbajtisae* Biakov, 2008 from the Lower–Middle Permian, Kungurian–Roadian (Kazanian) stages, of the western Verkhoyansk Region, Omolon Massif; *P. alitis* (Astafieva) from the Lower Permian, Kungurian Stage, of the southern Verkhoyansk Region and Okhotsk Massif; *P. kaschirtzevi* Kusnezov et Biakov, sp. nov. and *P. barajensis* Kusnezov et Biakov, sp. nov. from the Lower Permian, Kungurian Stage, of the western Verkhoyansk Region.

Comparison. *Praekolymia* differs from the nominative genus (*Kolymia*) in the almost undeveloped anterior ear.

Remarks. The Lower Permian (Kungurian) beds of the northern Verkhoyansk Region have yielded *Praekolymia* sp., which is similar to *P. kaschirtzevi*.

Praekolymia kaschirtzevi Kusnezov et Biakov, sp. nov.

Etymology. The species is named in honor of A.S. Kashirtsev, a well-known Yakut geologist.

Holotype. KFU, no. 551/290, mold of the right valve; western Verkhoyansk Region, left bank of the Arkachan River, Endybal Mountain; Lower Permian, Kungurian Stage, Tumara Horizon, Lower Tumara Subformation; collected by V.K. Lezhoev and A.M. Trushchelev in 1965.

Description (Figs. 2a, 2b). The shell is medium-sized, MD is up to 90 mm, triangular oval, longitudinally extended ($L : H = 1.3–1.64$), considerably oblique ($OA = 25^{\circ}–40^{\circ}$). The hinge line is straight, more than half of the shell length ($LHL : L = 0.51–0.64$). The anterior margin is relatively short, slightly convex, passes along a slightly convex arch into a long lower margin, outlined by arch of a large radius. The lower margin is connected through an abrupt arch to a long, slightly convex posterior margin, which passes into the hinge line at an angle about $150^{\circ}–160^{\circ}$, form-

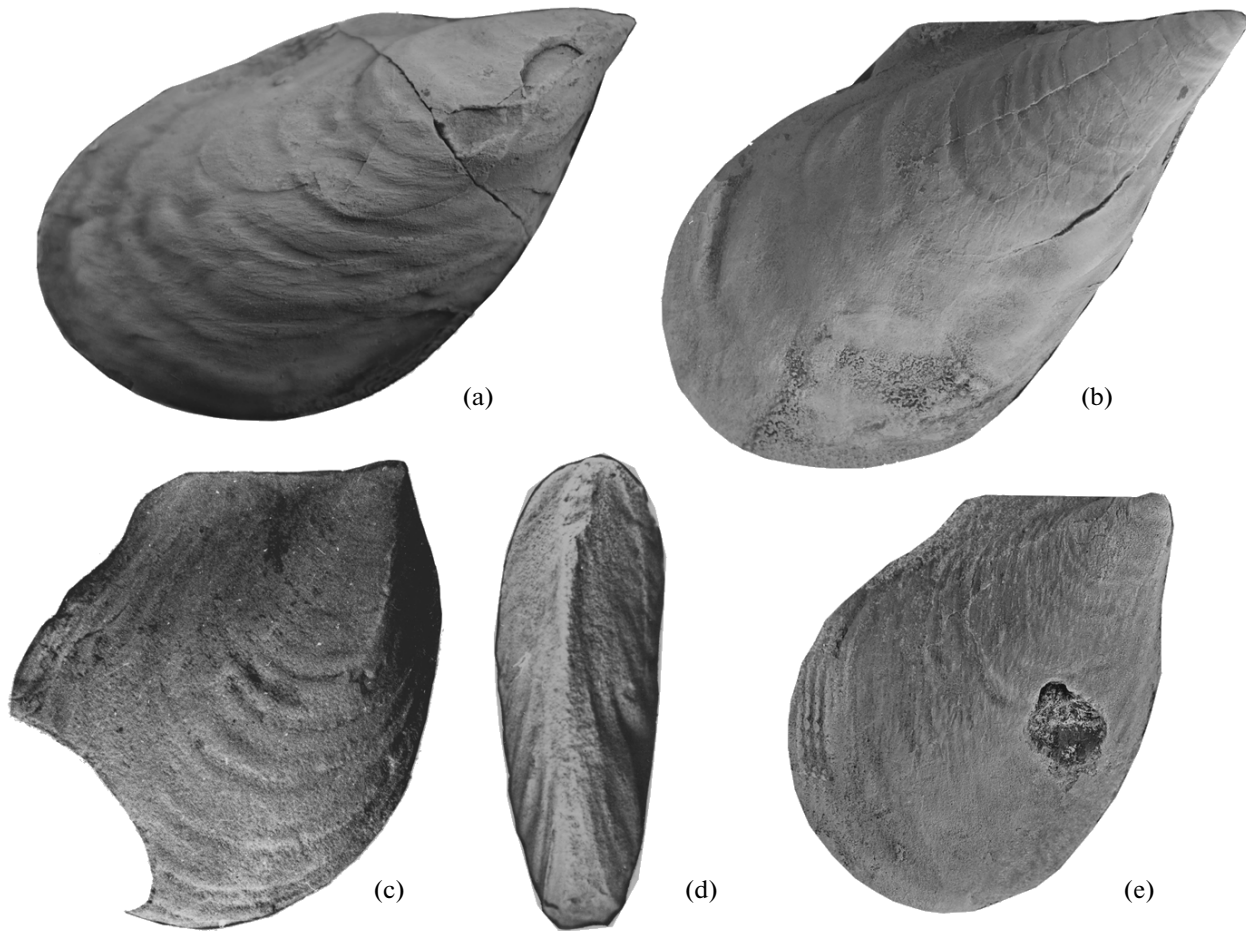


Fig. 2. New species of the genus *Praekolymyia* Biakov from the Lower Permian of the western Verkhoyansk Region (all specimens are natural sized): (a, b) *P. kaschirtzevi* sp. nov., right valve mold: (a) holotype KFU, no. 551/290; western Verkhoyansk Region, left bank of the Arkachan River, Endybal Mountain; Lower Permian, Kungurian Stage, Tumara Horizon, Lower Tumara Subformation; (b) specimen KFU, no. 551/291; the same age and locality; (c–e) *P. barajensis* sp. nov.: (c, d) holotype KFU, no. 551/113, incomplete bivalve mold; western Verkhoyansk Region, left bank of the Saganzha River, Igelte River; Lower Permian, Kungurian Stage, Tumara Horizon, upper part of the “Lower Tumara” Subformation: (c) view of the right valve, (d) view of anterior margin; (e) specimen KFU, no. 551/308, right valve mold; the same age and locality.

ing a small posterior ear. The valves are usually rather convex ($Vc : H = 0.25–0.43$), with the point of the greatest convexity in the upper quarter of the valve at approximately equal distance from the upper and anterior margins or slightly shifted to the latter. The posterior field of the valve is flattened in some specimens.

The beaks are medium-sized, relatively wide, blunted, turned slightly anteriorly, somewhat overhanging the hinge line. Ornamentation of the external surface is composed of concentric ribs, usually more or less regular folds and wrinkles retained on the mold. The prismatic layer is thin, up to 0.5 mm thick.

Variability. The new species varies rather widely, which is manifested in the varying length-to-height ratio, distinctness and regularity of ornamentation, flatness of the posterior field of the valve, extent of valve convexity, and variation of AA and OA.

Measurements in mm and ratios:

Specimen KFU, no.	L	H	Vc	MD	LHL	OA	AA	L : H	Vc : H	LHL : L
551/290 (holotype)	78	56	20	88	40	30°	50°	1.39	0.36	0.51
551/122	77	47	20	85	45	25°	70°	1.64	0.43	0.58
551/291	74	57	~14	~90	47	40°	45°	1.30	0.25	0.64

Comparison. *P. kaschirtzevi* is somewhat similar to *P. urbajtisae* in the general shell design and ornamentation and differs from it in the oblique shell, the larger size (almost twice as great), and in the better developed beaks.

Occurrence. Lower Permian, Kungurian Stage, Tumara Horizon, *Aphanaia andrianovi* Bivalve Zone; western Verkhoyansk Region.

Material. About ten molds of both valves, varying in preservation, sometimes with a partially pre-

served shell, from several localities; collected by V.K. Lezhoev and A.M. Trushchelev in 1965 and V.K. Lezhoev and A.V. Korobitsyna in 1965.

Praekolymia barajensis Kusnezov et Biakov, sp. nov.

E t y m o l o g y. From the Baraiy (Baraiya) River, large right tributary of the Aldan River in its lower reaches.

H o l o t y p e. KFU, no. 551/113, incomplete mold of bivalve specimen; western Verkhoyansk Region, left bank of the Saganzha River, Igelte River; Lower Permian, Kungurian Stage, Tumara Horizon, upper part of the “Lower Tumara” Subformation; collected by V.S. Khan and G.G. Kazanenko in 1967.

D e s c r i p t i o n (Figs. 2c–2e). The shell is medium-sized, MD is up to 75 mm, oval rhomboidal, almost as long as high (L : H = 0.91–0.97), moderately oblique (OA = 55°–60°). The hinge line is straight, relatively long, somewhat more than half of the shell length (LHL : L = 0.52–0.54). The anterior margin is long, ranges from weakly to considerably convex, passes along an abrupt arch into a relatively short, convex lower margin outlined by a somewhat more abrupt arch. It in turn passes through an arch with the same outline into a relatively short, convex posterior margin. The last is connected at a blunt angle about 140° to the hinge line, forming a distinct posterior ear. In the holotype, the anterior shell part is attenuated anteriorly, forming something like an anterior ear. The valves are only slightly convex (Vc : H = 0.2), the point of the greatest convexity is in the upper valve part and considerably shifted towards the anterior margin.

The beaks are relatively small, relatively narrow, adjoining each other, slightly pointed, not overhanging the hinge line. Ornamentation on the external surface is composed of smoothed regular concentric ribs–folds, which are retained on the mold. The prismatic layer is very thin, at most 0.07 mm thick, almost absent on the mold.

V a r i a b i l i t y is manifested in the extent of attenuation of the anterior shell part, ranging from well pronounced (in the holotype) to less distinct.

M e a s u r e m e n t s i n m m a n d r a t i o s:

Specimen KFU, no.	L	H	Vc	MD	LHL	OA	AA	L : H	Vc : H	LHL : L
551/113 (holotype)	58	60	12	~75	30	60°	65°	0.97	0.2	0.52
551/308	50	55	11	65	27	55°	65°	0.91	0.2	0.54

C o m p a r i s o n. The new species differs from all known congeners in the extraordinary shell shape,

with the anteriorly extended anterior part and well-pronounced surface ornamentation composed of regular smoothed concentric ribs–folds.

R e m a r k s. The shell of the new species is somewhat inequivalve because of a somewhat greater convexity of the right valve, which is in general atypical of the subfamily Kolymiinae and can be treated as an archaic character, making them similar to *Aphanaia*.

O c c u r r e n c e. Lower Permian, Kungurian Stage, Tumara Horizon, *Aphanaia andrianovi* Bivalve Zone; western Verkhoyansk Region.

M a t e r i a l. A well-preserved incomplete shell mold and mold of the right valve with a partially preserved shell from two localities; collected by V.S. Khan and G.G. Kazanenko in 1967 and by V.K. Lezhoev and A.M. Trushchelev in 1965.

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