

A New Genus *Perakella* gen. nov. (Gastropoda) from the Lower Permian Reef Limestone of Shakh-Tau

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Abstract—A new genus *Perakella* gen. nov. including two species: *P. shakhtauensis* sp. nov. from the Upper Asselian of Middle Cisuralia and *P. batteni* sp. nov. from the Middle Permian of Malaysia, is described. A unique find of this genus in the reef limestones of Shakhtau is further evidence of the presence of elements of Tethyan taxa in the Early Permian communities of the Uralian corridor.

Keywords: Gastropoda, Phymatopleuridae, *Borestus*, *Platypleurotomaria*, *Perakella*, morphology, taxonomy, Tethyan fauna, Ural corridor, Permian, Asselian Stage

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INTRODUCTION

This paper provides the description a new genus, *Perakella* gen. nov., which includes two species: *P. shakhtauensis* sp. nov. and *P. batteni* sp. nov. The former species was found in the reef limestone of Shakh-Tau of South Cisuralia; the latter was erroneously identified by Batten (1972) as *Borestus planiapicata* (Wanner, 1942) from the early Permian limestone of Malaysia. The age of the latter, as indicated by Batten, is determined within very wide limits: Late Artinskian—Early Guadalupian.

The occurrence of *Perakella* in the reef limestone of Shakh-Tau, following the recent account of specimens of the ammonoid *Properrinites* sp. (Perrinitidae) (Leonova and Boiko, 2018), supports the presence of Tethyan taxa in the Lower Permian molluscan assemblages of the Uralian corridor. This presence indicates a connection between the two large marine basins in the Early Permian, and a similarity in their temperatures and salinity.

The Uralian species is geochronologically older. Apparently, by the time of the closure of the southern termination of the Uralian corridor in the Late Artinskian, the genus *Perakella* had become widespread. The rarity of occurrences of this genus can most likely be explained by the poor state of knowledge of the taxonomic composition of Late Paleozoic gastropod assemblages from various regions.

MATERIAL

Specimens of *Perakella shakhtauensis* described in this paper were collected by the author in the Upper Asselian Reef limestones of the Shakh-Tau Quarry

(South Cisuralia). The geographical location details of the localities were previously published by Mazaev (2019).

During five expeditions from 2015 to 2017, specimens of this species were only found twice: in the spring of 2016, five specimens were found in one small block of limestone. (Locality no. 5538/7, south wall of the Shakh-Tau open pit, elevations 145–150), and one specimen was found in autumn 2016 at Locality no. 5538/11 (south wall of the Shakh-Tau open pit, elevations 135–140).

All specimens are represented by shell imprints in limestone. Unfortunately, the surface of all imprints is covered by thin crusts of calcite crystals. The mechanical removal of these crusts under the binocular microscope slightly improved the quality of the latex casts obtained, but the host rock matrix was extremely porous. For this reason, almost all casts only reproduce generalized details of the ornamentation.

The only specimen where fragments of the shell surface have fine details of the sculpture preserved comes from Locality no. 5538/11 (Figs. 1a–1f). To improve the quality of photographs, the casts were coated beforehand with butyral solution, and then with ammonium chloride. This technique provided a more accurate photography of elements of the sculpture on the background of the imprint, taken from a porous surface. In respect to other parameters, the casts were quite informative, both in the transfer of the general features of the shape of the shells, and the details of the aperture.

The material is housed at the Orlov Paleontological Museum, Paleontological Institute of the Russian Academy of Sciences, coll. no. 5538.

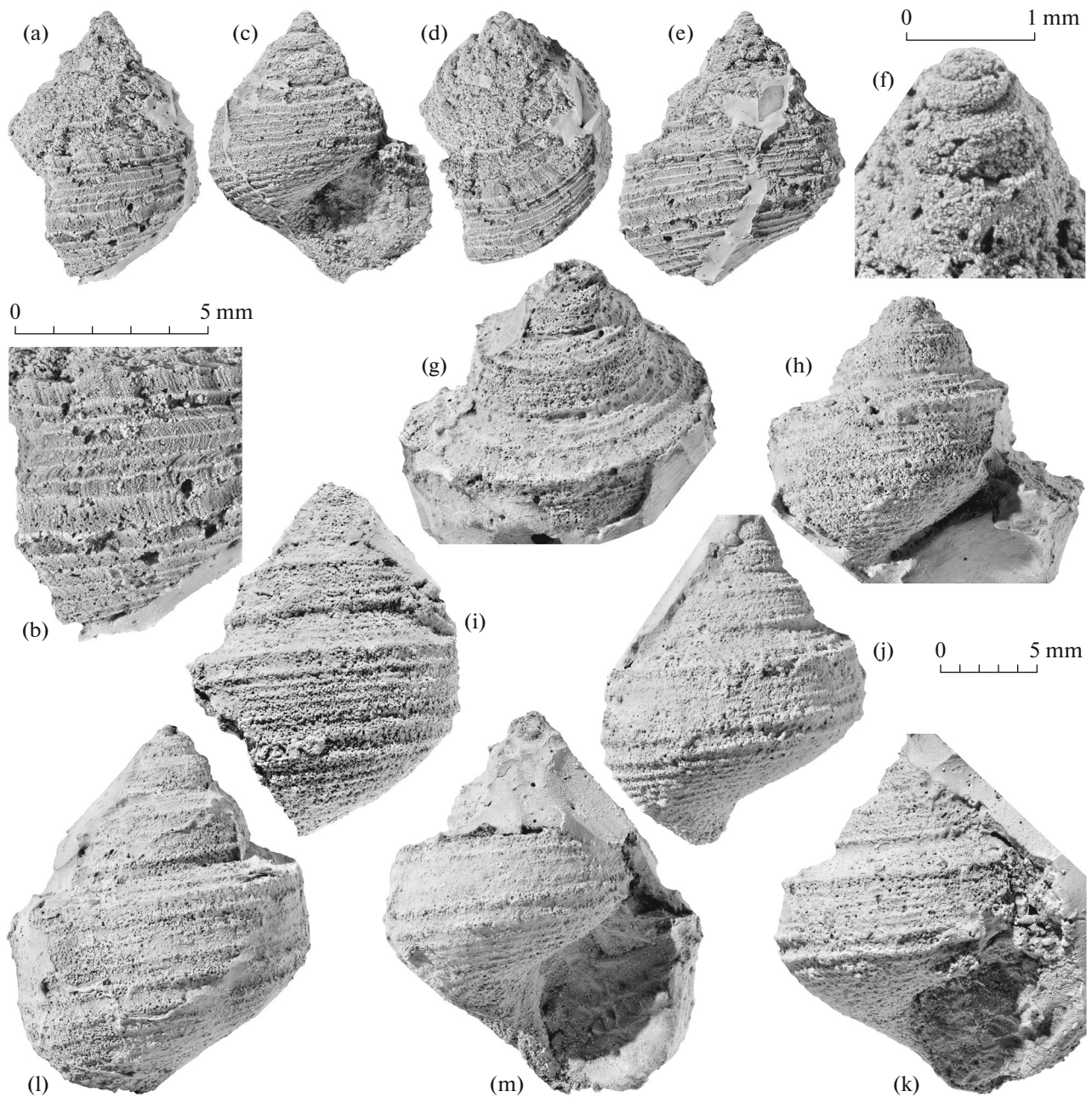


Fig. 1. *Perakella shakhtauensis* gen. et sp. nov., latex casts; all $\times 3$, except (b) and (f): (a–f) holotype PIN, no. 5538/11-4: (a) lateral view, (b) fragment of the lateral whorl surface, $\times 6$, (c) apertural view, (d) top oblique view, (e) opposite to apertural view, (f) initial whorls, $\times 20$; (g, h) paratype PIN, no. 5538/7-170: (g) top oblique view, (h) apertural view; (i) paratype PIN, no. 5538/7-185, lateral view; (j, k) paratype PIN, no. 5538/7-181: (j) lateral view, (k) apertural view; (l, m) paratype PIN, no. 5538/7-161: (l) lateral view, (m) apertural view.

DISCUSSION

In a diverse assemblage of Middle Permian gastropods from the vicinity of Perak (Malaysia), Batten (Batten, 1972) described two gastropod specimens, which he identified as *Borestus planiopicata* (Wanner, 1942). *Platypleurotomaria planiopicata* Wanner, 1942 was established by Wanner (1942) based on material

from Timor and proposed as the type species for the monotypic genus *Platypleurotomaria* Wanner, 1942.

However, Knight et al. (1960), and later Batten (Batten, 1972), based on the position of the selenizone, assigned this species to the genus *Borestus* Thomas, 1940, indicating *Platypleurotomaria* as its junior synonym.

Regardless of the systematic position of the species described by Wanner from Timor, the obvious morphological differences between the Malaysian specimens described by Batten (Batten, 1972, text-figs. 47, 48) and the Timorese type materials of Wanner (Batten, 1972, text-figs. 45, 46) cannot be considered to be species variability, as suggested by Batten.

Despite Batten's statements, referring to his earlier studies (Batten, 1966, pp. 100–101), the initial whorls of Timorese and Malaysian taxa differ significantly.

The level of differences observed appear to indicate a differentiation higher than the species level. The teleoconchs of these specimens also differ in rotational profile, set of sculptural elements, their position, size and the type of their selenizone. The study revealed that the Malaysian specimens, identified by Batten as *Borestus planiaticata* (Wanner, 1942), have features similar to those of the Uralian species *Perakella shakhtauensis* and obviously represent a separate species, described here as *Perakella batteni*. A set of specific traits of these two species make up the diagnosis of a new genus *Perakella*.

The type of whorl profile and the position of the selenizone in the middle of the lateral surface are similar in the new genus *Perakella* and in *Borestus* Thomas, 1940, *Dictyotomaria* Knight, 1945, *Glyptotomaria* Knight, 1945, *Phymatopleura* Girty, 1939, *Callitomaria* Batten, 1956, and also determine its systematic affiliation to the family Phymatopleuridae Batten, 1956. At the same time, the type of selenizone of this genus has little in common with both *Borestus* and other genera of this family. The boundaries of the selenizone are not defined by either the spiral elements of the sculpture (despite their presence), or by the presence of well-defined lunules. In fact, the selenizone is indicated only by a change in the shape of the growth lines.

Thus, the combination of the type of the selenizone with the whorl profile and with the general proportions of the shell (the ratio of the height of the last whorl to the height of the coil) are defining characters of *Perakella*, and provide an optimal diagnosis of the new genus, which clearly separates it from other representatives of Phymatopleuridae.

SYSTEMATIC PALEONTOLOGY

Family Phymatopleuridae Batten, 1956

Genus *Perakella* Mazaev, gen. nov.

Etymology. From the Malaysian toponym Perak, where the first species of this genus was found.

Type species. *Perakella shakhtauensis* gen. et sp. nov.; Russia, Bashkortostan, Shakh-Tau; Lower Permian, Asselian.

Diagnosis. Shell turbiniform, subsutural ramp bounded by a sharp keel; last whorl is encompassing, comparable to height of coil. Initial whorls almost

high-spired, rounded in section; suture depressed. Ornamentation of fine cordlike spiral ribs. Inter rib spaces wide and flattened. Selenizone wide, shifted downward from keel at a distance almost equal to its width; not pronounced in profile, its position is defined only by a change in the shape of the growth lines; above and below delineated by spiral ribs, the thickness of does not exceed the width of the other spiral ribs. Similar spiral ribs, one or more in number, can be present on the selenizone. Umbilicus absent. Columella long, straight, or weakly curved. Growth lines distinct, fine; almost straight or weakly prosocyrte on subsutural ramp, and below selenizone; they are prosocyrte above selenizone.

Species composition. Two species: *Perakella shakhtauensis* sp. nov. from the Early Permian of Eastern Europe and *P. batteni* sp. nov. from the Middle Permian of Malaysia.

Comparison. This genus is distinguished from *Platypleurotomaria* Wanner, 1942 and *Borestus* Thomas, 1940 by the elongated initial whorls, absence of clearly developed collabral ornamentation, and in the fundamentally different morphology of the selenizone, which in the new genus is distinguished only when the growth lines are present.

Perakella shakhtauensis Mazaev, sp. nov.

Etymology. From Shakh-Tau.

Holotype. PIN, no. 5538/11-4, shell imprint; Bashkortostan, Shakh-Tau, locality no. 5538/11; Lower Permian, Upper Asselian.

Description (Fig. 1). The shell turbiniform, of approximately seven whorls. The protoconch morphology is not known. The first three–four initial whorls are rounded in cross–section, ornamented by thin spiral ribs. Beginning from approximately the fourth whorl, the subsutural ramp is gradually formed, separated in the last two whorls by a sharp keel. The subsutural ramp is slightly narrower than the lateral surface width. The subsutural ramp is slightly convex in profile, ornamented by four spiral cordlike ribs. The first two ribs are separated by a relatively narrow intercostal space; the width of a band between the suture and the first rib equals the width of this intercostal space. The third rib is more massive, separated from the second by a slightly larger distance. The fourth rib marks the keel, the intercostal space between it and the third rib is the largest and equals the selenizone width. All intercostal spaces are distinctly concave, and the last, occurring near the keel, like the keel itself, has an undulating surface. The lateral surface of the whorl is straight or slightly convex in profile, subvertical or slightly inclined, so that the whorl periphery point marks the last lower or penultimate rib. There are nine ribs altogether, the upper rib marks the keel (which is in fact the fourth rib of the subsutural ramp). The two upper and two lower ribs are slightly wider and have a larger intercostal space, which is approximately the

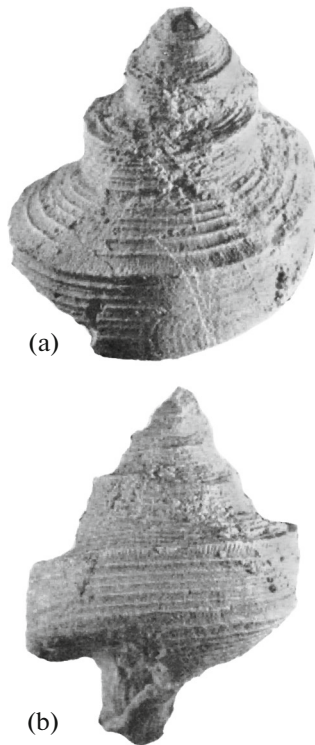


Fig. 2. *Perakella batteni* gen. et sp. nov.; fossil shells, $\times 2$ (after Batten, 1972, text-figs. 47, 48): (a) paratype AMNH 29068, oblique lateral view, (b) holotype AMNH 29069, lateral view.

same as the selenizone width. Other ribs (from third to seventh) are finer, separated by relatively narrow intercostal spaces. The selenizone is between the fourth and sixth ribs. The fifth rib is approximately in the middle of the selenizone. The ninth rib marks the boundary between the lateral and basal surfaces of the whorl. The lateral surface transits to the basal surfaces relatively smoothly. The basal surface is relatively convex, inclined to the shell axis approximately 45° . It is ornamented by evenly wide cordlike spiral ribs (10 to 12 in number), separated by approximately equal, relatively wide spaces. The uppermost space is somewhat wider than the others. The aperture is of complex shape. The columella is very long, arched, with a distinct narrow turnout of columellar lip. The transition of the columellar lip to the basal is smooth. The growth lines are distinct, thin; above and below the keel, and also are almost cordlike on the selenizone. On the subsutural ramp, owing to its poor preservation, growth lines are discernible only near the keel, where they are straight and approaching it at the right angle. On the lateral surface of the whorl, the growth lines above the selenizone are straight, prosocline, sharply bent immediately near the selenizone, forming lunules on the selenizone, prosocyrte below the selenizone and continuing smoothly onto the basal surface.

Dimensions in mm:

Specimen no.	Shell shape	Maximum diameter
5538/11-4 holotype	14.3	11.5
5538/7-161	>19.9	16.7

Comparison. This species is distinguished from *P. batteni* by the later development of the keel and by the narrower subsutural ramp with fewer spiral ribs above it.

Occurrence. Bashkortostan, Shakh-Tau reef; Lower Permian, Asselian.

Material. Six specimens: locality no. 5538/75 specimens; locality no. 5538/11 specimen.

Perakella batteni Mazaev, sp. nov.

Borestus planipectata (non Wanner, 1942): Batten, 1972, p. 37, text-figs. 47, 48.

Etymology. After the paleontologist R.L. Batten.

Holotype. American Museum of Natural History (AMNH), no. 29069; Malaysia, Perak, Kinta Valley near Kampar; Lower–Middle Permian.

Description (Fig. 2). The shell is turbiniform, of approximately seven whorls. The morphology of the protoconch and first two initial whorls is not known. Beginning approximately from the third whorl, a sharp cordlike keel appears, which subdivides the whorl into subsutural ramp and lateral surfaces. The subsutural ramp is slightly narrower than the lateral surface of the whorl. The subsutural ramp is convex in profile; in the last whorl ornamented by six spiral cordlike ribs. The sixth rib marks a sharp keel. The intercostal space near the keel is somewhat wide than the other spaces, smooth or with fine collabral ribs. The lateral surface of the whorl is straight in profile, ornamented by eight spiral cordlike ribs, including the rib marking the keel, and also the rib marking the boundary with the basal surface. The last two ribs are somewhat larger than the other. The intercostals spaces are wide; the upper and lower spaces are noticeably wider than the others. The surface of the upper intercostal space possesses very frequent cordlike collabral slightly opisthocline collabral ribs. The selenizone is between the third and fifth ribs. The fourth rib is approximately in the middle of the selenizone. The transition of the lateral surface into the basal surface is relatively smooth. The basal surface is convex, ornamented by cord like spiral ribs, the width of which equals the thickness of the spiral ribs of the lateral surface. The growth lines are distinct and fine, almost straight on the subsutural ramp, approach the keel at a right angle; on the lateral surface, growth lines above and below the selenizone are prosocyrte, forming distinct lunules on the selenizone.

Dimensions in mm:

Specimen no.	Shell height	Maximum diameter
AMNH 29068 paratype	24.1	12.1
AMNH 29069 holotype	19.8	14.5

Comparison. This species is distinguished from *P. shakhtauensis* by the earlier development of the keel between the subsutural ramp and the lateral surface of the whorl, and by the greater number of spiral ribs on the subsutural ramp.

Remarks. The size of the specimens and their illustrations are from Batten (1972, text-figs. 47, 48). The descriptions are based on these illustrations. Batten's description for *Borestus planiapicata*, contain characters both from Wanner's original specimens (Batten, 1972, text-figs. 45, 46), and Malaysian specimens.

Material. Two specimens from the type locality.

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