

Ademosynoides asiaticus Martynov, 1936, the Earliest Known Member of an Extant Beetle Family (Insecta, Coleoptera, Trachypachidae)

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Abstract—Fossil beetles are described from Kedrovka beds of the locality Babii Kamen', Kuznetsk Basin, Siberia. According to different authors, this locality is dated to the terminal Permian or basal Triassic. SEM studies have shown that *Ademosynoides asiaticus* Martynov, 1936, described from this locality, should be placed in the family Trachypachidae, which makes it the earliest known extant family of beetles. In addition to the re-studied holotype, further material is described for this species; a new species of the same genus and a new genus and species of the same family are also described. As a result, almost 10% of the 78 beetle fossils known from this locality are identified as belonging to Trachypachidae. Unfortunately, the study of these beetles is complicated by the rather poor preservation quality and very small size of the majority of the fossils, which usually cannot be properly studied without using SEM. However, even in this case there is no full certainty that the results are absolutely reliable.

Keywords: terminal Permian, Siberia, beetles, extant family, new taxa

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INTRODUCTION

Any records of fossil remains, including those of beetles, from the very end of the Permian and beginning of the Triassic are especially interesting, since it was during this period that processes which resulted in the largest extinction in the history of Earth took place in the biosphere. Climate changes caused by massive eruptions of lavas (Siberian traps of the Tunguska Basin) are named as the most likely cause of those biosphere reorganizations. The study of fossils from intertrappean deposits is of special interest, because they are marked by doubtless coincidence in time between events that took place in the biota and its inorganic surroundings. The studied locality, Babii Kamen' is located in the Kuznetsk rather than Tunguska Basin, but the two are close to each other, and the section of the locality also includes basalts.

When the locality was described, it was dated to the Early Triassic; some specialists still believe that it is Early Triassic (Durante and Luvsantseven, 2002; Shcherbakov et al., 2002); Losovsky (1998) believed that the lower beds of the Mal'tsevo Formation, to which this locality belongs, are Permian, and the upper beds are Triassic; Gomankov and Meyen (1986) considered the entire formation Permian, corresponding to the Vyatkian–Vetlugian gap; this is also what it was considered later by Gomankov (2005). In one of the most recent publications (Kukhtinov, Lozovsky,

and Voronkova, 2011), the Mal'tsevo Formation is definitely placed in the Permian, and dated to the Vyatkian. The composition of the beetle fossils collected here also allows considering this locality as belonging to the terminal Permian. In any case, Babii Kamen' is one of those fossil beetle localities that are especially close to the Permian–Triassic boundary. Preliminary study of the fossils has shown that they may include members of several extant beetle families. Beetles previously known only from the Mesozoic have also been found here.

The first beetle fossils were collected in the Babii Kamen locality as early as the 1930s by the paleobotanist M.F. Neiburg. One of them was described by Martynov (1936) as *Ademosynoides asiaticus*. In 2001 numerous fossil insects, including beetles, were collected by a paleontological expedition (headed by D.E. Shcherbakov) of the Borissiak Paleontological Institute, Russian Academy of Sciences (PIN), on the right bank of the Tom' River 10 km downstream of Ust'-Naryk village, Novokuznetsk District, Kemerovo Region, in Kedrovka beds of the Mal'tsevo Formation. Paleontologists vary in their views about the age of this locality, as well as about the age of localities of the Tunguska Basin. The same localities are considered terminal Permian by some specialists and Triassic by others. The authors of this study share the former view; the argumentation is given below.

Nearly half of the beetles collected in Babii Kamen' are more or less completely preserved fossils, although antennae and legs are almost invariably missing. This preservation quality is atypical of the Permian and Triassic: most beetle records from these periods are based on isolated elytra. All beetles are rather poorly preserved and very small; only some of them are at least 10 mm long; therefore, they were studied in detail using a TESCAN/Vega XMU scanning electron microscope of the Borissiak Paleontological Institute, Russian Academy of Sciences; a Leica M165c light stereomicroscope with a Leica DFC420 digital camera was also used.

The collection contains 78 beetle specimens, representing about 25 species, including members of Ademosynidae, Schizophoridae, Triaplidae, and Trachypachidae, and possible members of Haliploidea, Staphylinoidea, Elateroidea, Hydrophilidae, and Byrridae. The majority of isolated beetle elytra (about 40) have puncture grooves and should belong to the formal family Permosynidae, originally described from the Late Permian locality Belmont in Australia (Tillyard, 1924). In the Kuznetsk Basin members of this formal family emerge in the Erunakovian deposits; in European Russia, in the Upper Vyatkian deposits; in South Africa, in the Normandien Formation. The earliest beetle fossil with elytra of this type has been found in the Yinping, southern China, dated to the Upper Carboniferous. In addition to permosynid elytra, sporadic smooth schizocoleid elytra are present (about 20%); cupedoid elytra have not been found at the locality. This composition of beetle fauna corresponds to those known from the Upper Vyatkian deposits of European Russia (the localities Aristovo and Vyazniki). It is dissimilar from the composition of such Early Triassic localities as Nedubrovo and Tikhvinskoe and the Middle Triassic localities Hei-Yaga and Nakaz, where smooth elytra are clearly dominant. The absence of cupedids makes this composition dissimilar also from that of Middle Triassic localities in Voltzia sandstone in the Vosges, eastern France, where, in a published sample (Papier et al., 2005), permosynids and schizocoleids make up 35% and 45% of beetles, respectively. The composition in question is especially similar to that of several localities in the intertrappean deposits of the Tunguska Basin. More detailed comparison will be possible only after comprehensive examination of beetle fossils from both Babii Kamen' and the localities of intertrappean deposits. At present the hypothesis about the Permian age of both Babii Kamen' and the intertrappean localities of the Tunguska should be considered the most likely.

In addition to the holotype of *Ademosynoides asiaticus*, four more specimens have been found in the collection of beetles from Babii Kamen', probably representing the subfamily Eodromeinae of the family Trachypachidae; one of these beetles, represented by a pair of elytra, is provisionally placed in the same species, based on the similar size and characteristic pat-

tern of elytral grooves. Similar morphology of the elytra is found also in another beetle, but since its size is considerably smaller, it is described here as a member of a new species of the same genus. Another beetle, fossilized lying on one side, similar in size and outwardly very similar to ground beetles, is also placed in the same species. Another beetle is identified to this family by the metacoxae separating the thorax and abdomen and metepisternum reaching the mesocoxal cavities. It also has grooved elytra, rarely found in Eodromeinae. This beetle is described here as a new genus and species.

SYSTEMATIC PALEONTOLOGY

Family Trachypachidae Leconte, 1861

Subfamily Eodromeinae Ponomarenko, 1977

Genus *Petrodromeus* Ponomarenko et Volkov, gen. nov.

E t y m o l o g y. From the Latinized Greek *petros* (stone) and *dromeus* (runner).

T y p e s p e c i e s. *Ademosynoides asiaticus* Martynov, 1936.

D i a g n o s i s. Small, flattened, rather wide beetle. Head short, mandibles rather short. Pronotum markedly wider than long, weakly narrowed from base, without constriction, with anterior angles almost right angles. Mesocoxae closely set. Metepisternum strongly dilated anteriorly. Metaventricle rather long, only twice as wide at posterior margin as long. Paracoxal suture of metaventricle straight. Metacoxae fully separating thorax and abdomen. Femoral plate of metacoxa rather small, laterally reaching only middle of coxa, with posterior margin almost straight. Abdomen narrowing from base, with six sternites. Elytral grooves narrow, without distinct punctures (Pl. 9, fig. 2b), groove 6 (counting from suture) fused near apex with groove 8.

S p e c i e s c o m p o s i t i o n. Two species from Babii Kamen' locality.

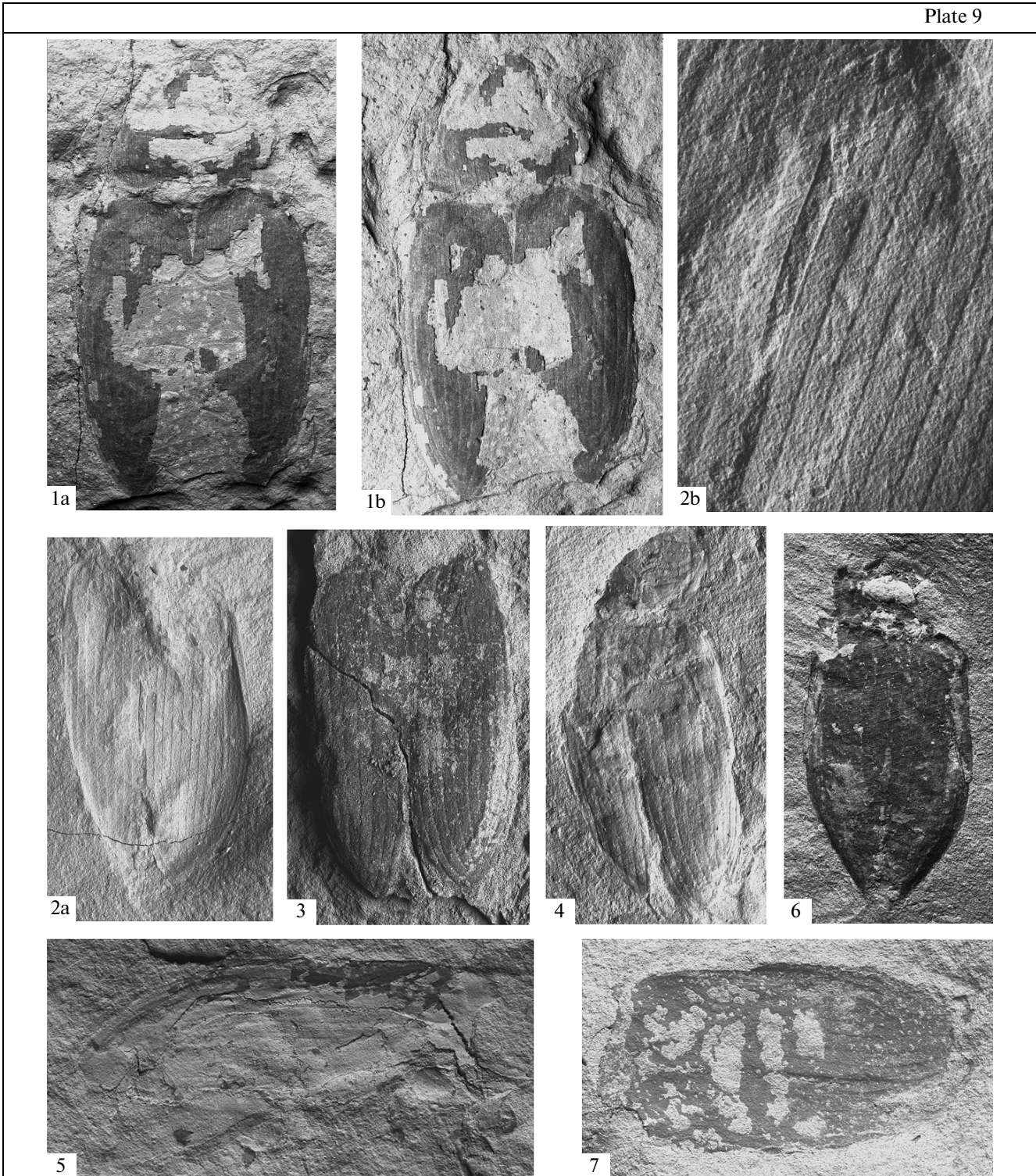
C o m p a r i s o n. In the pronotum markedly wider than long, almost rectangular, and shape of the femoral plate of the metacoxa, the new genus is especially similar to the Jurassic genus *Karatoma* Ponomarenko, 1977, and differs from it in the shorter head, which is only slightly narrower than pronotum, absence of long mandibles protruding anteriorly, long metaventricle, and elytra with grooves.

Petrodromeus asiaticus (Martynov, 1936)

Plate 9, figs. 1, 2

Ademosynoides asiaticus: Martynov, 1936, p. 1253, fig. 2.

H o l o t y p e. PIN, no. 1061/2, incomplete, distorted part and counterpart of beetle body with head and pronotum, without antennae and appendages, with sides asymmetrical; Kemerovo Region, Novokuznetsk District, right bank of Tom' River 10



Explanation of Plate 9

SEM images of beetles from Babii Kamen' locality; presumably terminal Permian, Kedrovka beds.

Figs. 1 and 2. *Petrodromeus asiaticus* (Martynov, 1936): (1) holotype PIN, no. 1061/2, $\times 19.0$: (1a, 1b) images taken at different positions of detector; (2) paratype PIN, no. 4887/98: (2a) habitus, $\times 24.1$; (2b) part of right elytron, $\times 60.2$.

Figs. 3–5. *Petrodromeus minor* sp. nov.: (3) holotype PIN, no. 4887/80, $\times 30.0$; (4) paratype PIN, no. 4887/79, $\times 29.2$; (5) specimen PIN, no. 4887/36, $\times 23.8$.

Figs. 6 and 7. *Permunda nana* sp. nov.: (6) holotype PIN, no. 4887/97, $\times 22.9$; (7) paratype PIN, no. 4887/55, $\times 36.4$.

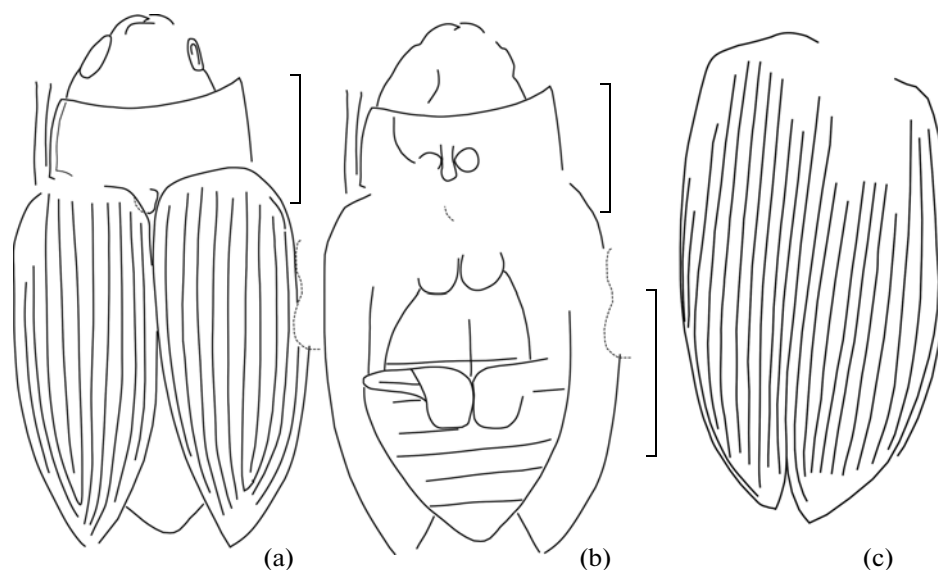


Fig. 1. *Petrodromeus asiaticus* (Martynov, 1936): (a, b) holotype PIN, no. 1061/2: (a) in dorsal view, (b) in ventral view; (c) paratype PIN, no. 4887/98, in dorsal view. Scale bars in Figs. 1–3, 1 mm.

km downstream of Ust'-Naryk village, Babii Kamen' locality; Mal'tsevo Formation, Kedrovka beds.

Description (Fig. 1). The body is twice as long as wide. The head is transverse, nearly twice as wide as long. The clypeus is protruding anteriorly. The eye is rather large, oval, and considerably longer than the temple. The pronotum is more than twice as wide as long. The anterior angles of the pronotum are acute; the posterior angles are almost right angles; the anterior margin of the pronotum is weakly incised. The prosternum is longer than the rounded procoxae. The prosternal process reaches beyond the procoxae and is slightly dilated preapically. The mesocoxae are large, rounded, closely set. The metaventrite is roundedly narrowed anteriorly, half as long as wide at the posterior margin. The posterior margin of the metepisternum is half as wide as the anterior margin. The first visible abdominal sternite is small; sternite 2 is longer than the third; sternites 3–5 are of equal length; the apical sternite is nearly twice as long as either of sternites 3–5 and half as wide basally as the base of the abdomen. The elytra are rather wide, rounded basally, with the external margin straight until the apical third, then narrowed, sutural margin weakly convex, elytral apex acute, symmetrical, reaching slightly beyond the apex of the abdomen. The number of the elytral grooves is ten; the scutellar groove is absent; the sutural groove reaches the apical quarter of the elytron; the next groove is slightly longer. The punctation is very fine.

Measurements, mm. Body length (holotype), 4.2; body width, 2.0; elytron length, 2.8. Elytron length of specimen PIN, no. 4887/98, 2.7.

Material. Holotype and specimen PIN, no. 4887/98 (paired isolated elytra).

Petrodromeus minor Ponomarenko et Volkov, sp. nov.

Plate 9, figs. 3–5

Etymology. From the Latin *minor* (smaller).

Holotype. PIN, no. 4887/80, paired elytra; Kemerovo Region, Novokuznetsk District, right bank of Tom' River 10 km downstream of Ust'-Naryk village, Babii Kamen' locality; Mal'tsevo Formation, Kedrovka beds.

Description (Fig. 2). The body is approximately 2.5 times as long as wide. The head is slightly bent downwards, only slightly shorter than the pronotum. The clypeus is protruding anteriorly. The eye is rather large, almost round in lateral view, considerably longer than the temple. The pronotum is more than twice as wide as long. The mesocoxae are large, rounded, closely set. The metaventrite is roundedly narrowed anteriorly, half as long as wide at posterior margin. The posterior margin of the metepisternum is half as wide as the anterior margin. The elytra are rather wide, rounded basally, with the external margin straight until the apical third, then narrowed, sutural margin weakly convex, elytral apex reaching slightly beyond the apex of the abdomen. The number of the elytral grooves is ten; the scutellar groove is absent; the sutural groove almost reaches the apex of the elytron. The punctation is very fine.

Measurements, mm. Body length, about 3.02–3.30; body width, 2.02–2.30; elytron length, 2.13–2.30.

Comparison. The new species differs from the type species in the smaller size and longer head, abdomen, and sutural groove of the elytron.

Material. In addition to the holotype, this species is probably represented also by the incomplete deformed impression of a beetle, specimen PIN, no. 4887/80, and impression of a beetle lying on one side, specimen PIN, no. 4887/36, which has partly preserved legs; the latter species is placed in this species provisionally, according to the size, habitus typical of ground beetles, and elytron with narrow grooves without punctures.

Genus *Permunda* Ponomarenko et Volkov, gen. nov.

Etymology. From the Permian period and the generic name *Unda* Ponomarenko, 1977.

Type species. *Permunda nana* sp. nov.

Diagnosis. Small, flattened, rather wide beetle. Pronotum strongly transverse, weakly narrowed from base, without constriction, anteriorly with rectangular incision, and with anterior angles protruding anteriorly, acute. Procoxae large; prosternum no longer than procoxae. Elytra wider than pronotum. Metepisternum strongly dilated anteriorly. Metaventricle short, three times as wide at posterior margin as long. Metacoxae completely separating thorax and abdomen. Femoral plate of metacoxa rather small, laterally reaching only middle of coxa. Abdomen narrowed from base, with six sternites. Elytra with six grooves; elytral grooves narrow, without distinct punctures.

Species composition. Type species.

Comparison. The new genus is specially similar to *Unda*, and differs from it in the rectangular shape of the incision of pronotum, large procoxae, and elytra with grooves. It differs from the genus *Petrodromeus* gen. nov. in the pronotum incised anteriorly and in the smaller number of elytral grooves.

***Permunda nana* Ponomarenko et Volkov, sp. nov.**

Plate 9, figs. 6, 7

Etymology. Feminine form of the Latin *nanus* (dwarf).

Holotype. PIN, no. 4887/97, incomplete, distorted part and counterpart of beetle body with head and pronotum, without antennae and appendages, with asymmetrical sides of impression; Kemerovo Region, Novokuznetsk District, right bank of Tom' River 10 km downstream of Ust'-Naryk village, Babii Kamen' locality; Mal'tsevo Formation, Kedrovka beds.

Description (Fig. 3). The body is twice as long as wide. The head is transverse, nearly twice as wide as long. The eye is rather large, oval, longer than the temple. The pronotum is more than twice as wide as long. The anterior angles of the pronotum are acute; the posterior angles are almost straight angles; the anterior margin of the pronotum has an almost rectangular incision. The pronotum is shorter than

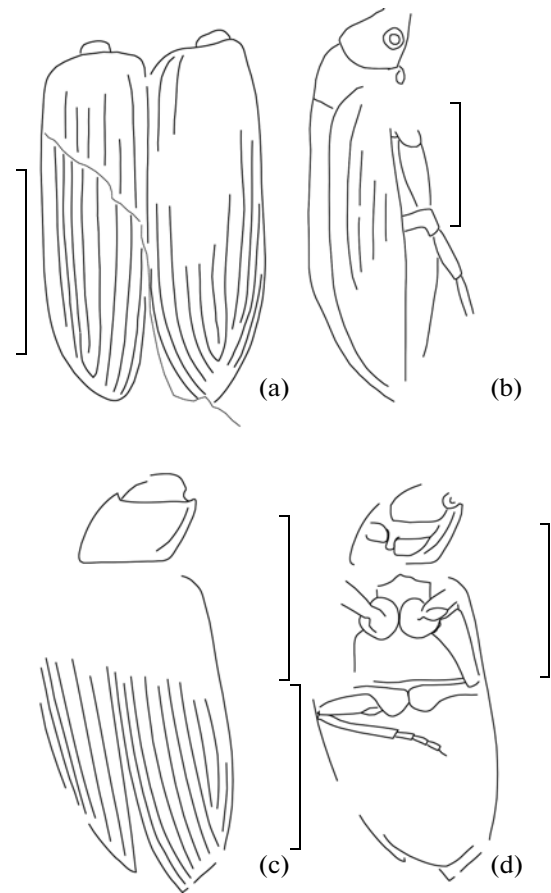


Fig. 2. *Petrodromeus minor* sp. nov.: (a) holotype PIN, no. 4887/80, in dorsal view; (b) specimen PIN, no. 4887/36, in lateral view; (c, d) specimen PIN, no. 4887/79: (c) in dorsal view, (d) in ventral view.

the large, rounded procoxae. The prosternal process reaches beyond the procoxae. The metaventricle is roundedly narrowed anteriorly, half as long as wide at the posterior margin. The first visible abdominal sternite is small; sternite 2 is longer than sternite 1. The elytra are rather wide, rounded basally, with the external margin straight until the apical third, then narrowed, sutural margin weakly convex, elytral apex acute, symmetrical, reaching slightly beyond the apex of the abdomen. The number of the elytral grooves is six; the scutellar groove is absent; the sutural groove reaches the apical third of the elytron; the next groove is longer, almost reaches the apex. The punctuation is very fine.

Measurements, mm. Body length (holotype), about 3; body width, 1.4; elytron length, 2.27. Elytron length of paratype, 1.87.

Material. Holotype and paratype PIN, no. 4887/55 (paired isolated elytra).

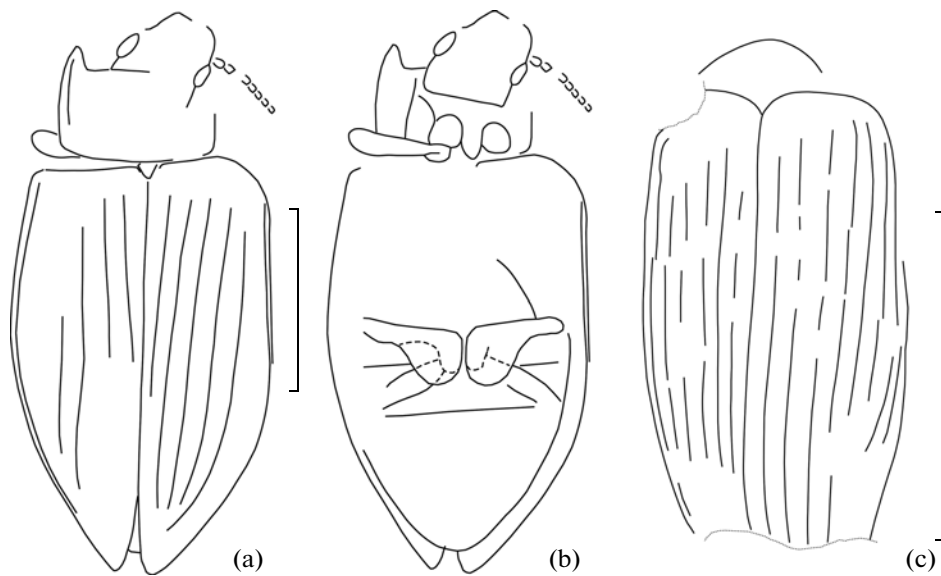


Fig. 3. *Permunda nana* sp. nov.: (a, b) holotype PIN, no. 4887/97: (a) in dorsal view, (b) in ventral view; (c) paratype PIN, no. 4887/55, in dorsal view.

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