A revision of the fossil family Berendtimiridae WINKLER, 1987, with description of a new genus in Baltic amber (Coleoptera: Elateroidea)

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A revision of the fossil family Berendtimiridae Winkler, 1987, with description of a new genus in Baltic amber (Coleoptera: Elateroidea)

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Abstract

With the discovery of *Maigus sontagae* gen. nov., sp. nov. in Baltic amber, all the literature of the fossil family Berendtimiridae Winkler, 1987 is revised. The family is now polytypic, with the subfamilies Berendtimirinae Winkler, 1987 (nominotypical) and Retromalisinae subfam. nov. This new subfamily is established to include *Retromalisus* Kazantsev, 2020 and *Maigus* gen. nov. In addition, *Jantarokrama utilis* Kirejtshuk & Kovalev, 2015 is transferred from Elateridae: Omalisinae to Berendtimiridae: Berendtimirinae, joining *Berendtimirus* Winkler, 1987.

Keywords: Baltic amber, palaeoentomology, new taxa, Berendtimiridae, subfamilies.

1. Introduction

Until now, the fossil family Berendtimiridae Winkler, 1987 consisted of two monotypic genera, both species found in Baltic amber: *Berendtimirus progenitor* Winkler, 1987 and *Retromalisus damzeni* Kazantsev, 2020 (Winkler 1987; Weitschat & Wichard 2010; Bouchard et al. 2011; Ślipiński et al. 2011; Alekseev 2017b; Kazantsev 2020; Ding et al. 2022). A careful study of diagnostic characters allows us to add to this family another species, *Jantarokrama utilis* Kirejtshuk & Kovalev, 2015, originally attributed to the family Omalisidae (Kirejtshuk & Kovalev 2015; Alekseev 2017a, 2022; Kundrata et al. 2020a, 2020b, 2021; Pačková 2021). The original attribution of this species to Omalisidae (currently, Elateridae: Omalisinae; Kusy et al. 2018) had been controversial (e.g., Bocek et al. 2018). With the discovery of the new genus described here, this extinct family from Baltic amber can now be considered polytypic, with two subfamilies. Our analysis is designed to help clarify the taxonomic position of the family Berendtimiridae by highlighting its variability.

2. Material and methods

The holotype is embedded in a clear yellow piece of Baltic amber measuring approximately 17 x 5.5 x 4 mm, and preserved at the Museum of Amber Inclusions in Gdańsk, Poland. The specimen, found in the Kaliningrad region in Russia, was examined using a Carton stereomicroscope 0.8–40x. Photographs were taken with a Canon EOS 70D camera equipped with a Canon MP-E 65 mm macro lens and processed with PhotoImpact Viewer SE.

3. Systematic palaeoentomology

Family Berendtimiridae Winkler, 1987

Subfamily Berendtimirinae Winkler, 1987

Type genus: *Berendtimirus* Winkler, 1987.

Genera included: *Berendtimirus* Winkler, 1987; *Jantarokrama* Kirejtshuk & Kovalev, 2015.

Diagnosis: The subfamily is characterized by six ventrites exposed. The sixth ventrite is considerably retracted in the genus *Jantarokrama*.

Distribution: Known only from Baltic amber.

Remarks: Another specimen that closely resembles *Jantarokrama utilis* is present in the Kaliningrad Regional Amber Museum in Kaliningrad, Russia (Alekseev 2022), while the holotype of *Jantarokrama utilis* is preserved in the National Museum of Natural History of Paris (MNHN), France (Kirejtshuk & Kovalev 2015; Kundrata et al. 2021; Pačková 2021).

Subfamily Retromalisinae nov.

urn:lsid:zoobank.org:act:F3A68794-D2CB-4D0A-BCC5-A51DC5C25371

Type genus: *Retromalisus* Kazantsev, 2020.

Genera included: *Retromalisus* Kazantsev, 2020; *Maigus* nov.

Diagnosis: The subfamily is characterized by eight ventrites exposed.

Distribution: Known only from Baltic amber.

Genus *Maigus* nov.

urn:lsid:zoobank.org:act:C9C6E409-E477-42D8-95DC-908733BDD1AD

Type species: *Maigus sontagae* gen. nov., sp. nov., by monotypy.

Etymology: Named in honour of the Museum of Amber Inclusions, Gdańsk (MAIG), Poland, where the amber piece is deposited. The gender is masculine.

Differential diagnosis: Very similar to the genus *Retromalisus*, the new genus differs by having more elongated and extruded posterior corners, elytral epipleura that do not fully reach the elytral apexes (fully sclerotised epipleura extending to the elytral apices in *Retromalisus*) and a pronotum without ribs and carinae, while in *Retromalisus* the disk medially has an obscure longitudinal rib, and laterally transverse carinae reaching the lateral margins (Kazantsev 2020).

Description: Small size. Head transverse, rounded. Last maxillary palpomere globular and apically pointed. Antennae 11-segmented, filiform, antennomere II about 1.5 times shorter than scape. Pronotum transverse, trapezoidal, without rib and carinae, with posterior corners very extruded. Elytra elongated with 10 regular longitudinal rows of impressed punctuation, epipleura almost completely developed. Prosternum short. Abdomen with eight ventrites, the first medially completely interrupted by metacoxae, the last largely invaginated. Tarsal formula 5-5-5 with the penultimate tarsomere bilobed, claws simple.

Distribution: Currently known only from Eocene Baltic amber found in the Kaliningrad region in Russia.

Maigus sontagae sp. nov.
Figs. 1, 2

urn:lsid:zoobank.org:act:6FDC85B5-B830-4193-A274-C5487AE8FEE2

Etymology: Named in honour of Elżbieta Sontag (Museum of Amber Inclusions, Gdańsk), founder and long-term curator of the museum.

Type: Holotype: Likely male, Baltic amber, housed at the Museum of Amber Inclusions, Gdańsk, Poland, with the code MAIG 7001 (ex coll. Jonas Damzen: JDC11137).

Type locality: Amber mine in the Yantarny settlement, Sambian Peninsula, Kaliningrad region, Russia.

Type horizon: Middle Eocene (Lutetian) (47.8–41.2 Ma) to late Eocene (Priabonian) (37.8–33.9 Ma).

Description: Adult, winged, elongate, rather robust, probably male. Body length: about 2.5 mm (the specimen is slightly bent). Body entirely dark brown. Head moderately large, transverse, slightly narrowed posteriorly, almost completely exposed, pubescent. Eyes large, spherical, inserted in lateral-upper part of the head, interocular dorsal distance ca. 1.4 times greater than eye diameter. Palps small, slender; ultimate palpomeres very elongated, narrowed and pointed apically. Antennae long, reaching the apex of elytra, 11-segmented, filiform, strongly pubescent; antennomere I elongated, robust, slightly club-shaped; antennomere II about 1.5 times shorter than scape; antennomere III approximately as long as second and only very slightly longer; antennomeres IV–VIII longer than previous one, subequal with antennomeres VII–VIII only very slightly shorter; antennomeres IX–X shorter than previous ones; antennomere XI elongated with pointed apex. Pronotum transverse, narrower than head, trapezoidal; anterior margin rather straight with rounded corners; posterior margin straight, protruded backward in the middle; posterior corners acute and long; sides straight, slightly wider at posterior part, shallowly incised before posterior angles; disk pubescent and sparsely punctate, flat, without longitudinal rib and transverse carinae; margins bordered. Scutellum short, elongated, pointed at apex. Elytra elongated, almost parallel-sided, wider than pronotum, with 10 regular longitudinal rows of impressed punctuation with the distance between punctures subequal to their diameter and a short humeral carina along interspace 6; epipleura sclerotized not fully reaching elytral apices; pubescence short, apex rounded. Metathoracic wings fully developed, as long as elytra or slightly longer. Prosternum short, wide at base, with impressed punctuation. Abdomen with eight transverse, pubescent ventrites; penultimate ventrite semicircularly incised; ultimate ventrite largely invaginated. Legs relatively long and slender; coxae elongated, very robust; trochanters elongated, rounded at apex, apically overlaying bases of femora; femora straight, cylindrical, enlarged from middle to apex; tibiae cylindrical, shorter than femora, tibial spurs absent; tarsi 5-segmented, tarsomeres I–III narrow without plantar pad, tarsomere II about 1.5 times shorter than first, tarsomere III about 1.4–1.5 times shorter than second, tarsomere IV incised to the base and conspicuously widened; claws simple.

Syninclusions: Air bubbles, stellate hairs, botanical remains.

4. Discussion

A small subfamily of beetles distributed in the western Palearctic region, the Omalisinae are classified in the superfamily Elateroidea, with obscure phylogenetic relationships that have been traditionally placed in the cantharoid clade (Bocák & Brlik 2008). Omalisinae were once classified as a family (Omalisidae), but recent genomic and phylogenetic analyses indicate the terminal positions of the beetles are within the broadly defined well-sclerotized and fully metamorphosed Elateridae, and therefore they are now considered a subfamily of Elateridae (Omalisinae) (Kusy et al. 2018). Interestingly, molecular phylogenies have demonstrated the morphological similarity with other soft-bodied beetles is a case of parallel evolution, homoplasy rather than apomorphy.

The typical characters that distinguish the Berendtimiridae family from its closest taxa are the second and third antennomeres similar in size and vestiture, and the cranium that resembles a raised flat shield-like structure (Winkler 1987; Poinar & Fanti 2016). *Retromalisus* differs from species in Cantharidae and Omalisinae in possessing complete sclerotised elytral epipleura, a short prosternum with a short intercoxal process and wide and deeply incised penultimate tarsomeres (Kazantsev 2020).

Kirejtshuk & Kovalev (2015) described *Jantarokrama* as a member of the family Omalisidae, though remarking about its close resemblance to *Berendtimirus*. In fact,

Fig. 1. *Maigus sontagae* gen. et sp. nov. in Baltic amber (code MAIG 7001). **A** – Holotype, dorsal view; **B** – ventral view.

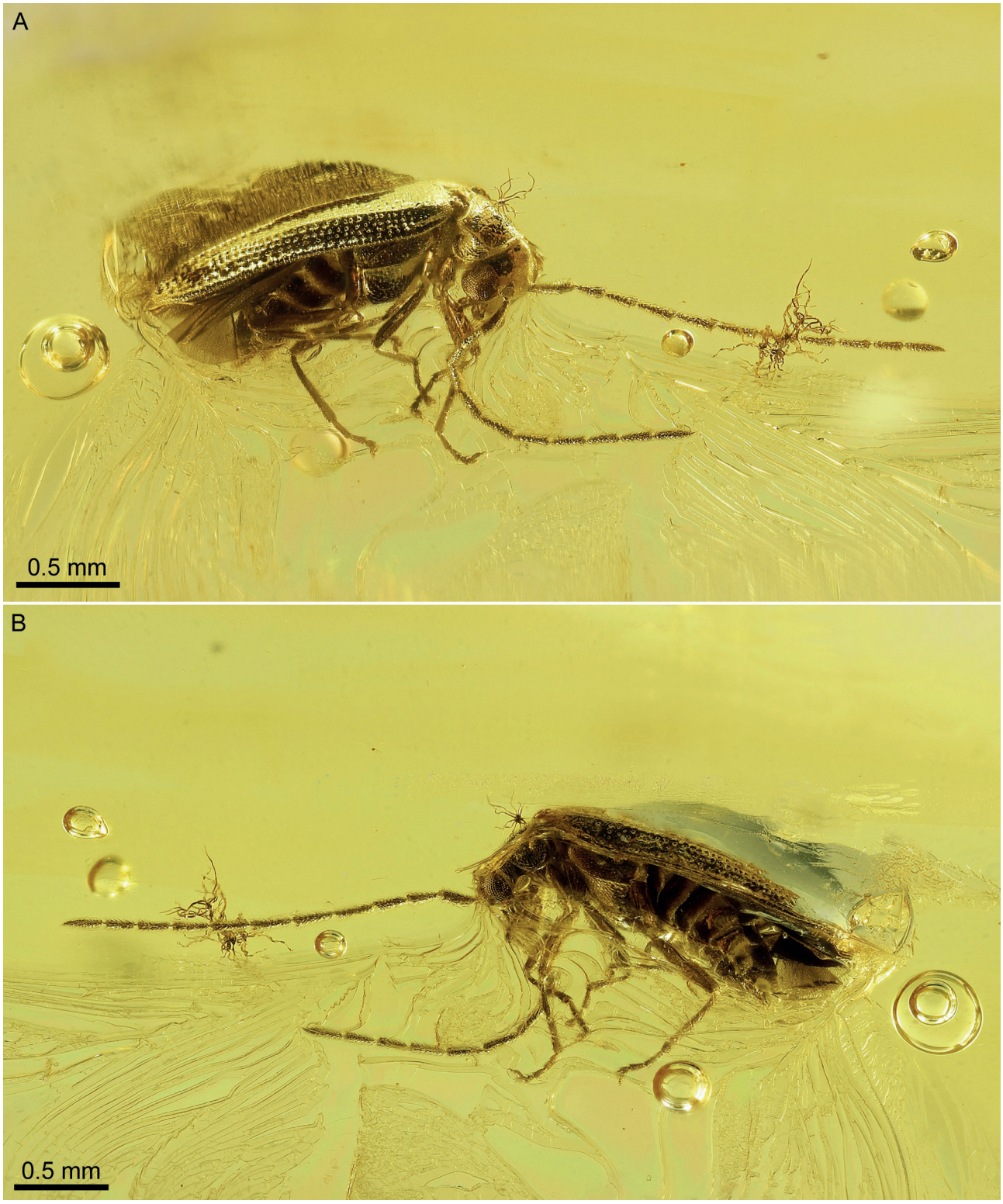

Fig. 2. *Maigus sontagae* gen. et sp. nov. in Baltic amber (code MAIG 7001). **A, B** – Holotype, lateral views.

Jantarokrama shows some small characters in common with the Omalisinae, including the short antennomere II (only slightly longer in Berendtimiridae) and narrowly separated antennal insertions (widely separated in Berendtimiridae). In contrast, *Jantarokrama* differs from all representatives of Omalisinae in having a particularly long scape, somewhat longer antennomeres, more narrowly separated antennal bases, much shorter elytra with broadly arcuate sides, a different shape of the prosternum and no elytral costae. *Jantarokrama* appears more like *Berendtimirus*, showing similar elytral sculpture and pronotal shape, with the same number of ventrites (six) and a short prosternal process. Based on Bocák & Brlik (2008), genera of Omalisidae such as *Omalisus, Thilmanus* and *Phaeopterus* have seven ventrites visible. Therefore, we assign *Jantarokrama* to Berendtimiridae Berendtimirinae.

With the discovery of the new genus and our analysis of *Jantarokrama* and Berendtimiridae, it is clear that important morphological characters can vary widely in the family, which is why we establish a new subfamily here. For example, the number of ventrites – an important trait in distinguishing among the various families of soft-bodied beetles (Crowson 1972) – differs between Berendtimirinae and Retromalisinae.

It is important to note that the phylogenetic relationship of Berendtimiridae to other taxa remains obscure (Jeng 2008; Tihelka et al. 2019). As part of the Elateroidea, this family could be related to Elateridae Omalisinae but also to Lycidae or Cantharidae. Discoveries of additional specimens will help clarify the relationships among these intriguing beetles.

Key to Berendtimiridae subfamilies:

1. Six ventrites exposed (sixth considerably retracted in *Jantarokrama*).....Berendtimirinae
-. Eight ventrites exposed, last largely invaginated.....
.....Retromalisinae

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5. References

Alekseev, V. I. (2017a): Coleoptera from the middle-upper Eocene European ambers: generic composition, zoogeography and climatic implications. – Zootaxa, **4290**(3): 401–443.

Alekseev, V. I. (2017b): A new coleopterous family Wabbelidae fam. nov. (Coleoptera: Cucujoidea) from Baltic amber (Cenozoic, Paleogene, Eocene). – Baltic Journal of Coleopterology, **17**(1): 29–41.

Alekseev, V. I. (2022): Inclusions of beetles (Coleoptera) in Baltic amber of the Kaliningrad Amber Museum: an inventory of illusions and reality. – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, **306**(3): 209–225.

Bocák, L. & Brlik, M. (2008): Revision of the family Omalisidae (Coleoptera, Elateroidea). – Insect Systematics & Evolution, **39**(2): 189–212.

Bocek, M., Fancello, L., Motyka, M., Bocakova, M. & Bocák, L. (2018): The molecular phylogeny of Omalisidae (Coleoptera) defines the family limits and demonstrates low dispersal propensity and ancient vicariance pattern. – Systematic Entomology, **43**: 250–261.

Bouchard, P., Bousquet, Y., Davies, A. E., Alonso-Zarazaga, M. A., Lawrence, J. F., Lyal, C. H. C., Newton, A. F., Reid, C. A. M., Schmitt, M., Ślipiński, S. A. & Smith, A. B. T. (2011): Family-group names in Coleoptera (Insecta). – ZooKeys, **88**: 1–972.

Crowson, R. A. (1972): A review of the classification of Cantharoidea (Coleoptera), with the definition of two new families, Cneoglossidae and Omethidae. – Revista de la Universidad de Madrid. Estudios de Entomologia, **21**(82): 35–77.

Ding, Q., Li, L. L., Lu, Y. Y., Zhou, X., Dai, S., Yang, F., Wang, J. B., Chen, Y. N., Sheng, Y. Y., Gu, S. & Bai, M. (2022): The world new taxa of Coleoptera in 2020. – Biodiversity Science, **30**(3): 21507.

Jeng, M.-L. (2008): Comprehensive phylogenetics, systematics, and evolution of neoteny of Lampyridae (Insecta: Coleoptera). – PhD Thesis, University of Kansas, Lawrence, Kansas, vii + 388 pp.

Kazantsev, S. V. (2020): *Retromalisus damzeni*, gen. et sp. nov., a second Baltic amber taxon of the extinct family Berendtimiridae (Insecta: Coleoptera). – Journal of Natural History, **54**(17/18): 1073–1080.

Kirejtshuk, A. G. & Kovalev, A. V. (2015): First fossil representative of the family Omalisidae (Coleoptera, Elateroidea sensu lato) from the Baltic Amber. – Paleontological Journal, **49**(13): 1413–1416.

Kundrata, R., Bukejs, A., Prosvirov, A. S. & Hoffmannova, J. (2020a): X-ray micro-computed tomography reveals a unique morphology in a new click-beetle (Coleoptera, Elateridae) from the Eocene Baltic amber. – Scientific Reports, **10**(1): 20158.

Kundrata, R., Pačková, G. & Hoffmannova, J. (2020b): Fossil genera in Elateridae (Insecta, Coleoptera): a Triassic origin and Jurassic diversification. – Insects, **11**: 394.

Kundrata, R., Pačková, G., Prosvirov, A. S. & Hoffmannova, J. (2021): The fossil record of Elateridae (Coleoptera: Elateroidea): described species, current problems and future prospects. – Insects, **12**: 286.

Kusy, D., Motyka, M., Bocek, M., Vogler, A. P. & Bocák, L. (2018): Genome sequences identify three families of Coleoptera as morphologically derived click beetles (Elateridae) – Scientific Reports, **8**: 17084.

Pačková, G. (2021): Fosilní záznam čeledi Elateridae (Coleoptera: Elateroidea). – Thesis, Univerzita Palackého v Olomouci. Přírodovědecká fakulta. Katedra botaniki, Olomuc, 163 pp.

Poinar, G. O. Jr. & Fanti, F. (2016): New fossil soldier beetles (*Coleoptera: Cantharidae*) in Burmese, Baltic and Dominican amber. – Palaeodiversity, **9**: 1–7.

Ślipiński, S. A., Leschen, R. A. B. & Lawrence, J. F. (2011): Order Coleoptera Linnaeus, 1758. In: Zhang, Z.-Q. (ed.): Animal biodiversity: An outline of higher-level classification and survey of taxonomic richness. – Zootaxa, **3148**: 203–208.

Tihelka, E., Huang, D. & Cai, C. (2019): A new genus and tribe of Cretaceous net-winged beetles from Burmese amber (Coleoptera: Elateroidea: Lycidae). – Palaeoentomology, **2**(3): 262–270.

Weitschat, W. & Wichard, W. (2010): Baltic Amber. In: Penney, D. (ed.): Biodiversity of fossils in Amber from the major world deposits: 80–116; Manchester (Siri Scientific Press).

Winkler, J. R. (1987): Berendtimiridae fam. n., a new family of fossil beetles from Baltic Amber. – Mitteilungen der Münchner Entomologischen Gesellschaft, **77**: 51–59.

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