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Article

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Two new silken fungus beetle species (Coleoptera, Cucujiformia, Cryptophagidae) from Rovno amber

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Abstract
Two new extinct species of the genus *Atomaria* Stephens, 1829 are described and illustrated: *A. (Anchicera) bukejsi* **sp. nov**. and *A. (Anchicera) archibaldi* **sp. nov.**, both from late Eocene Rovno amber. *Atomaria (Anchicera) bukejsi* **sp. nov**. appears close to *A. (Anchicera) gedanicola* Lyubarsky et Perkovsky, 2013, but differs in the structure of the pronotum and antennae. *Atomaria (Anchicera) archibaldi* **sp. nov.** is similar to *A. telnovi* Lyubarsky et Perkovsky, 2023, but differs in the structure of the pronotum and antennae.

Key words beetle, *Atomaria*, *Anchicera*, key, late Eocene, fossil.

Introduction

The fossil records of Cryptophagidae (Coleoptera) are rather numerous (Cai & Wang 2013; Peris *et al.* 2017; Lyubarsky & Perkovsky 2021). New species described herein belong to the family Cryptophagidae due to the combination of the following features: tarsal formula 5–5–5, antennal club three-segmented, procoxal cavities closed externally, tarsomeres simple, not lobed, abdominal ventrite 1 longer than combined length of remaining ventrites, punctures of elytra confused, epipleura incomplete. Discussed new findings from Rovno amber belong to the genus *Atomaria* Stephens, 1829.

Two of the studied specimens belong to the genus *Atomaria*. Representatives of this genus are distributed in all biogeographic realms as well, although they are more common in the Holarctic and

less diverse in South Africa, Australia, and South America. The genus *Atomaria* comprises more 120 extant species in the Palaearctic realm.

Fossil Atomariinae are well-known (Cai & Wang 2013; Lyubarsky & Perkovsky 2018; Lyubarsky & Bukejs 2022). The most speciose genus of the subfamily, *Atomaria*, is recorded from Eocene by seven species of the subgenus *Anchicera: Atomaria* (*Anchicera*) *gedanicola* Lyubarsky et Perkovsky, 2013, *A.* (*A.*) *groehni* Perkovsky et Lyubarsky, 2014, *A.* (*A.*) *alekseevi* Lyubarsky et Bukejs, 2022, *A.* (*A.*) *propinqua* Lyubarsky, Alekseev et Bukejs, 2023 from Baltic amber (Lyubarsky & Perkovsky 2013, 2021; Lyubarsky & Bukejs 2022; Perkovsky & Lyubarsky, 2014; Lyubarsky *et al*. 2023a), *A.* (*A.*) *saxonica* Lyubarsky et Perkovsky, 2018 from Bitterfeld amber, and *A.* (*A.*) *perkovskyi* Lyubarsky et Bukejs, 2022, and *A.* (*A.*) *telnovi* Lyubarsky, Perkovsky et Vasilenko, 2023 from Rovno amber (Lyubarsky & Bukejs 2022; Lyubarsky *et al*. 2023b). Another specimen of *A. groehni* from Baltic amber has been found in the collections of the Paleontological Institute (PIN 964/1325) (Lyubarsky & Perkovsky 2021); two Baltic amber specimens of *A. alekseevi* have been found in the same collection (PIN 964/1334, PIN 964/1335) (Lyubarsky *et al.* 2023c). One Baltic amber specimen of *A. alekseevi* reported by Lyubarsky et al. (2023a). Both new extinct species discussed herein are assigned to the subgenus *Anchicera* within *Atomaria* based on the combination of the following features: the distance between antennal insertions greater than the distance between antennal insertion and anterior eye margin, and lateral margins of elytra widely rounded in dorsal view, not parallel.

Material and methods

Rovno amber is the southern coeval of Baltic amber (Mitov *et al.* 2021). In the last ten years majority of inclusions with known localities were collected in former Dubrovitsa and Zarechoje districts (now Varash District) of Rovno Oblast, especially from Voronki and nearby Luko (e. g. Perkovsky & Olmi 2018; Legalov *et al.* 2019, 2023; Perkovsky & Makarkin 2019, 2020; Makarkin & Perkovsky 2020; Perkovsky *et al.* 2020; Colombo *et al.* 2021; Perkovsky & Nel 2021; Olmi *et al.* 2022; Simutnik *et al.* 2022; Belokobylskij *et al.* 2023; Telnov et al 2023; Kirichenko-Babko & Perkovsky 2023; Fedotova *et al.* 2024). Significantly less documented are inclusions from Perebrody (Dietrich *et al.* 2021) and, particularly, Stare Selo (former Rokitne District, now Sarny District) in the northeast of Rovno Oblast – these inclusions were mainly indicated as originated from "Rovno Oblast", especially when amber mined in former Rokitne District and Perebrody is mixed with smaller amount of amber mined in Varash District (e. g. Turbanov *et al*. 2023). The amber sample with the inclusion SIZK L-425 was mined in Voronki (clear piece L-343, weight before cutting 13 g, size 52x29x20 mm), sample with SIZK CC-21 - in Stare Selo (clear piece, weight after primary cutting 12.9 g, size 41x15x37 mm).

Observations and images were made using a Nikon E-800 microscope (dry x4 and x10 objectives), equipped with an Olympus OM-D E-M10-II digital camera.

All specimens are deposited in the Schmalhausen Institute of Zoology, Kiev, Ukraine (SIZK).

Taxonomy

Family Cryptophagidae Kirby, 1826
Subfamily Atomariinae LeConte, 1861

Genus *Atomaria* Stephens, 1829
Type species: *Dermestes nigripennis* Paykull, 1798

Subgenus *Anchicera* Thomson, 1863

Atomaria (*Anchicera*) *bukejsi* Lyubarsky et Perkovsky, **sp. nov.**
https://zoobank.org/urn:lsid:zoobank.org:act:32CCA127-9090-42DD-9F94-5BF622F23281
(Figs. 1, 2A)

Type material. Holotype. SIZK CC-21, Stare Selo, Rovno amber, late Eocene.

Syninclusions: SIZK CC-17: a worker of *Lasius schiefferdeckeri* Mayr, 1868, a larva of an indet. Coleoptera; SIZK CC-18–SIZK CC-20: three specimens of the same species of Corticariinae (Latridiidae); stellate hairs.

Etymology. Patronymic. Named for our dear colleague Dr. Andris Bukejs (Institute of Life Sciences and Technologies, Daugavpils University, Daugavpils, Latvia).

Differential diagnosis. *Atomaria bukejsi* sp. nov. appears similar to *A. gedanicola* Lyubarsky et Perkovsky (2013), but differs from it due to the convex pronotal disc (*A. gedanicola*: pronotal disc flat), the pronotum with a maximum width afore midlength (*A. gedanicola*: behind midlength), the depressed pronotal base (*A. gedanicola*: base of pronotum without depression), antennomeres 3, 5, and 7 subquadrate (*A. gedanicola*: elongate), and more transverse pronotum, about 1.68 times as wide as long (*A. gedanicola*: about 1.44 times as wide as long).

Description. Measurements: body length (from anterior margin of head to elytral apex along midline) about 1.65 mm, body maximum width across both elytra 0.76, pronotum length 0.36, pronotum maximum width 0.64, elytra length 1.1, elytra maximum width 0.76. Body elongate (Figs 1A, 1B), moderately convex, covered with slightly curved, semierect, moderately long, pale setation. Body, legs and antennae unicolorous dark brown. Head transverse, finely punctate, with hemispherical, coarse faceted eyes. Eye well developed, with nine facets in lateral eye margin (counted in dorsal view at maximum eye length). Antennae long, slender, with club extending beyond base of pronotum (Figs 1A, 1D). Antennal shape as in Figures 1A and 1C; antennomeres 1–3 elongated, about 1.5 times as long as wide, antennomeres 4–8 short, about 1.0–1.2 times as long as wide, antennomere 9 slightly transverse, antennomere 10 subquadrate, terminal antennomere obliquely oval. Antennal insertions widely separated basally. Pronotum strongly transverse, widest at or just behind midlength where it about 1.68 times as wide as long, strongly narrowed anteriorly and slightly - posteriorly. Anterior margin non-sinuate and not notched, anterolateral angles without thickening or callosity. Lateral margins only visible from above in basal half of pronotum. Pronotal disc convex, moderately strongly and densely punctate, distance between punctures 1× diameter of one puncture. Base of the pronotum without median depression (Fig. 1D); posterolateral angles rectangular. Posterior margin finely edged, basal margin slightly bilobed. Pronotum rather wide, not narrower than elytra. Prosternum strongly and densely punctured. Scutellar shield small, oval, transverse, more than twice wider than long. Elytra elongate oval, moderately convex, weakly curved at lateral margins, widest about at anterior one-third, 3.2 times as long as pronotum, 1.5 times as long as combined wide. Elytral surface moderately densely, confusedly punctate, punctures in basal part of elytra slightly smaller compared to those on pronotal disc, and separated by about 1.0–1.5 their diameters; elytral humeri rounded, not toothed. Epipleura narrowed posteriorly, incomplete, extending about to abdominal ventrite 4. Longitudinal metasternal line absent. Legs slender, long, relatively similar in shape, finely punctate. Procoxae large, widely suboval, slightly transverse; mesocoxae round; metacoxae narrowly oval, strongly transverse. Femora elongate-oval, flattened. Tibiae thin, almost straight, parallel-sided, nearly as long as femora, with two terminal spurs (Fig. 2A). Tarsi long and thin; tarsomeres simple, not lobed; tarsal formula 5-5-5 (Fig. 2A). Pretarsal claws simple. Abdomen with five visible, freely articulated ventrites; ventrite 1 longest, covered with rather coarse punctation, ventrites 2–5 with fine and denser punctures; ventrite 5 evenly arcuate; ventrite 5 without crenulations, surface unmodified.

Remarks. According to our observations, ants of the genus *Lasius* Fabricius and beetles of the family Latridiidae are quite often found together with *Cryptophagus*. *Cryptophagus* is lacking special connections with *Lasius* ants. According to our data, combined findings of the following species were noted: *Cryptophagus cellaris* Scopoli, *C. dorsalis* C.R. Sahlberg, *C. falcozi* Roubal, *C. fuscicornis* Sturm, *C. intermedius* Bruce, *C. lycoperdi* (Scopoli), and *C. quercinus* Kraatz. Most of these species are widespread (across a large part of the Palaearctic) and quite common. *Cryptophagus cellaris*, for instance, besides to *Lasius* nests was found in underground nests of mice and other mammals, at basements of various buildings, in the meadows, in a mill and wheat warehouses, in rotten straw, in a bee hive, and under spruce bark. *Cryptophagus dorsalis* was found under pine bark, on birch sap, and in forest litter. *Cryptophagus lycoperdi* was found in bee hives, bumblebee nests, on fungi, and in forest litter. Co-occurrence with latridiids most likely point on sharing same habitat in litter, most likely - forest litter. As far as is known, *Lasius* ants do not occur together with *Atomaria*. Perhaps this accidental co-location can be explained by *Atomaria* and *Lasius* occurrence together in Eocene, for instance, in forest litter.

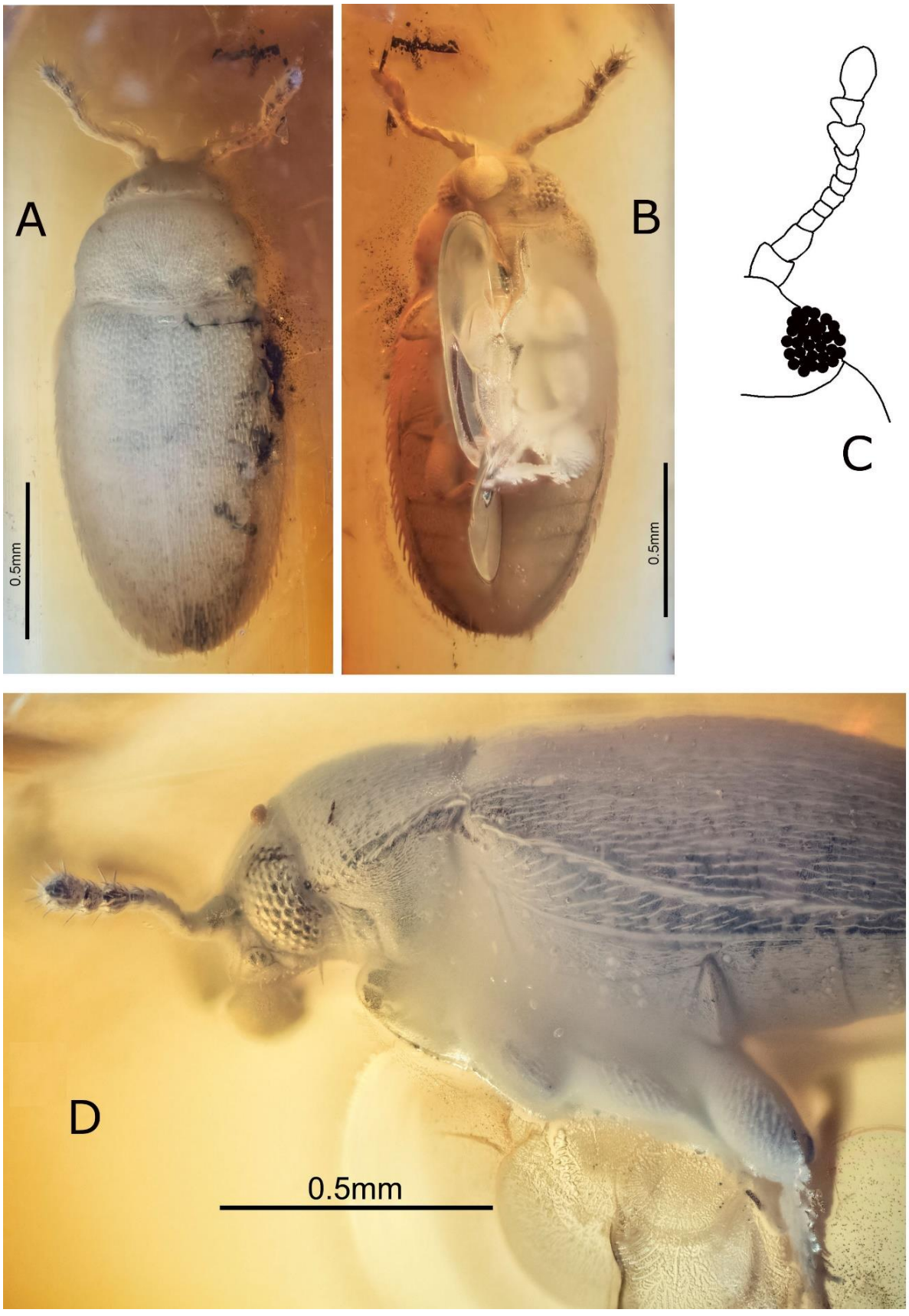
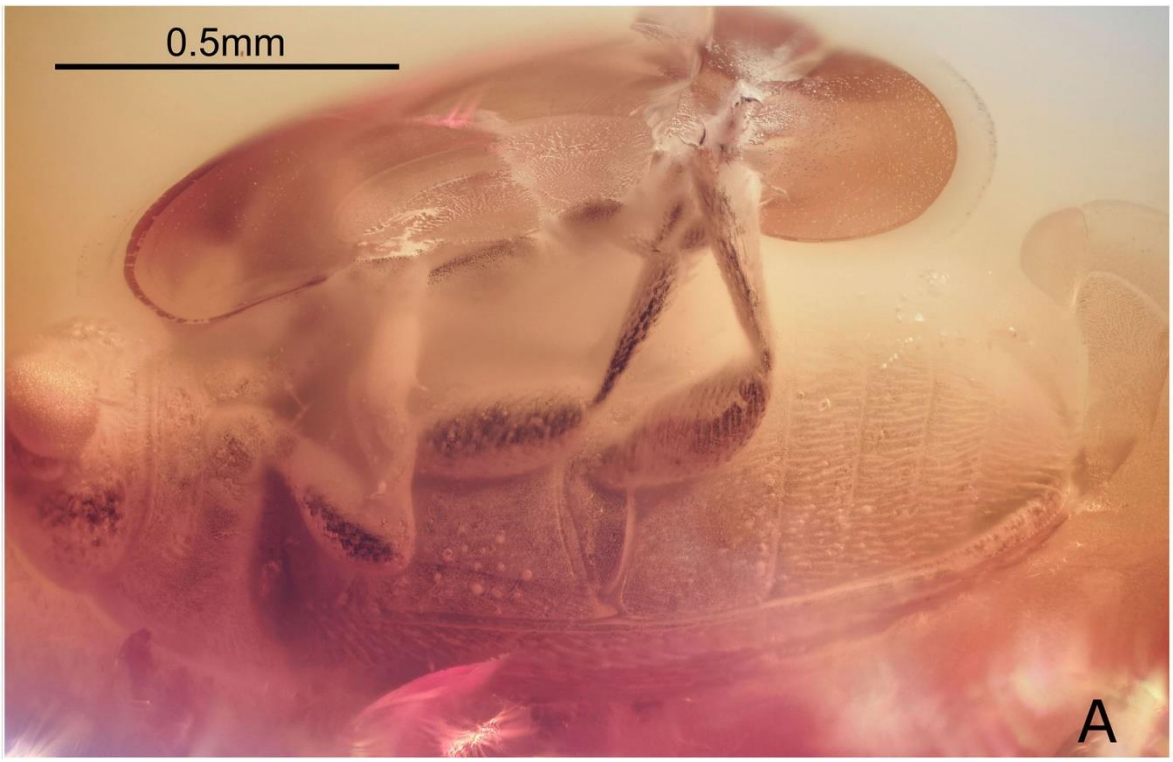


Figure 1. *Atomaria* (*Anchicera*) *bukejsi* **sp. nov.:** A – dorsal view (image), B – ventral view (image), C – antenna (drawing), D – lateral view (image).



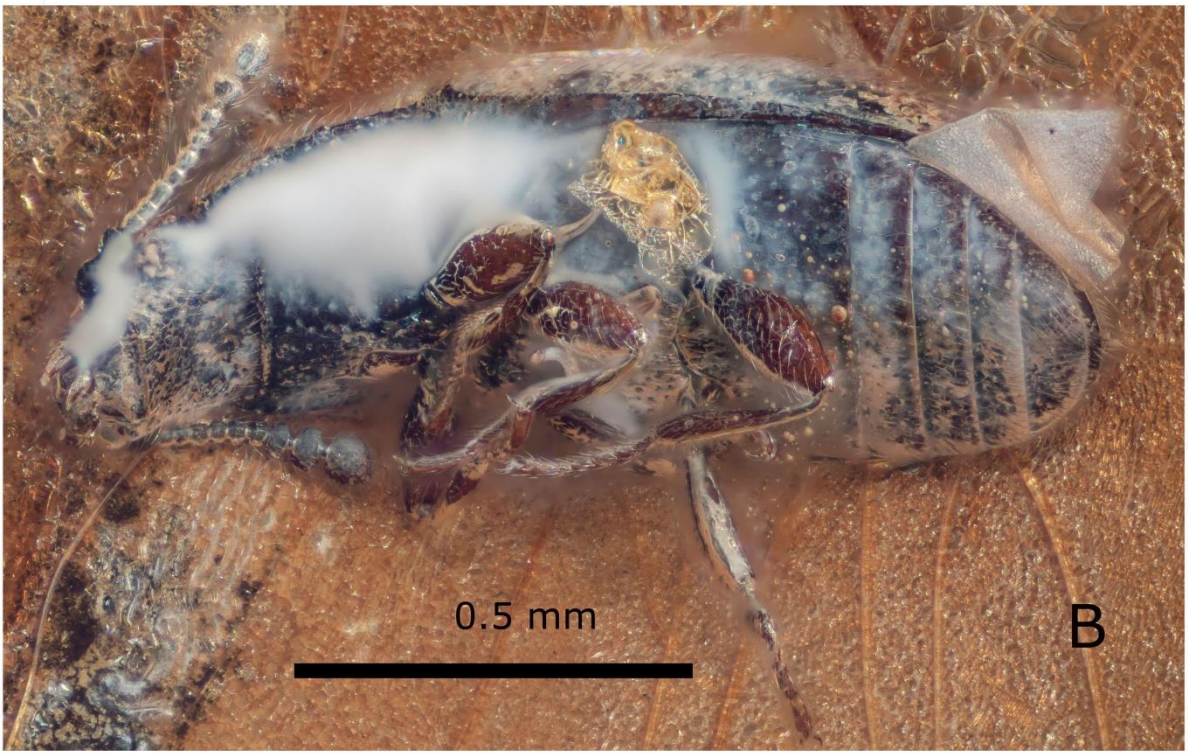


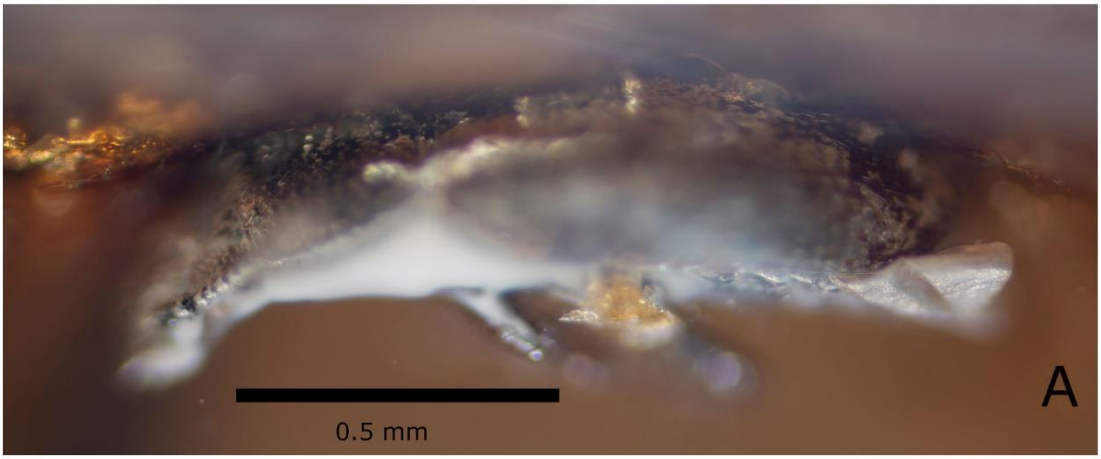
Figure 2. Fossil *Atomaria* sp.: A – *A.* (*Anchicera*) *bukejsi* **sp. nov.,** legs and abdomen (image), B – *A.* (*Anchicera*) *archibaldi* **sp. nov.**, ventrolateral view (image).

Atomaria (*Anchicera*) *archibaldi* Lyubarsky et Perkovsky, **sp. nov.**
https://zoobank.org/urn:lsid:zoobank.org:act:8EB7C712-080C-4475-83FD-C5FDD6FCD265
(Figs 2B, 3)

Type material. Holotype. SIZK L-425, Voronki, Rovno amber, late Eocene.
Syninclusion: SIZK L-426: Collembola Entomobryomorpha.

Etymology. Patronymic. Named for our dear colleague Dr. S. Bruce Archibald (University of British Columbia, Vancouver, Canada).

Differential diagnosis. *Atomaria archibaldi* **sp. nov.** appears similar to *A. telnovi* Lyubarsky et Perkovsky, but is specifically different from it in the pronotum widest at base (*A. telnovi:* widest at midlength), the pronotal base without median depression (*A. telnovi*: base of pronotum with strong median depression), the antennomere 5 longer than antennomere 3 (*A. telnovi:* same length), the antennomere 7 elongate, longer than antennomere 8 (*A. telnovi:* same lenght), and the antennomeres 9–10 strongly transverse, 1.3–1.4× as wide as long (*A. telnovi:* antennomeres 9–10 slightly transverse).



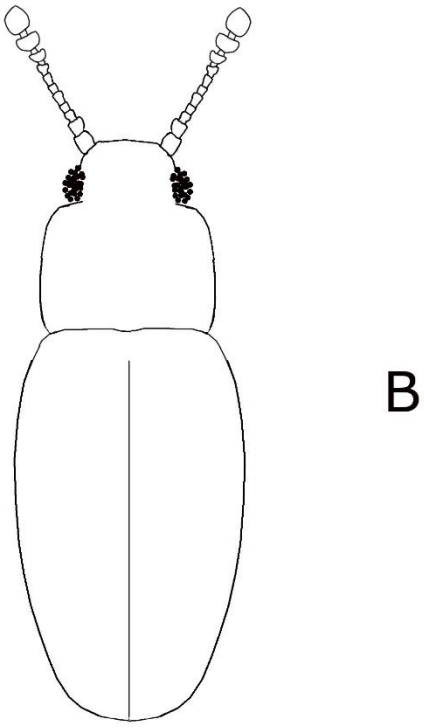


Figure 3. *Atomaria* (*Anchicera*) *archibaldi* **sp. nov.:** A – lateral view (image), B – total view (drawing).

Description. Body length 1.31 mm; body elongate (fig. 2B), moderately convex, covered with slightly curved, semierect pale moderately long setation. Body and antennae unicolorous dark brown, legs paler, reddish brown. Head transverse, finely punctured, with hemispherical, coarsely faceted eyes. Eye well developed. Antennae 11-segmented with 3-segmented loose club, short, slender, club not extending beyond base of pronotum (Figs 2B, 3B). Antennal shape as in Figures 2B and 3B, antennomere 1 subcylindrical, elongate, 1.3× as long as wide; antennomere 2 slightly elongate, 1.1× as long as wide; antennomere 3 conical, elongate, about 1.3× as long as wide, distinctly narrower and slightly shorter than antennomere 2; antennomere 4 slightly elongate, 1.1× as long as wide; antennomere 5 conical, elongate, 1.4× as long as wide, longer than antennomere 3; antennomere 6 slightly elongate, 1.1× as long as wide; antennomere 7 conical, elongate, 1.4× as long as wide, longer than antennomere 8; antennomere 8 subquadrate, nearly as long as wide; antennomeres 9–10 trapezoid, strongly transverse, 1.3–1.4× as wide as long; antennomere 11 widely oval, with rounded apex, 1.3× as long as wide. Pronotum transverse, 0.54 times as wide as long, widest at base, strongly narrowed anteriorly. Anterior margin non-sinuate, without notch; anterolateral angles without thickening or callosity. Lateral margin only visible from above in basal half of pronotum. Pronotal disc slightly convex, moderately strongly and moderately densely punctate, distance between punctures 1× diameter of one puncture. Base of pronotum without median depression (fig. 3A); posterolateral angles rectangular. Pronotum relatively wide, not narrower than elytra at base. Prosternum strongly and densely punctured. Elytra elongate oval, moderately convex, slightly rounded at lateral margins, widest about in anterior one-third, 2.7 times as long as pronotum, 1.54 times as long as combined wide. Elytral surface moderately densely, confusedly punctate, punctures in basal part slightly smaller than those on pronotal disc, and distance between punctures 1.0-1.5× diameter of one puncture; elytral humeri rounded, not toothed. Longitudinal metasternal line absent. Legs slender, long, relatively similar in shape, finely punctate. Procoxae large, widely suboval, slightly transverse; mesocoxae round; metacoxae narrowly oval, strongly transverse. Femora elongate-oval, flattened. Tibiae thin, almost straight, parallel-sided, nearly as long as femora, with two terminal spurs (Fig. 2B). Tarsi long and thin; tarsomeres simple, not lobed; tarsal formula 5-5-5 (Fig. 2B). Pretarsal claws simple. Abdomen with five visible, freely articulated ventrites; ventrite 1 longest, covered with rather coarse punctation, ventrites 2–5 with fine and denser punctures; ventrite 5 evenly arcuate; ventrite 5 without crenulations, surface unmodified.

Remarks. Co-occurrence with Collembola suggests occurrence in soil or forest litter.

Key to extinct Eocene species of *Atomaria (Anchicera)*

1.	Body size 1.35 mm or smaller. Antennae short or long.	2
-	Body size larger than 1.35 mm. Antennae long, antennal club extending beyond base of pronotum when directed posteriad	6
2.	Body length 1.0–1.2 mm. Antennae short or long	3
-	Body length 1.35 mm. Antennae short, antennal club not extending beyond base of pronotum when directed posteriad	4
3.	Lateral margins of pronotum visible from above for entire length. Maximum pronotal width afore midlength. Antennae long, antennal club extending beyond base of pronotum. Antennomere 5 conical, elongated, 1.5× as long as wide. Body length 1 mm. Baltic amber	*A. groehni* Perkovsky et Lyubarsky, 2014
-	Lateral margins of pronotum visible from above only in basal half of pronotal length. Pronotum narrows towards base. Maximum pronotal width at midlength. Antennae short, antennal club not extending beyond base of pronotum. Antennomere 5 conical, 1.1× as long as wide. Body length 1.19 mm. Rovno amber	*A. perkovskyi* Lyubarsky et Bukejs, 2022
4.	Antennomere 3 elongated, 1.5× as long as wide, slightly shorter than antennomere 2. Antennomere 7 about as long as antennomere 6 and 8. Pronotum indistinctly narrowed towards base. Basal margin of pronotum slightly lobed. Body length 1.35 mm. Bitterfeld amber	*A. saxonica* Lyubarsky et Perkovsky, 2018
-	Antennomere 3 elongated, 1.3 times as long as wide, distinctly shorter than antennomere 2. Antennomere 7 longer than previous	5

5.	Pronotum distinctly narrowed basally, base of pronotum with strong median depression. Antennomere 5 equally long as antennomere 3, antennomere 7 equally long as antennomere 8, antennomeres 9–10 slightly transverse, 1.2× as long as wide. Body length 1.35 mm. Rovno amber	*Atomaria telnovi* Lyubarsky, Perkovsky et Vasilenko, 2023
-	Pronotum not narrowed basally, base of pronotum without median depression. Antennomere 5 longer than antennomere 3, antennomere 7 elongate, longer than antennomere 8, antennomeres 9–10 strongly transverse, 1,4× as long as wide. Body length 1.35 mm. Rovno amber	*Atomaria archibaldi* Lyubarsky et Perkovsky, **sp. nov.**
6.	Antennal flagellum stout, about 0.33× as wide as dorsal eye length. Antennomeres 9–10 slightly transverse. Body length 1.46 mm. Baltic amber	*Atomaria propinqua* Lyubarsky, Alekseev et Bukejs, 2023
-	Antennal flagellum slender, about 0.2× as wide as dorsal eye length	7
7.	Antennomeres 9–10 strongly transverse. Antennomere 3 about twice as long as wide. Pronotal disc convex. Maximum pronotal width nearly at midlength. Base of pronotum with shallow median depression. Body length 1.39–1.57 mm. Baltic amber	*A. alekseevi* Lyubarsky et Bukejs, 2022
-	Antennomere 10 subquadrate, nearly as long as wide. Antennomere 3 about 1.5× as long as wide	8
8.	Pronotal disc flat. Maximum width of pronotum well beyond midlength. Base of pronotum without median depression. Body length 1.65 mm. Baltic amber	*A. gedanicola* Lyubarsky et Perkovsky, 2013
-	Pronotal disc convex. Maximum pronotal width afore midlength. Base of pronotum with median depression. Body length 1.65 mm. Rovno amber.	*A. bukejsi* Lyubarsky et Perkovsky, **sp. nov**.

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