

## Two new species of *Cantharis* Linnaeus, 1758 from Baltic amber

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### Abstract

Two new species of soldier beetles (Coleoptera, Cantharidae) from the Priabonian deposits in Yantarny, Russia (Baltic amber) are described. *Cantharis crisantha* sp. nov. is characterized by its relatively small body size, laterally rounded prothorax, and simple claws with a small basal tooth. Of particular interest, this specimen has its aedeagus extruded—a feature described for the first time in a representative of the genus *Cantharis* found in amber, and something rarely seen in all known fossil species of the Cantharidae family. The second described species, *Cantharis raeorum* sp. nov., is characterized by a pronotum with straight sides and a transverse and concave part near the posterior margin. The species are compared with earlier reported fossil *Cantharis*.

**Key words:** Coleoptera, Cantharidae, soldier beetles, Eocene, paleoentomology, new taxa, male genitalia

### Introduction

The genus *Cantharis* Linnaeus, 1758 (Coleoptera, Cantharidae) is widely distributed in the Nearctic, Oriental and Palaearctic regions, with more than 350 extant and extinct species (Delkeskamp 1977; Ramsdale 2002; Kazantsev & Brancucci 2007; Fanti & Damgaard 2019). In the panorama of the entire Cantharidae family, the species of this genus are characterized by a medium-large body size and by an aposematic coloration based on the contrast between black and red, and eventually black and yellow/orange body parts. This coloration is displayed in a variety of beetle families, such as the Lycidae, Elateridae, Cerambycidae, Meloidae, Tenebrionidae, and Coccinellidae (Brakefield 1985; Fanti & Vitali 2017), as well as the Cleridae, Chrysomelidae, and many others. It's a visible warning to predators that many of these beetles possess toxic substances such as alkaloids, diterpenes, and acids that make them unpalatable (Durvaux *et al.* 2007; Fanti & Vitali 2017). For the family of Cantharidae, this warning coloration (especially of *Cantharis* but also of *Chauliognathus*) gave rise to the nickname “soldier beetles,” as it was reminiscent of old military uniforms.

Only in the last decade have new species of *Cantharis* been described from amber (Fanti 2017; Kazantsev 2018; Fanti & Damgaard 2019). Others are known as Oligocene and Miocene compression fossils from various localities in Europe (Fanti & Poschmann 2019; Fanti & Walker 2019). Here, we describe two new species discovered in Eocene Baltic amber, with one that is particularly remarkable for having its aedeagus almost completely extruded.

### Material and methods

Both of these Baltic amber specimens were found in the “Primorskoje” mine close to Yantarny in Russia’s Kaliningrad Region. As noted by Bukejs *et al.* (2020), this succinate was formed in shallow marine waters and is at least the secondary deposit for this amber. In fact, based on Bukejs *et al.* (2019), the Baltic amber was created independently in two stages (Bartonian and Priabonian), and the horizon of the Prussian Formation formed during the Priabonian by a gradual sea transgression and erosion of paleosoils (Standke 2008; Bukejs *et al.* 2019). The photographs of

the inclusions were taken using a Canon DSLR camera and macro lenses and with a focus stacking software. Plates were processed using PhotoImpact Viewer SE. The specimens were donated to the Museum of Comparative Zoology at Harvard University in Cambridge, Massachusetts (USA). The morphology of aedeagus follows Magis (1971) and Kuška (1995).

## Systematic treatment

### Family Cantharidae Imhoff, 1856

#### Subfamily Cantharinae Imhoff, 1856

#### Tribe Cantharini Imhoff, 1856

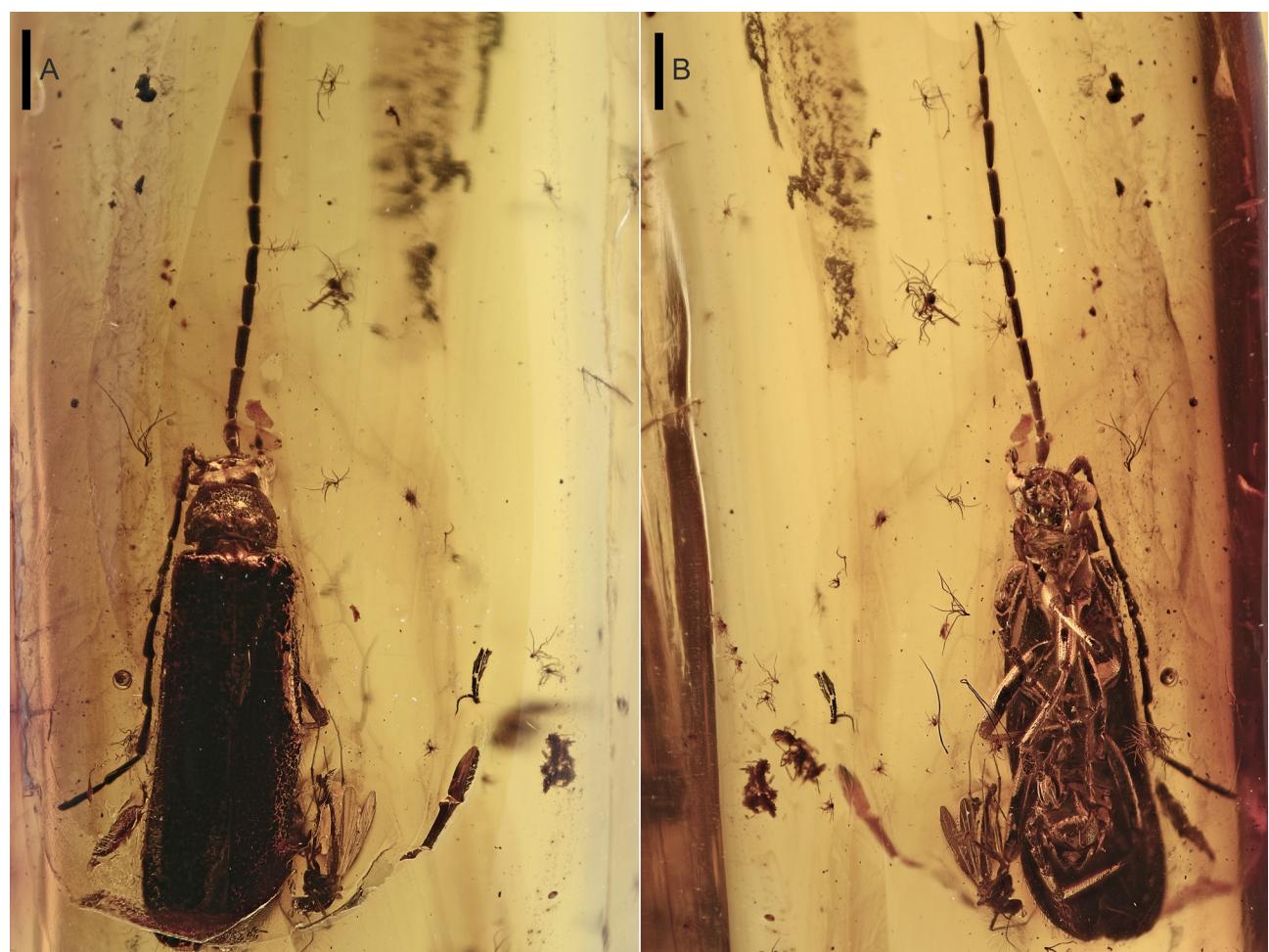
#### Genus *Cantharis* Linnaeus, 1758

#### Subgenus *Cantharis* Linnaeus, 1758

#### *Cantharis (Cantharis) crisantha* FANTI & M. G. PANKOWSKI sp. nov.

(Figs. 1–3)

**Description.** Adult, winged. Male, based on the long antennae and extruded aedeagus. Body entirely dark brown. Body length: 6.1 mm; elytra 5.0 mm; head and pronotum 1.1 mm, antennae 5.3 mm long.



**FIGURE 1.** *Cantharis (Cantharis) crisantha* sp. nov. in Baltic amber. A: Holotype, dorsal view, scale bar = 1.0 mm. B: Holotype, ventral view, scale bar = 1.0 mm.

Head partially covered by pronotum, wide, with scattered long setae. Eyes large, convex, prominent, inserted in the upper-lateral part of the head, interocular dorsal distance about 3.3 times greater than eye diameter (Figs. 1, 2B). Mandibles elongate, slender, falciform, pointed apically, without any tooth. Maxillary palpi 4-segmented, with first palpomere short; second palpomere elongate and robust; third palpomere globular and slightly longer than first; last palpomere slender, elongate, securiform, pointed apically. Labial palp 3-segmented. Antennae 11-segmented, long, not reaching the apex of elytra, filiform, pubescent and adorned with sparse setae; scape short, very robust, club-shaped; antennomere II short, half the length of scape; antennomere III filiform, elongate, about 1.2 times longer than scape; antennomere IV slightly shorter than antennomere III; antennomeres V–VII subequal, slightly shorter and slightly more robust than antennomere IV (Fig. 2C); antennomeres VIII–IX longer than antennomere III; antennomere X shorter than previous ones; antennomere XI long, slender, rounded at apex (Fig. 2C). Pronotum transverse, almost 2.0 times wider than long, slightly wider than the head, equipped with scattered and long setae, anterior margin strongly rounded, sides rounded, posterior margin almost straight and slightly bordered (Fig. 2B), surface flat, anterior corners strongly rounded, posterior corners very slightly pointed. Scutellar shield triangular with rounded apex. Elytra wider than pronotum, elongate, covering and surpassing the last abdominal segment, parallel-sided, equipped with sparse and short setae, rounded at apex, surface smooth without any surface structure, suture and sides not bordered (Figs. 1A, 2A). Hind wings totally covered by elytra, infuscate. Sternum subquadrate, with shallow punctures, strongly rounded posteriorly. Abdominal ventrites transverse, slightly pubescent (Figs. 1B, 3). Legs covered with long pubescence, pro- and mesothoracic legs short, posterior pair of legs long; coxae robust and rounded; trochanters elongate with rounded apex; femora cylindrical and only slightly compressed, moderately curved; pro- and mesotibiae as long as pro- and mesofemora or a bit shorter, metatibiae shorter than metafemora, slender, slightly sturdier at apex, cylindrical. Tarsi 5-segmented, equipped with long setae; first tarsomere elongate, robust; second tarsomere shorter than first tarsomere; tarsomere III slightly shorter than second, inconspicuously lobed at sides; tarsomere IV short and strongly bilobed; tarsomere V thin and elongate; claws simple with very small and obtuse basal tooth. Aedeagus visible in its dorsal face (thus the parameres cannot be observed) with large dorsal shield that is emarginate and slightly hollowed at the margin, two elongated lateral sclerites (Fig. 3). Female unknown.



**FIGURE 2.** *Cantharis (Cantharis) crisantha* sp. nov. in Baltic amber. A: Holotype, dorsal view (larger details), scale bar = 1.0 mm. B: Holotype, detail of head, pronotum, and scutellar shield, scale bar = 0.5 mm. C: Holotype, detail of right antenna (ventral view), scale bar = 0.5 mm.



**FIGURE 3.** *Cantharis (Cantharis) crisantha* sp. nov. in Baltic amber. Holotype, detail of last urites and aedeagus, scale bar = 0.4 mm.

**Etymology.** The specific epithet “*crisantha*” is an anagram of the genus name *Cantharis*. Derived from the Latin noun “*chrȳsōs*” = gold (borrowed from the Ancient Greek χρῡσός / *khrūsós*) and thus also in reference to the coloration of the amber specimen.

**Holotype.** Male, adult specimen in a Baltic amber piece: Catalog number MCZ:Ent:PALE-43614, in the Museum of Comparative Zoology (MCZ) at Harvard University.

**Type locality.** Open pit mine (“Primorskoje”) in Yantarny (formerly Palmnicken), Baltic Sea Coast, Sambian Peninsula, Kaliningrad Region, Russia.

**Type strata.** Baltic amber, Eocene, Priabonian, Prussian Formation, “Blue Earth—Blaue Erde” sediment (age 38.0–35.6 million years).

**Syninclusions.** Stellate hairs, botanical remains, gas vesicles (air bubbles), an ant, and a dipteran (Nematocera: Culicomorpha: Chironomidae).

**Systematic placement.** The securiform last maxillary palpomere, laterally rounded pronotum, the filiform 11-segmented antennae, the shape of male genitalia, third bilobed tarsomere, and the simple claws with a basal tooth reliably place the new species in the genus *Cantharis* and its nominotypical subgenus (Brancucci 1980; Kazantsev 2018).

**Differential diagnosis.** In addition to various specimens determined only at the generic level (Fanti 2017), currently seven other species of the genus *Cantharis* (Kuška 1992, 1996; Fanti & Damgaard 2018, 2019; Kazantsev 2018; Kupryjanowicz & Fanti 2019), plus an undetermined specimen close to the living *C. nigricans* (Burmeister 1832), are known from Baltic amber. *Cantharis (Cyrtomoptila) mikkelsenorum* Fanti & Damgaard, 2018 is larger, while *C. (s. str.) hoffeinsorum* Kazantsev, 2018 and *C. (s. str.) borki* Fanti & Damgaard, 2019 are smaller, and all have different pronotal shapes compared to *Cantharis crisantha* sp. nov. In *Cantharis (Cyrtomoptila) sucinokotejai* (Kuška, 1996), the pronotum is almost square. *C. (s. str.) dougi* Kupryjanowicz & Fanti, 2019 has a pronotum subrectangular, very transverse with straight lateral margins, while *C. (s. str.) sucinonigra* Kuška, 1992 has a smaller head, a widely rounded pronotum, and different lengths of antennomeres II–V. The most similar species to *C. crisantha* sp. nov. in habitus is *C. (s. str.) hanswerneri* Kazantsev, 2018 but its antennomeres II–IV have very different lengths and its pronotal anterior margin is less rounded. Other species of *Cantharis* have been described as compression fossils from Enspel (Fanti & Poschmann 2019), Rott (Heyden & Heyden 1866; Fanti & Walker 2019), and Oeningen (Heer 1847, 1865) in Germany, as well as in Radoboj in Croatia (Heer 1847). Still others are known from compression fossils from Puy-Saint-Jean in France (Piton & Théobald 1936) and Randecker Maar in Germany (Schawaller 1986).

**Remarks.** The golden yellow amber piece is rectangular and measures approximately 19 x 9 mm. The inclusion is complete and easily visible. The beetle’s legs are curled up, its abdomen is bent, and it has an extruded aedeagus in dorsal view.

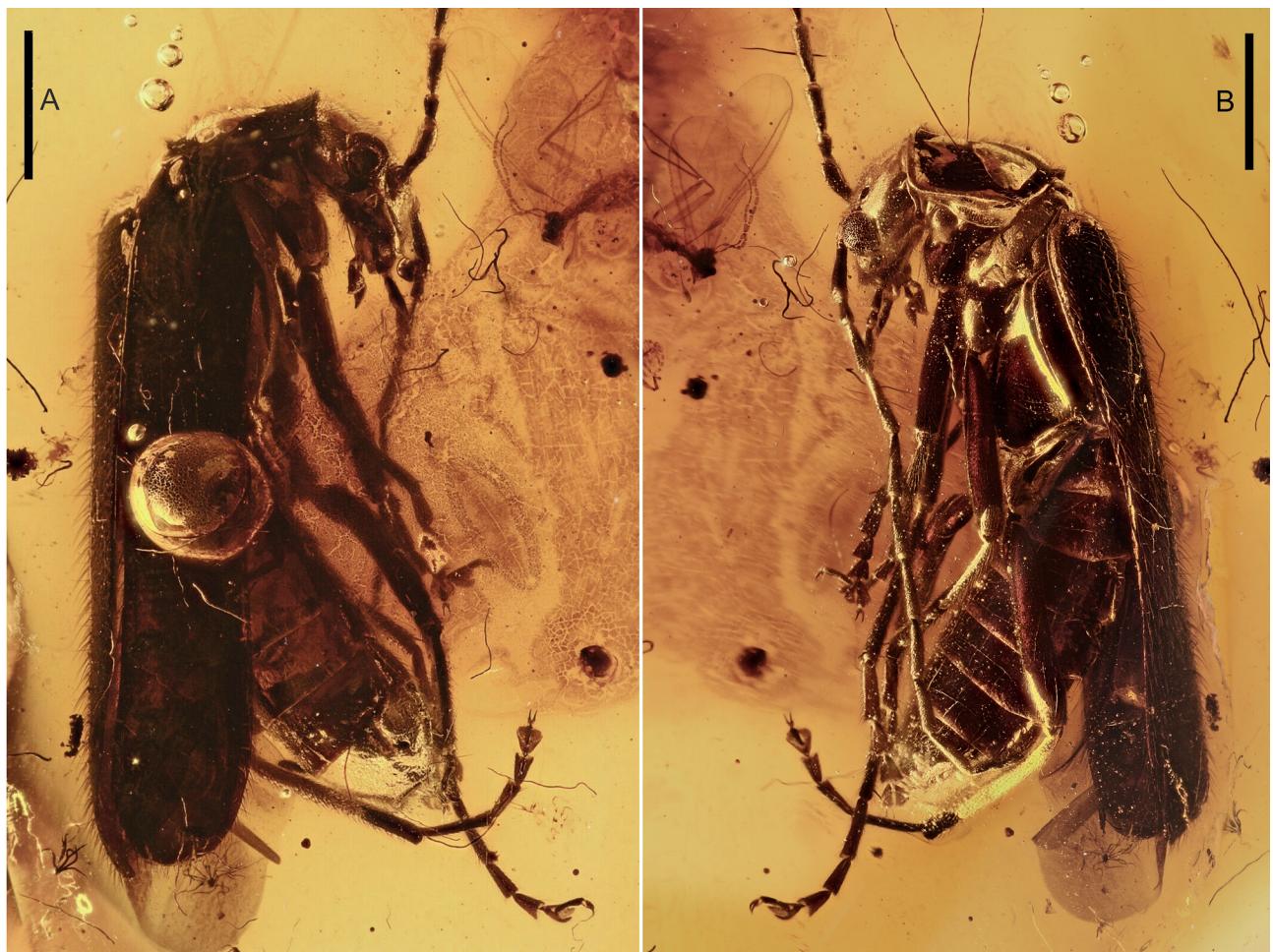
#### *Cantharis (Cantharis) raeorum* FANTI & M. G. PANKOWSKI sp. nov.

(Figs. 4–6)

**Description.** Adult, winged. Female, based on transverse, rounded shape of last ventrite. Body entirely dark brown to black. Body length: 5.8 mm; elytra 4.7 mm; antennae 4.6 mm long.

Head almost completely exposed, wide, slightly elongated anteriorly, with scattered and short setae. Eyes small, convex, prominent, inserted in the upper-lateral part of the head. Mandibles elongate, slender, falciform. Maxillary palpi 4-segmented, with first palpomere short; second palpomere elongate and robust; third palpomere globular and slightly longer than first; last palpomere robust and strongly securiform, with rounded tip. Labial palpi 3-segmented. Antennae 11-segmented, rather long, surpassing half of the elytra and not reaching the apex, filiform, adorned with some short setae plus a few other long setae especially near apices of antennomeres; scape elongate, robust, little club-shaped; antennomere II short, about 2.7–2.8 times shorter than the scape; antennomere III filiform, elongate, shorter than scape; antennomeres IV–VI sub-equal, longer than antennomere III and same length as scape; antennomeres VII–IX each very slightly shorter than previous one; antennomere X longer than antennomere IX; antennomere XI filiform, robust, rounded at apex (Fig. 5D). Pronotum elongate, longer than wide, narrower compared to head, equipped with scattered and long setae, anterior margin widely rounded and strongly bordered with the edge thick and apparent, lateral sides straight and bordered, posterior margin almost straight and not bordered, surface

fairly flat except part adjacent to anterior margin and with transverse and concave line/part near posterior margin, all corners rounded (Fig. 5B). Scutellar shield triangular, very wide at base, rounded at apex. Elytra wider than pronotum, elongate, surpassing the last abdominal segment, parallel-sided, equipped with long setae, rounded apically, surface slightly rugose, sides slightly bordered especially at humeri (Figs. 4A, 5A). Hind wings completely covered by elytra except for apex, infuscate. Sternum subquadrate, rugose, posteriorly fairly straight (Figs. 4B, 5C, 6). Abdominal ventrites transverse, slightly pubescent, last ventrite large, rounded and not triangular (Figs. 4B, 5C, 6). Legs long, slender, covered with numerous long setae, pro- and mesothoracic legs short, posterior legs long; coxae robust, globular, with rounded apex; trochanters elongate, with rounded apex; femora cylindrical, slightly curved; tibiae much shorter than femora, slender, cylindrical, slightly curved. Tarsi 5-segmented equipped with long setae; first tarsomere elongate, first pro- and mesotarsomere sturdier than first metatarsomere; second tarsomere shorter than first tarsomere; third tarsomere shorter than second, strongly lobed; fourth tarsomere robust and strongly bilobed; fifth tarsomere thin and elongate; claws simple with a very small and obtuse basal tooth (Fig. 4). Male unknown.



**FIGURE 4.** *Cantharis (Cantharis) raeorum* sp. nov. in Baltic amber. A: Holotype, dorso-lateral view, scale bar = 1.0 mm. B: Holotype, ventro-lateral view, scale bar = 1.0 mm.

**Etymology.** Species named after the Rae family— aunt, uncle, and cousins of the second author—who have touched numerous lives with their love, faith, and generosity.

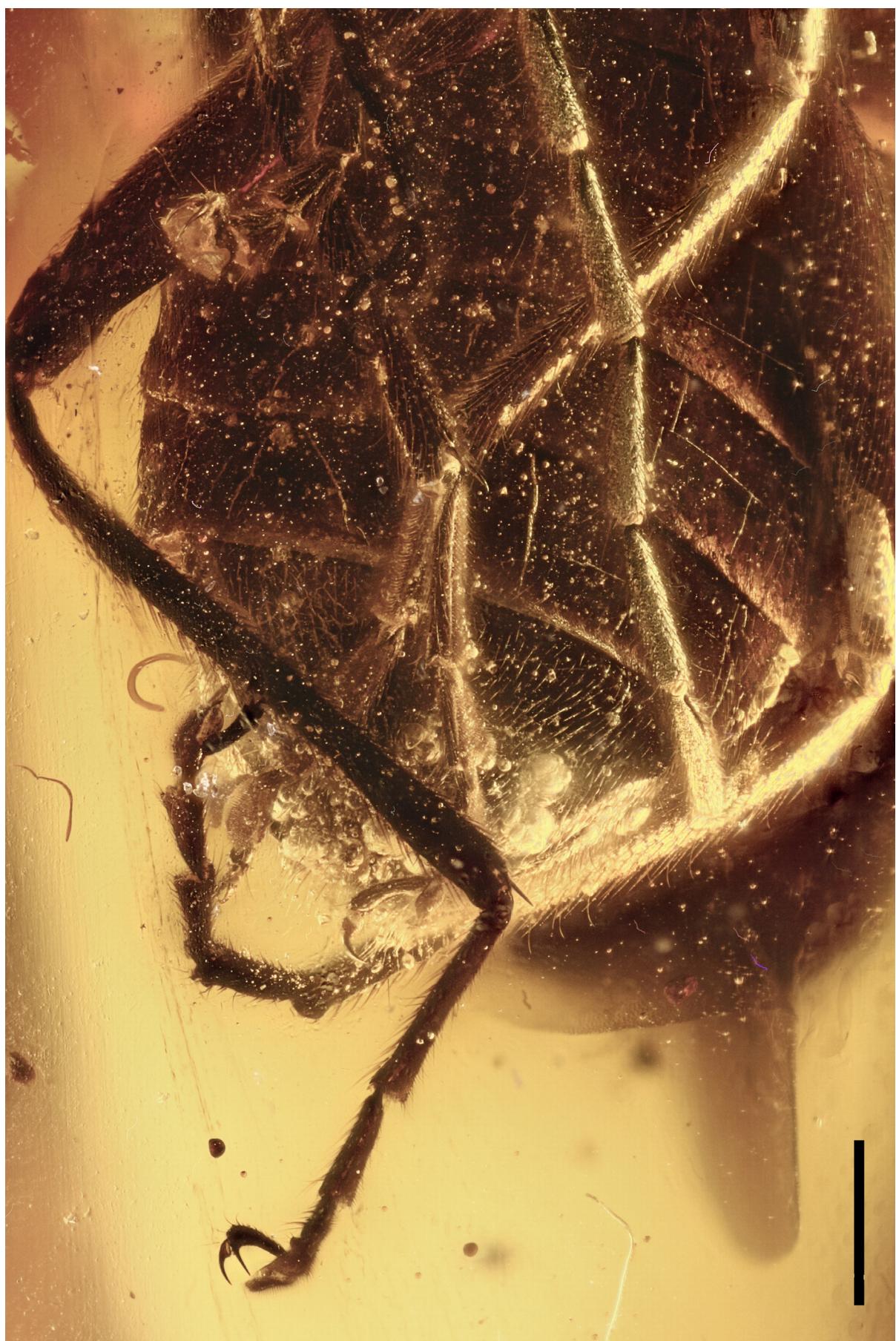
**Holotype.** Female, adult specimen in a Baltic amber piece: Catalog number MCZ:Ent:PALE-43615, in the Museum of Comparative Zoology (MCZ) at Harvard University.

**Type locality.** Open pit mine (“Primorskoje”) in Yantarny (formerly Palmnicken), Baltic Sea Coast, Sambian Peninsula, Kaliningrad Region, Russia.

**Type strata.** Baltic amber, Eocene, Priabonian, Prussian Formation, “Blue Earth—Blaue Erde” sediment (38.0–35.6 MYA).



**FIGURE 5.** *Cantharis (Cantharis) raeorum* sp. nov. in Baltic amber. A: Holotype, dorsal view (larger details), scale bar = 1.0 mm. B: Holotype, detail of pronotum and scutellar shield, scale bar = 0.3 mm. C: Holotype, detail of head, pronotum, metasternum, and palps (lateral view), scale bar = 0.5 mm. D: Holotype, detail of right antenna (ventral view), scale bar = 0.5 mm.



**FIGURE 6.** *Cantharis (Cantharis) raeorum* sp. nov. in Baltic amber. Holotype, detail of last ventrites, scale bar = 0.2 mm.

**Syninclusions.** Stellate hairs, botanical remains, gas vesicles (air bubbles), a dipteran (Nematocera: Bibionomorpha), and an unidentified insect (possibly a neanid).

**Systematic placement.** The securiform last maxillary palpomere, the 11-segmented antennae that are filiform, bilobed third tarsomere, and the simple claws with a small and obtuse basal tooth place the new species in the genus *Cantharis* and its nominotypical subgenus (Brancucci 1980; Kazantsev 2018).

**Differential diagnosis.** The species that appears most closely related to *Cantharis raeorum sp. nov.* is *Cantharis (s. str.) borki* Fanti & Damgaard, 2019, which is tinier (4.5 mm), has different antennae (in particular, the antennomere X is shorter than previous ones IV-IX in *C. borki*, while the antennomere X of *C. raeorum sp. nov.* is slightly longer than the antennomere IX), and has the pronotum that is more concave in the middle part and less concave near the posterior margin (Fanti & Damgaard 2019). In addition, *C. raeorum sp. nov.* differs from *Cantharis (Cyrtomoptila) sucinokotejai* (Kuška, 1996) based on the latter species' simple claws without a basal tooth, and the pronotum that is almost square and fairly flat near the posterior margin (Kuška 1996).

**Remarks.** The yellow amber piece has a half-moon shape, measures approximately 13 x 7 x 4 mm, and weighs 0.2 grams. The inclusion is complete and easily visible. The beetle's head, pronotum, and legs are bent.

## Discussion

Scientists have described relatively few fossil species of the genus *Cantharis* Linnaeus, 1758 in amber. This could be due to a number of different factors. The relatively large size of the beetles may have allowed them to escape amber-producing resins. In addition, extant species search for food in open spaces—feeding on small arthropods, pollen, and nectar as well as shoots of fruit trees (Fiori 1949)—places where resin in the Eocene was clearly deposited to a lesser extent than in forests. The other factor to be taken into consideration is the fact that living species are often easily recognizable only by the differences in genital structures or by their coloration, aspects rarely possible to observe in amber inclusions. It is therefore plausible that the number of Eocene species—as well as for other genera of Cantharidae such as the *Malthodes* (Fanti & Sontag 2019; Parisi & Fanti 2020)—was greater than the number described so far. The Eocene high thermal gradient would have led to more speciation (Parisi & Fanti 2020), especially with an intact environment without humans to alter it. *Cantharis crisantha sp. nov.* is the first species described of this genus from amber where the aedeagus is visible (on its dorsal side). This is rarely seen, even among all fossils of the entire Cantharidae family (Kupryjanowicz & Fanti 2019). Only a single fossil specimen, *Cantharis bradburyi* Fanti & Walker, 2019, described from a compression fossil from the Oligocene Rott Formation in Germany, has a partially extruded aedeagus, in this case on the ventral side (Fanti & Walker 2019). If more fossil specimens with this feature could be found, this could become an intriguing element for the study of the taxonomy and phylogeny of various genera and subfamilies (Brancucci 1980). Finally, based on the extruded aedeagus, we can deduce that the beetle was attempting to mate when it became ensnared in the resin. If the aedeagus was extended because the beetle had been compressed, we would see evidence that the beetle's last ventrites were deformed in some way. But we do not observe this. As for the beetle's partner, the female seems to have escaped the resin—fortunately for her but unfortunately for science.

## Acknowledgements

We are grateful to Marius Veta (Palanga, Lithuania) for providing excellent photographs of the specimens. We would also like to thank Ladislav Bocak for his comments on the previous version of the manuscript.

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