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Description of two clown beetles (Coleoptera: Staphyliniformia: Hydrophiloidea: Histeridae) from Baltic amber (Cenozoic, Paleogene, Eocene)

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The first representatives of the tribe Paromalini within the subfamily Dendrophilinae from Eocene Baltic amber are presented, with description of two new species *Carcinops donelaitisi* sp. nov. and *Xestipyge ikanti* sp. nov. placed in the recent genera *Carcinops* Marseul, 1855 and *Xestipyge* Marseul, 1862, respectively. The importance of humidity for the surviving of several Eocene European beetles in other geographical territories is pointed out.

Key words: taxonomy, Paleogene, fossil resin, new species, *Carcinops donelaitisi*, *Xestipyge ikanti*

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INTRODUCTION

The family Histeridae Gyllenhal, 1808 comprises 4252 species and 391 genera worldwide (Mazur 2011), grouped in 11 subfamilies: Niponiinae, Abraeinae, Trypeticinae, Trypanaeinae, Saprininae, Dendrophilinae, Onthophilinae, Tribalinae, Histerinae, Haeteriinae, and Chlamydopsinae. Histerids are small to medium-sized beetles (0.7-25 mm) and occur in many habitats, from dense forests to deserts and dunes. Adults and larvae of Histeridae are almost exclusively carnivorous, and prey on other insects, usually beetle and fly larvae. They live in a variety of decomposing organic material such as dung, carrion, rotten wood, seashore debris, rotting mushrooms and forest litter, under loose bark of woody plants, in galleries of wood-boring insects, vertebrate nests, and in nests of social insects (ants and termites). Several specialized soil and cave dwelling species also exist (Kryzhanovkij & Reichardt, 1976).

The fossil history of Histeridae is sparse and few species have been described. The oldest definitive histerids are Mesozoic records, *Pantostictus burmanicus* Poinar et Brown, 2009 and *Cretonthophilus tuberculatus* Caterino, Wolf-Schwenninger et Bechly, 2015 from the earliest Cenomanian (or Upper Albian) Burmese amber. The first of these was not assigned to any subfamily, and second belongs to Onthophilinae. From the Eocene-Oligocene

phosphorites of Quercy, France, is known one species in a recent genus, *Onthophilus intermedius* Handschin, 1944 in the subfamily Onthophilinae (Chatzimanolis et al. 2006; Schwermann et al. 2016). In addition, one histerid species has been described from Early Miocene Dominican amber in the subfamily Trypanaeinae: *Trypanaeus hispaniolus* Chatzimanolis, Caterino et Engel, 2006. A number of other taxa (e.g. numerous *Hister* spp. from mid-Miocene deposits at Öhningen) have been reported from limestone fossils (Heer 1862).

Various histerid genera such as *Acritus* Leconte, 1854 and *Abraeus* Leach, 1817 (subfamily Abraeinae), *Platysoma* Leach, 1817 and *Hister* Linnaeus, 1758 (subfamily Histerinae), *Bacanius* Leconte, 1853 and *Carcinops* Marseul, 1855 (subfamily Dendrophilinae) have been listed from middle Eocene (Lutetian or Priabonian) Baltic amber, but none have been described or confirmed (Klebs 1910; Larsson 1978; Spahr 1981; Chatzimanolis et al. 2006; Alekseev 2013).

In this study, descriptions of two new extinct species, *Carcinops donelaitisi* sp. nov. and *Xestipyge ikanti* sp.nov. belonging to the tribe Paromalini of Dendrophilinae are presented. These new species are the first formally described histerid beetles from Baltic amber and the first fossil representatives of the subfamily Dendrophilinae.

MATERIAL AND METHODS

The amber pieces with the beetle inclusions were obtained from commercial sources. The inclusions examined originate from the private collection of Christel and Hans Werner Hoffeins (Hamburg, Germany) [CCHH] and from the author's private collection (Kaliningrad, Russia) [CVIA].

The CCHH type material will subsequently be deposited in the Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany [SDEI]; the CVIA amber will be deposited in the Paleontological Institute, Russian Academy of Science (Moscow) for permanent preservation.

The CCHH piece was prepared for examination (cut, polished and embedded in GTS-polyester resin [Voss Chemie]) following the method described by Hoffeins (2001). The CVIA amber with inclusion was polished by hand and was not subjected to any supplemental fixation.

Photos were taken with a Zeiss AxioCamICc 3 digital camera mounted on a Zeiss Stemi 2000-stereomicroscope. The measurements were made using an ocular micrometer in a stereoscopic microscope. Reconstructions were made based on free hand drawing during examination of the original specimens. The figures were edited using Adobe Photoshop CS8.

Morphological terms used in this paper mainly follow Ôhara (1994). For generic attribution and comparisons with related species see Kryzhanovkij & Reichardt (1976); Ôhara (1994), Zhang & Zhou (2007), Vienna (1993).

SYSTEMATIC PALAEONTOLOGY

Family Histeridae Gyllenhal, 1808
Subfamily Dendrophilinae Reitter, 1909
Tribe Paromalini Reitter, 1909
Genus *Carcinops* Marseul, 1855
***Carcinops donelaitisi* sp. nov.**
(Figs. 1-3)

Material examined. Holotype: Nr AWI-098 [CVIA]. The beetle inclusion is preserved in a polished piece of transparent amber with an orange shade without any further fixation. The amber piece is oval, with maximum length 14 mm and maximum width 5 mm. The beetle inclusion is slightly damaged: the elytra are slightly deformed and dorsal surface is not

clearly visible, because of the hypothesized thermal processing of the amber piece in an autoclave. The right antennal club is lost. Syninclusions: legs and abdominal apex of two Diptera, three Collembola specimens, numerous small pieces of organic material.

Type strata. Baltic Amber, Eocene.
Type locality. Yantarny settlement [Palmnicken], Sambian [Samland] peninsula, Kaliningrad region, Russia.

Description. Total length (measured from anterior margin of pronotum to posterior margin of elytra) 1.5 mm, maximal body width 0.8 mm. Body elongate, parallel-sided, slightly convex, glossy, smooth, without visible punctures (except stria on elytra, femora ventrally, propygidium and pygidium). Color black throughout.

Head. Transverse, narrower than prothorax. Eyes present, oblong, lateral. Antennae geniculate. Scape (1. antennomere) long, three times longer as pedicel (2nd antennomere); funicle consists of pedicel and 5 visible segments; pedicel slightly longer than 2 following antennomeres combined; the antennal club rounded, without visible segmentation.

Thorax. Pronotum transverse (length/width ratio 0.67), parallel-sided, with clearly defined marginal striae; anterior margin almost straight, weakly emarginate behind head. Prosternal lobe present, projected and truncate anteriorly, impressed along anterior margin by marginal stria. Antennal cavities situated in front of procoxa forming longitudinal deep furrows. Prosternal keel with short separated carinal stria medially. Intercoxal process almost parallel-sided, apically rounded. Mesoventrite short, transverse, about 1.5 times wider than long. Scutellum distinct, triangular. Mesocoxal cavities broadly separated, distance 2.5 times wider than between procoxae and slightly narrower than between metacoxae. Meso-metasternal suture arcuate. Lateral metasternal sutures present. Metaventrite with longitudinal suture.

Wings. Elytra glabrous, shining, truncate, almost parallel, with punctures in striae only; two external striae distinct in full length and comparatively deep; 3 inner striae at the disc shallow and clearly visible on specimen in apical part of elytron only and with distance between punctures larger than each puncture diameter. Hind wings not apparent.

Legs. Femora flattened, with sparse and large punctures ventrally. Pro- and mesotibiae dilated, rounded in outline, with small teeth on the pro- and mesotabiae. Protibia with shallow tarsal groove on the dorsal surface and with four weak teeth on outer margin. Protibial spur long, curved. Tarsal formula 5-5-5. All tarsomeres longer than wide, the ultimate tarsomere the longest. Claws simple, acute, symmetrical.

Abdomen. Two last visible tergites are exposed and not covered by the elytra. Propygidium almost twice shorter than pygidium. Pygidium and propygidium with large and sparse punctures as on femora. Pygidium convex, apically rounded. First visible abdominal sternite the longest, almost equal to all others combined. Lateral stria of first abdominal sternite obscured by position of legs.

Remark. The carinal striae on prosternal keel are poorly discernible in the specimen and apparently form two symmetrical separate lines in medial part of keel only (e.g. are not joined apically).

Differential diagnosis. The specimen AWI-098 can be referred to the subfamily Dendrophilinae Reitter, 1909 due to the longitudinal antennal cavities and the presence of a prosternal lobe. The new species is assigned to the tribe Paromalini Reitter, 1909, which is characterized by more or less dorsoventrally flattened body, expanded protibiae, presence of a narrow prosternal lobe, and broad trapezoidal epistoma (Kryzhanovskij & Reichardt 1976; Ôhara & Paik 1998). Two external characters (well-developed frontal stria, transverse labrum) diagnostic of tribal placement (Zhang & Zhou 2007) are not clearly visible on specimen. The specimen AWI-098 was assigned to the genus *Carcinops* Marseul based on the following characters: (1) elytral disk with distinct dorsal striae; (2) prosternal keel with carinal stria; (3) elongate tarsomeres I-IV; (4) triangular distinct scutellum; and (5) metaventrite with longitudinal suture but without second lateral striae.

Carcinops donelaitisi sp. nov. differs from majority of the extant congeneric species by the non-oval body form and is similar to the Nearctic *C. tejonicus* (Horn, 1873) in that character. The new species from Baltic amber can be easily distinguished from *C. tejonicus* by the almost indistinct pronotal and interstrial elytral punctuation; by the shortened carinal striae of prosternal keel with posterior ends not united with each other; and by the form and distance between protibial teeth.

Derivatio nominis: The epithet of this new species is devoted to the poet Kristijonas Donelaitis [(1714 (Lasdinehlen) 1780 (Tollmingkehmen)], who lived in Lithuania Minor [Kleinlitauen, present-day eastern parts of Kaliningrad region] and wrote the first classical poem in Lithuanian language, "Metai" ("The seasons"), which became one of the principal works of Lithuanian poetry and a classical work of Lithuanian literature.

Genus *Xestipyge* Marseul, 1862
***Xestipyge ikanti* sp. nov.**
(Figs. 4-8)

Material examined. Holotype: No. 1470-6 [CCHH]. A complete beetle is included in a small yellow amber piece embedded in a block of GTS-polyester resin with dimensions 12 x 7 x 3.5 mm. Syninclusions are absent. Ventral part and pygidium of the beetle is obscured by dense milky foam.

Type strata. Baltic Amber, Eocene.
Type locality. Yantarny settlement [Palmnicken], Sambian [Samland] peninsula, the Kaliningrad region, Russia.

Description.
Habitus. Total length (measured from the anterior margin of the pronotum to the posterior margin of the elytra) 1.5 mm, maximal body width 1.3 mm. Body oval, convex, shiny, smooth, finely punctured. Color blackish.

Head. Eyes present, lateral. Antennae geniculate, clubbed. Antennal club finely pubescent, without visible segmentation, with rounded apical margin. Frons concave (depressed medially), with symmetrical elevations above antennal cavities. Labral setation is not clearly discernible. Punctuation of the frons fine, sparse, separated by distance 2 x that of the puncture diameter.

Thorax. Pronotum transverse (length/width ratio 0.67), with sides convergent apically. Marginal stria complete laterally and present anteriorly, but obsolete in medial part of pronotum. Anterior pronotal margin almost straight; posterior margin arcuate. Anterior angles triangular, acute. Pronotal punctuation fine, comparatively dense, separated by distance 1-2 x that of the puncture diameter. Scutellum extremely small, triangular.

Figures 1-2. *Carcinops donelaitisi* sp. nov. Holotype; No. AWI-098 [CVIA]. Habitus: 1 - Dorsal view; 2 - Ventro-lateral view.

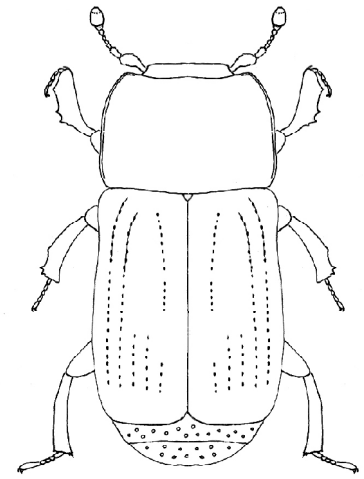

Figure 3. *Carcinops donelaitisi* sp. nov Habitus dorsally, reconstruction

Figures 4-6. *Xestipyge ikanti* sp. nov. Holotype; No. 1470-6 [CCHH]. Habitus: 4 - Dorsal view; 5 - Ventral view; 6 - Dorso-frontal view.

Figure 7. *Xestipyge ikanti* sp. nov. Holotype; No. 1470-6 [CCHH]. Elytral striae basally (left side): subhumeral, 1-5 dorsal and sutural.

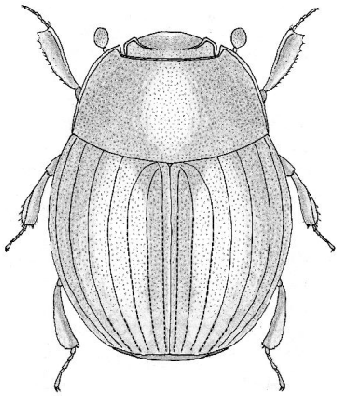

Figure 8. *Xestipyge ikanti* sp. nov. Habitus dorsally, reconstruction.

Wings. Elytra glabrous, shining, truncate, widest in anterior one-third, with seven complete striae: one marginal (subhumeral), five dorsal and one sutural. Dorsal stria 4 arched towards elytral suture and apparently connects with the united before sutural and dorsal stria 5. The basal interspace between discal striae 3 and 4 distinctly the widest (Fig. 7). Elytral punctuation similar to that on the pronotum , fine and comparatively dense, becoming obsolete at elytral inclination in apical one-fourth, where it seems to be smooth. Sutural and discal striae 2-5 becoming shallow in apical part of elytron, with distinct longitudinal punctures visible. Hind wings are not apparent.

Legs. Femora flattened. Meso- and especially protibiae explanate, rounded in outline, with small teeth. Protibia with twelve weak and thin, gradually smaller outer marginal teeth. Protibial spur long, curved. Tarsal formula 5-5-5. All tarsomeres longer, than wide; tarsomere V the longest. Claws simple, acute and symmetrical.

Remark. The form of prosternal lobe, antennal cavities, details of venter and abdomen are not visible in the specimen. The generic placement is tentative at the moment, because many important characters are insufficiently visible in the studied inclusion. Further investigations by micro-computer tomography or finding of a ventrally visible specimen can help to make an indisputable systematical assignment.

Differential diagnosis. The specimen 1470-6 [CCHH] may be placed in the recent genus *Xestipyge* Marseul based on the following characters: (1) dilated protibiae with small teeth and meso- and metatibiae distinctly slender; (2) characteristic position of the 4 and 5 dorsal and sutural striae on elytral base.

Resembling recent species of *Xestipyge* Marseul in body shape, sculpture, striae on elytra, and other visible characters, *X. ikanti* sp. nov. differs by the distinctly smaller body size (so the length of *X. ornatum* Reitter, 1888 comprises 2.2-2.7 mm; the length of *X. puncticulatum* Desbordes, 1919 is 1.8-2.6 mm; the length of *X. simplex* Vienna, 1993 is 2.0-2.3 mm; the length of *X. geminatum* (LeConte, 1860) is 2.8-3.0 mm; the length of *X. conjunctum* (Say, 1825) comprises 2.2-2.5 mm) and by the distinctly depressed frons. The newly described species differs from the relatively close in size *X. puncticulatum* and *X. simplex* by the longer and distinct dorsal stria 5 connected with sutural stria, absence of the near sutural depression (present in *X. puncticulatum*) and uniform punctuation of the dorsum. *X. ornatum* clearly differs by row of large punctures on the pronotal basis and finely rugose elytral apex; the North American species *X. conjunctum* and *X. geminatum* have the comparatively shorter dorsal stria 5 which is distinctly separated from sutural or dorsal stria 4.

Derivatio nominis: The epithet of this new species is devoted to the Prussian philosopher Immanuel Kant (22 April 1724 - 12 February 1804), who was born and lived in Königsberg, East Prussia. His contributions to metaphysics, epistemology, ethics, and aesthetics have had a profound impact on European philosophy.

DISCUSSION

The new taxa represent the oldest known representatives of the subfamily Dendrophilinae and are the oldest records of two recent genera of Histeridae. These new species of Paromalini

are assumed to be associated with forest habitats.

About 50 species of the genus *Carcinops* have been described worldwide. The majority of them are known from the New World, though some occur in the Oriental, Ethiopian and Australian regions. The beetles are found in decaying remains of animals and plants; some live in bird and rodent nests (Kryzhanovkij & Reichardt 1976). For *Carcinops donelaitisi* sp. nov. which superficially resembles the recent Asian-European *Paromalus parallelepipedus* (Herbst, 1792), the similar subcortical arboreal habitat in coniferous and mixed forests under the loose bark is supposed. The recent genus *Xestipyge* Marseul includes 11 described species from the Neotropic (1 sp.), Nearctic (4 spp.), Ethiopian (2 spp.), Oriental (1 sp.) and Palaearctic (3 spp.) regions (Kryzhanovkij & Reichardt 1976; Vienna 1993). The representatives of the genus *Xestipyge* live on carrion and dung, in tree holes and leaf litter. For the fossil species, a similar biology connected with old trees can be assumed.

The plant community of the amber forest was represented by a thermophilous humid mixed forest (Alekseev & Alekseev 2016). The attribution of the fossil beetles to the "tropical", "subtropical", "warm", "temperate", "nemoral", "boreal" or "cold" climate is mostly made on the basis of the temperature preferences of its extant congeners. The distribution of groups is not caused simply by climate and environmental conditions; the 'historical' factor is also implicated. All recent and ancient biotas are heterotopic, that is, consisting of elements of different geographical origin. The presence of species from groups with different modern temperature preferences in the Eocene Baltic amber can be explained from historical (palaeobiogeographical) perspectives too. Additionally, it could be expected that humidity preferences of insects are not less important (in comparison with thermal factors) by explanation of the modern distributional patterns of surviving taxa. The post-Eocene European fauna lost not the warm-requiring genera, but in first place the moisture-loving and hygrophilous ones. Not the cooling down alone, but the aridization of the climate caused the main faunal changes since Eocene in Southern Europe and Northern Africa. Inclusion in Baltic amber of genera from such families as histerids, ptinids, zopherids and dermestids, which contain both meso- and xerophilic species, does not indicate restricted or disjunctive distributional areas at present, as these are mostly recent Holarctic or cosmopolitan genera. The present-day Southern European or Mediterranean fauna of these taxa is allied and generally comparable with the fauna of the European Eocene. The groups of humid subtropical conditions are absent in the present Europe; they can have southern North American, South-Eastern Asian, South American, Eastern African or East Australian distribution areas or be completely extinct.

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