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A revision of Eocene Bittacidae (Mecoptera) from Baltic amber, with the description of a new species

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ABSTRACT

The Bittacidae of the Eocene Baltic amber are revised, recognising one species of the genus *Bittacus*, *B. succinus* Carpenter; the remaining four species are transferred to *Hylobittacus* Byers; *H. antiquus* (Pictet) is resurrected from synonymy; one new species is described: *H. picteti* sp. n.

KEY WORDS: Baltic amber, Mecoptera, Bittacidae, *Bittacus*, *Hylobittacus*, hanging fly, Eocene, new species.

INTRODUCTION

The family Bittacidae comprises about 270 extant species, which mainly inhabit tropical and subtropical regions. The oldest known fossil representative is *Archibittacus exilis* Riek, 1955 from the Upper Triassic of Australia (Riek 1955). Their greatest known generic diversity was in the Jurassic, with ten genera currently recognised (Novokshonov 2002).

The oldest known Palaeogene record of the family is *Thyridates novokschonovi* Petrulevičius, 2003 from the late Palaeocene Maíz Gordo Formation of Argentina (Petrulevičius 2003). The Eocene records of Bittacidae include *Palaeobittacus eocenicus* Carpenter, 1928 and *Bittacus egestionis* Carpenter, 1955 from the Early Eocene Green River Formation in western USA; and the Baltic-amber species discussed here. Oligocene bittacids include *Bittacus veternus* (Cockerell, 1921) and the unnamed species *Bittacus* sp. A (Jarzembowski 1980) from the Late Eocene/Early Oligocene of the Isle of Wight in Southern England, and *Bittacus biamensis* Novokshonov 1993 from Biamo (Bol'shaya Svetlovodnaya) in Primorye, Russia (Novokshonov 1993). These are the only known fossil species of *Bittacus* and *Palaeobittacus*; fossil *Hylobittacus* is known only from the Baltic amber.

The earliest descriptions of Bittacidae from the Baltic amber were by Pictet (1854), who described *Bittacus antiquus*, and Hagen (Pictet-Baraban & Hagen 1856), who described *B. validus*, later identified as a trichopteran (Carpenter 1976). Hagen found the original drawing of the venation of *B. antiquus* by Pictet to be incorrect and published his own reconstruction (Pictet-Baraban & Hagen 1856). Carpenter revised the generic placement of this species twice (see below).

The papers by Pictet (1854), Hagen (Pictet-Baraban & Hagen 1856) and Carpenter (1931, 1954, 1976) cover all known records of Bittacidae preserved in Baltic amber; that is, about 12 specimens altogether. Not all this material is available for study at present. The oldest specimens described by Hagen and Pictet seem to be lost, but sometimes such old, seemingly lost specimens are found in museum or private collections. Such was the fate of the famous collection of Koenigsberg, re-discovered in Goettingen, what I had an opportunity to check while being there.

The purpose of this paper is to revise the Bittacidae from Baltic amber, including material described by Carpenter (op. cit.) and 18 new specimens. Ten of them were purchased from a private source and are now in the collection of the Natural History Museum of the Institute of Systematics and Evolution of Animals in Krakow. Ten additional specimens of Bittacidae were also examined, but are not listed as they remain in private collections. However, this material is included in the conclusions presented within this paper. The classification to the genera *Bittacus* and *Hylobittacus* follows Byers (1979) and is based on the presence of two pterostigmal cross-veins versus one, respectively. In applying this system, I also consider the opinion of Weitschat and Wichard (2002).

MATERIALS AND METHODS

This study was based on an examination of 28 fossils in Baltic amber kept in the following institutions: the Natural History Museum, London (BMNH); Deutsches Entomologisches Institut im Zentrum für Agrarlandschafts- und Landnutzungsforschung e.v., Müncheberg, Germany (DEIM); Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA (MCZ); the Natural History Museum of the Institute of Systematics and Evolution of Animals, Krakow, Poland (MP); Museum of the Earth, Warsaw, Poland (MZW).

All wings are shown in standard aspect, with the apex to the right; some photographs are reversed left-right for comparison with drawings (see captions). The terminology for wing venation (Fig. 1) follows Byers (1979); the terminology for genitalia follows Webb *et al*. (1975).

TAXONOMY

Family Bittacidae Handlirsch, 1906

Genus *Bittacus* Latreille, 1805

Bittacus succinus Carpenter, 1954

Figs 2, 7A

Bittacus succinus: Carpenter 1954: 39–40, figs 3B, 4C.

Diagnosis: Provided by Carpenter (1954).

Redescription:

Male.

Forewing 17 mm long (Fig. 2B). Two pterostigmal crossveins, Pcv1, Pcv2; Sc long, ending distally far beyond fork of Rs; sc–r opposite fork of Rs, which is opposite fork of Mb; numerous additional veins in cells r3, r4, r5, r6, m1, m2, m3.

Genitalia (Figs 2C, 7A): epiandrial lobe distinctly widened about proximal 1/3, gradually tapering toward apex.

Female. Unknown.

Holotype (examined): MCZ 5204 (= old no. 5112), a fairly intact male, missing some leg parts, clearly preserved on one side, with milky covering on the other.

Remarks: Upon re-examination of the holotype, the wing venation as illustrated by Carpenter (1954, fig. 3B) is in part incorrect, and a revised drawing is provided here (Fig. 2B).

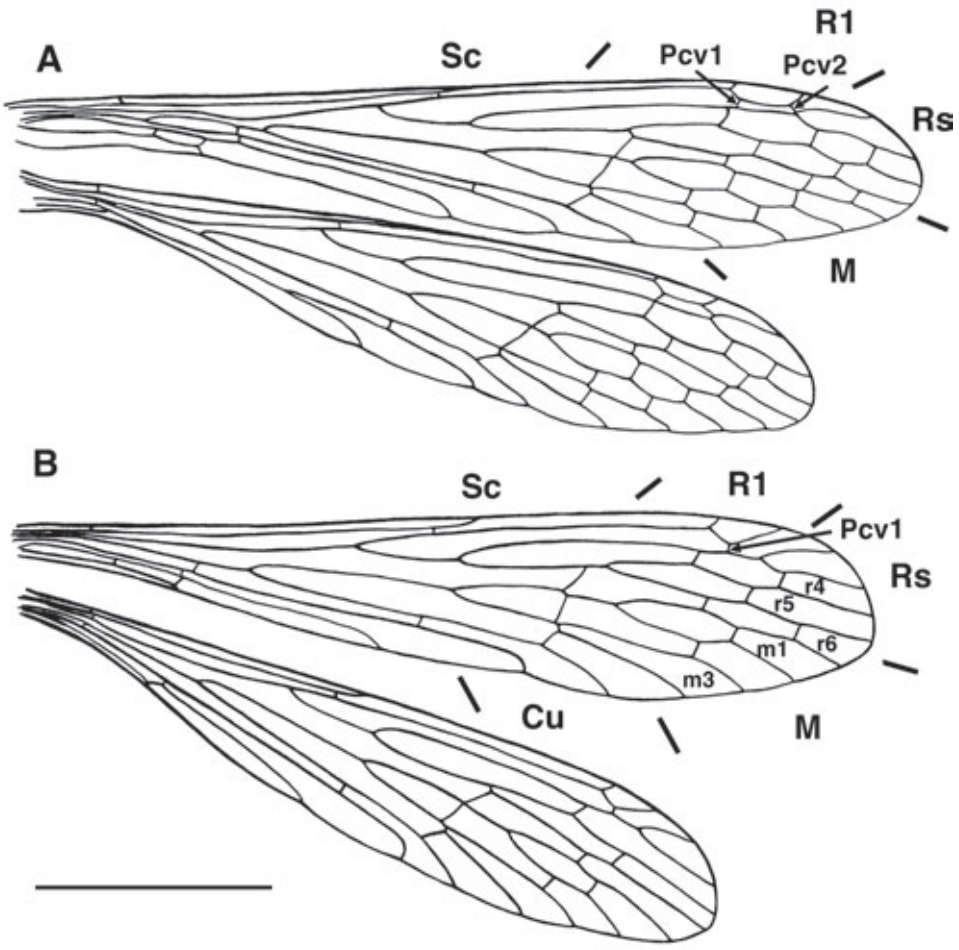

Fig. 1. Fore- and hind wing venation in extant *Bittacus* and *Hylobittacus*: (A) *Bittacus* sp., Europe; (B) *Hylobittacus apicalis* (Hagen), North America (after Byers, 1979). Abbreviations: Pcv1, Pcv2 – pterostigmal cross-veins. Scale bar = 5 mm.

Genus *Hylobittacus* Byers, 1979

Hylobittacus antiquus (Pictet, 1854), **comb. n.**

Fig. 3

Bittacus antiquus: Pictet 1854: 379, fig. 26.
Bittacus antiquus: Pictet-Baraban & Hagen 1856: 92, fig. 22.
Electrobittacus antiquus: Carpenter 1931: 410.

Diagnosis: Separated from all species of *Hylobittacus* in Baltic amber by a combination of: Sc very long, ending distally far beyond fork of Rs; additional cross-veins in cells r5, r6 and sometimes m1.

Redescription (based on female MP 1/1145/188/01):

Female.

Forewing 19 mm long, uniformly light brown, pterostigma slightly darker; shape and venation as in Figs 3D and 3E; single pterostigmal cross-vein; very long Sc reaching

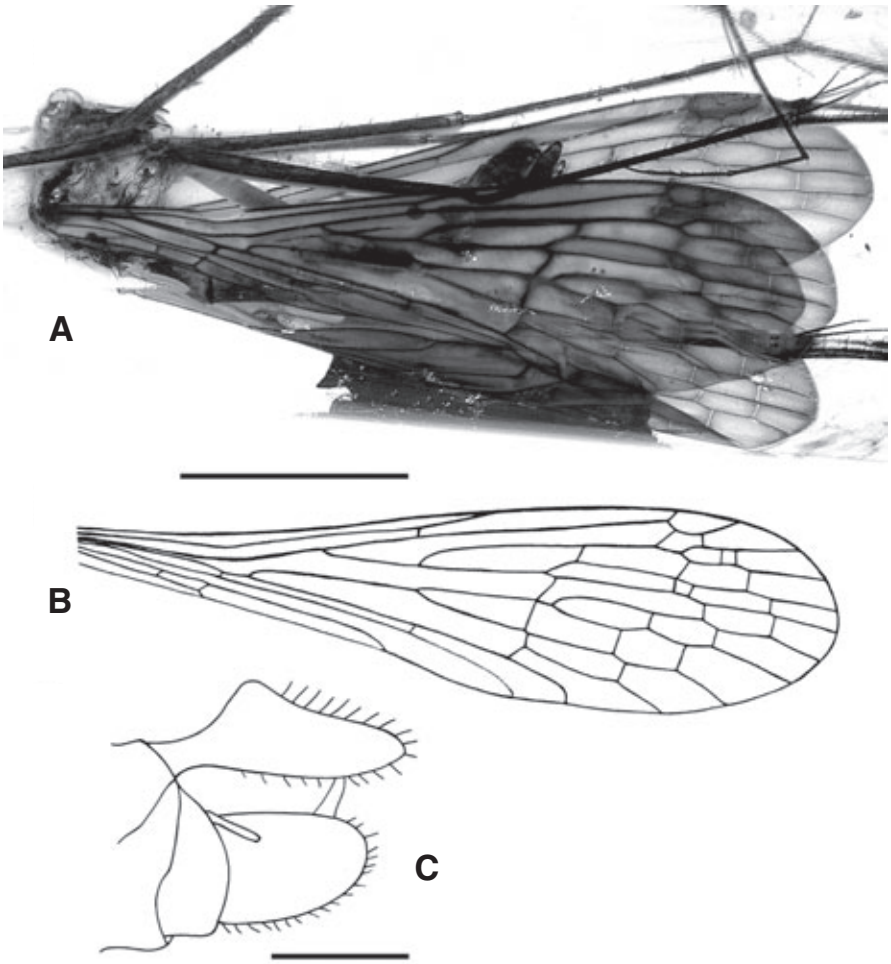

Fig. 2. *Bittacus succinus* Carpenter, holotype: (A) habitus, reversed left-right; (B) forewing; (C) male genitalia in lateral view (after Carpenter 1954). Abbreviation: e – epiandrial lobe. Scale bars: Figs 2A, 2B = 5 mm, Fig. 2C = 1 mm.

margin far beyond fork of Rs; crossvein sc–r at about nine times its length before end of Sc; 2 or 3 additional crossveins in cells r5, r6, m1.

Male. Unknown.

Material examined: MP 1/1145/188/01, female with head and thorax missing, most of the legs partially preserved, abdomen and three wings complete (donation of J. Serafin); MCZ 5210 (old number MCZ 5118), female, condition as in Carpenter (1954) determined as *B. fossilis* by Carpenter (1954).

Remarks: Carpenter reclassified this species twice. Initially, he placed it in a new, monotypic genus *Electrobittacus*, based on Pictet's (1854) drawing of the head, which he found bore an abnormally short rostrum for a bittacid (Carpenter 1931). Later, he considered this genus name to be a *nomen dubium* and, further, synonymised the species with *Bittacus fossilis*, based on a comparison of with a specimen of *H. antiquus* of his collection (female MCZ 5210 = old number 5118; Carpenter 1954) with Pictet's drawing. Carpenter also suggested that this drawing might illustrate a trichopteran. This does not

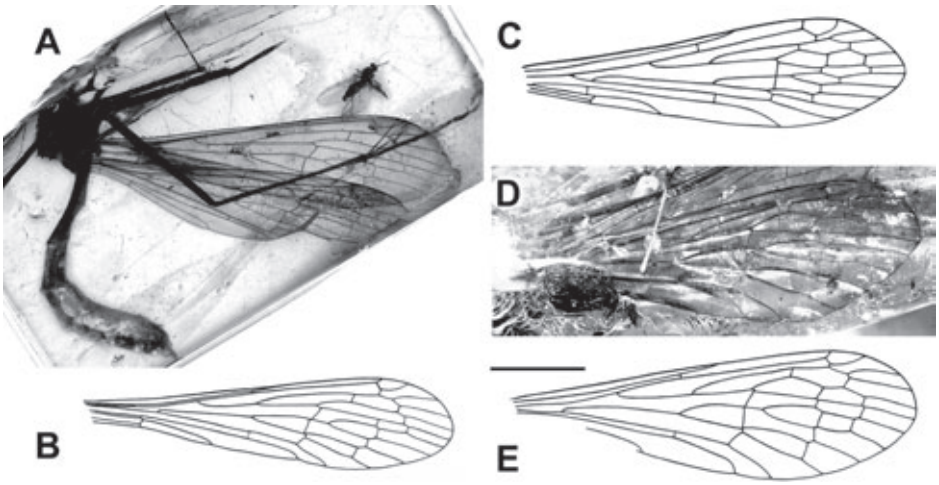

Fig. 3. *Hylobittacus antiquus* (Pictet): (A, B) specimen MZC 5210, general appearance and details of forewing venation; (C) venation of forewing (after Pictet-Baraban & Hagen, 1856); (D, E) specimen MP 1/1145/188/01, general appearance of wing and details of venation. Scale bar = 5 mm.

seem plausible, since the leg of the specimen resembles that of a bittacid and not a trichopteran.

Carpenter's procedure was incorrect for three reasons. Firstly, an improved drawing of Pictet's specimen was published by Hagen (Pictet-Baraban & Hagen 1856), who therefore should be regarded the first reviser of this species. Secondly, Carpenter incorrectly considered differences in venation in the specimen illustrated by Hagen to be non important and within the range of intraspecific variation of *B. fossilis*. And third, in his synonymy, Carpenter used a junior, instead of the senior name.

Upon examination of an additional specimen in the MP collection, the length of Sc and the presence of additional cross-veins in the apical region of the wing (Figs 3D, 3E) clearly conform to the drawing of *H. antiquus* by Hagen (Pictet-Baraban & Hagen 1856, fig. 22, table VIII; also see Fig. 3C in this paper). This is in agreement with Hagen's interpretation, and so *H. antiquus* (Pictet) is resurrected here from synonymy.

The species is now known from three specimens: the specimen which was illustrated by Hagen (Pictet-Baraban & Hagen 1856, fig. 22; Fig. 3C, this paper), a second in the MP collection (MP 1/1145/188/01, Fig. 3E), and a third examined by Carpenter and included by him in *H. fossilis* (MCZ 5210; Figs 3A, 3B). Although the location of the specimen described by Pictet and examined and illustrated by Hagen is unknown at present, a neotype is not designated here, assuming that it is not permanently lost nor destroyed.

Hylobittacus fossilis (Carpenter, 1954), **comb. n.**

Figs 4, 7B

Bittacus fossilis: Carpenter 1954: 37, 38, figs 3A, 4B.

Diagnosis: Separated from all species of *Hylobittacus* in Baltic amber by a combination of: Sc short, ending well before fork of Rs; epiandrial lobe with deeply incised margin dorsally.

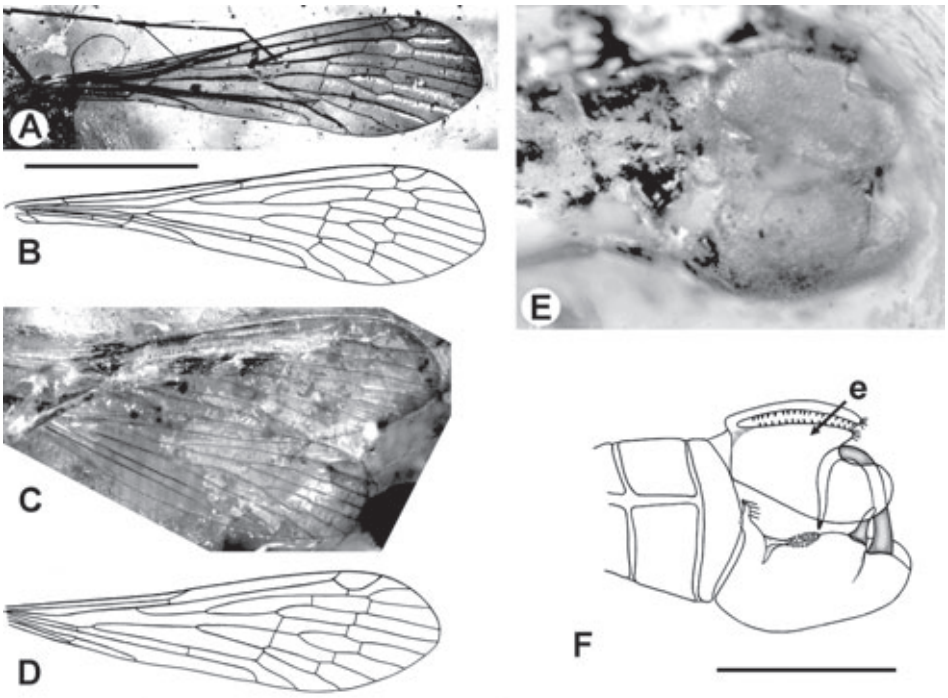

Fig. 4. *Hylobittacus fossilis* (Carpenter): (A, B) male DEIM 1150/1, general appearance of wing and details of venation; (C, D) female MP/1/1/551/05/A, general appearance of wing (reversed left-right) and details of venation; (E, F) male genitalia, DEIM 1150/1 general appearance and details. Abbreviation: e – epiandrium. Scale bars: Figs 4A–D = 5 mm, Figs 4E, 4F = 1 mm.

Redescription:

Male.

Forewing (Figs 4A–D) 13–16 mm long. Single pterostigmal cross-vein; Sc short, ending well before fork of Rs; sc–r at two to four times its length before end of Sc; cubital cross-vein below fork of Mb; no additional cross-veins in radial, medial distal cells. Genitalia (Figs 4E, 4F, 7B): epiandrial lobe with deeply incised margins dorsally, forming posterior lobe; upper, inner margin of epiandrial lobe with numerous spines; basistyle large.

Holotype (examined): MCZ 5209 (old no. 5117), male, mostly clearly preserved on one side, milky coating on portions of the other, some legs, half of right forewing and apical portion of right hind wing missing as a result of preparation.

Other material examined: MCZ 4898, specimen complete except for left wings missing, clearly preserved except for some milky covering in places; DEIM 1150/1, a complete male specimen in perfect condition (Hoffeins coll.); MP 1/1/551/05/A, female, an entire specimen in good condition, only head partially obscured; MP 1/2/552/04, three males in one piece of amber: two entire specimens in perfect condition; third one only partially preserved, without head, and only a portion of thorax and one wing present, abdomen obscured by milky layer; MP 1/1/552/04, female with only two wings, fragments of legs and abdomen preserved; MP 1/5/552/04, sex unknown, only fragments of wings and one leg preserved; MZW 19996, sex unknown, two wings and small fragment of thorax and legs preserved.

Remarks: *H. fossilis* seems to be the most frequent bittaciid found in Baltic amber (pers. observ.). Its venation shows remarkably little variation.

Fig. 5. *Hylobittacus minimus* (Carpenter): (A) holotype MCZ 5205, general appearance; (B, C) male 674/2, reconstruction of forewing and genitalia. Scale bars: Figs 5A, 5B = 5 mm, Fig. 5C = 1 mm.

Hylobittacus minimus (Carpenter, 1954), **comb. n.**

Figs 5, 7C

Bittacus minimus: Carpenter 1954: 39, fig. 4D.

Diagnosis: Separated from all species of *Hylobittacus* in Baltic amber by a combination of: Sc ending opposite fork of Rs and epiandrial lobe broad basally.

Redescription:

Forewing (based on specimen 674/2, Fig. 5B) 13 mm long; single pterostigmal cross-vein; Sc ending opposite fork of Rs; cubital cross-vein far before fork of Mb; no additional cross-veins in distal radial and medial cells.

Male genitalia (Figs 5A–C, 7C): epiandrial lobe short, without dorsal incision, broad basally; basistyle small, rather narrow.

Holotype (examined): MCZ 5205 (old no. 5113), male, condition as in Carpenter (1954).

Other material examined: DEIM 674/2, male with only two wings, fragment of thorax and abdomen partially obscured by milky cloud (Hoffeins coll.); BMNH In. 18855, entire female partially obscured by milky cloud; MP 1/3/552/04, poorly preserved female, only three wings and fragments of legs recognisable, abdomen obscured by milky cloud.

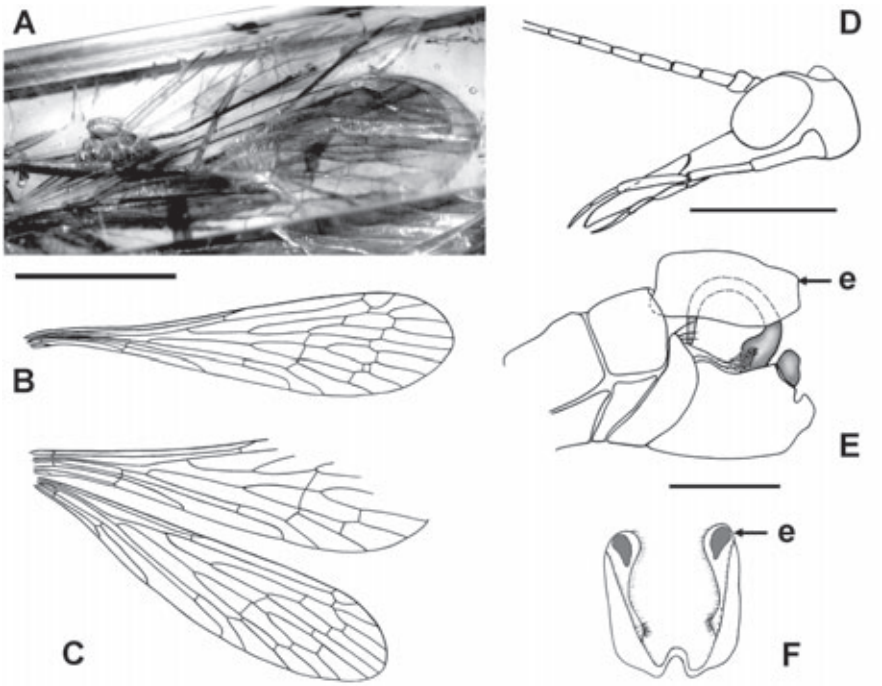

Fig. 6. *Hylobittacus picteti* sp. n.: (A, B) forewing of female 1150/2, general appearance and details of venation; (C–F) holotype DEIM 674/1: (C), fore- and hind wing, (D) head with antenna and palp, (E) male genitalia, lateral aspect; (F) epiandrium, dorsal aspect. Abbreviation: e – epiandrium. Scale bars: Figs 6A–C = 5 mm, Figs 6D–F = 1 mm.

Hylobittacus picteti sp. n.

Figs 6, 7D

Etymology: The specific epithet is a patronym formed from the surname of F.J. Pictet, author of the first description of *Bittacus* from Baltic amber over 150 years ago.

Diagnosis: Separated from all species of *Hylobittacus* in Baltic amber by a combination of: Sc ending just behind fork of Rs, epiandrial lobe broad and slightly narrowed apically, basistylus broad and large.

Description: Antenna most likely 16-segmented; palp 5-segmented (Fig. 6D).

Forewing (Figs 6A–C) 15–17 mm long; Sc ending just behind fork of Rs; sc–r before fork of Rs, opposite 2/3 of Rs length, and at four times its length before end of Sc; fork of Mb distinctly before fork of Rs; cubital cross-vein opposite fork of Mb; no additional cross-veins in distal radial and medial cells.

Male genitalia (Figs 6E, 6F, 7D): epiandrial lobe broad, only a little narrowed distally; basistyle very broad, with terminal portion incised, forming a small lobe.

Holotype: DEIM 674/1, well preserved male, only distal portion of costal field in right forewing missing (Bitterfeld amber; Hoffeins coll.).

Other material examined: DEIM 1150/2, female without head, portion of thorax, legs and two wings (Hoffeins coll.); MP 1/797/188/01, almost complete female surrounded by milky cloud and with wings partially damaged (donation of J. Serafin).

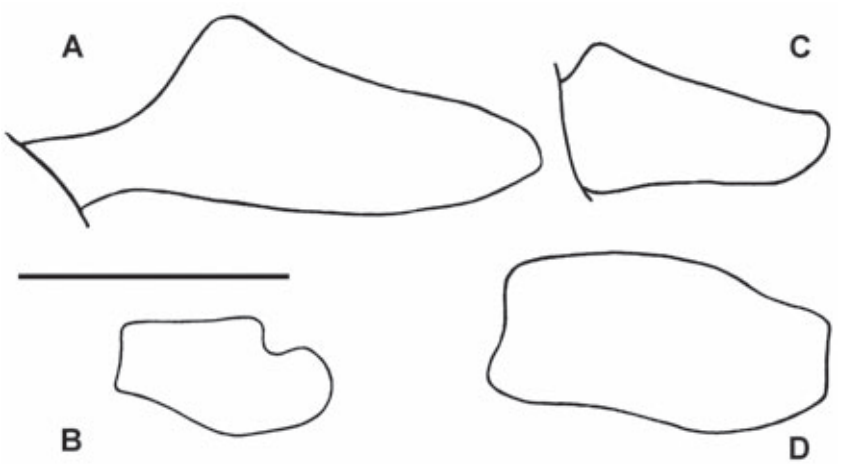

Fig. 7. Epiandrial lobes of Baltic amber Bittacidae in lateral aspect: (A) *Bittacus succinus* Carpenter; (B) *Hylobittacus fossilis* (Carpenter); (C) *Hylobittacus minimus* (Carpenter); (D) *Hylobittacus picteti* sp. n. Scale bar = 1 mm.

Remarks: *H. picteti* sp. n. resembles *H. fossilis* in wing venation, but differs significantly from the latter in epiandrial lobe morphology (Figs 6E, 6F, 7D).

The holotype is from the Saxonian (or Bitterfeld) amber from Saxonia, Germany. Although Saxonian amber has been found in younger sediments, Weitschat and Wichard (2002) state that this is most likely Baltic amber, which was re-deposited several times.

DISCUSSION

Over the last two decades there has been a growing interest in amber inclusions and an increase in scientific literature related to this topic. As a result of this, museum and private collections of amber fossils are steadily growing. However, studies on this rich source of material are hindered by the lack of thorough revisions of genera and families, in the extant fauna of the world. There are several factors which either delay such studies or make them impossible:

1. The number of specialists is insufficient and existing numbers are dwindling.
2. Many holotypes described at the end of the nineteenth and beginning of the twentieth centuries are lost or destroyed.
3. Some material, especially in private collections, is not available. Even if it is known and examined, it should be used with caution, because of the uncertain fate of private collections, which may be sold or lost. The International Code of Zoological Nomenclature (I.C.Z.N. 1999, Recommendation 16C) recommends deposition of type specimens in an institution with facilities for preserving them and making them available for study.

This study has been successful despite these difficulties. As a result of this study, the number of bittacid specimens described has more than doubled. This is encouraging, since this family is generally poorly represented in the fossil state, both in resins and sediments.

It is interesting that in the Baltic amber only a single specimen (and species) was found with two pterostigmal cross veins, while all remaining specimens have only one.

This sample of the bittacid amber fauna, however small, may represent true dominance of this form in the Eocene amber forest. Among Recent representatives the reverse proportion is observed: most species of *Bittacus* have two pterostigmal cross veins, while one cross vein is present only in a few species of this genus, scattered over the world, and in one species of *Hylobittacus*. A revision of both genera is thus necessary, in order to determine the importance of this character for the systematics of Bittacidae.

The small degree of variation in the wing venation of Bittacidae in the Baltic amber is most remarkable. It is however difficult to compare this with Recent species, as there are no studies on the patterns of wing venation. It may only be noted that Carpenter must have considered intraspecific variation great, as he included various patterns in one species (Carpenter 1954).

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