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The first fossil Dipsocoridae found in the early Eocene amber of France (Hemiptera: Heteroptera)

*Le premier Dipsocoridae fossile découvert dans l'ambre Éocène basal de France (Hemiptera : Heteroptera)*Viktor Hartung^a, Romain Garrouste^b, André Nel^{b,*}^a Staatliches Museum für Naturkunde Karlsruhe, Erbprinzenstrasse 13, 76133 Karlsruhe, Germany^b Institut de systématique, évolution, biodiversité, ISYEB, UMR 7205 CNRS, MNHN, UPMC, EPHE, Entomologie, Muséum national d'histoire naturelle, Sorbonne universités, 57, rue Cuvier, CP 50, 75005 Paris, France

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ABSTRACT

Cryptostemma eocenica sp. nov., the first fossil representative of the family Dipsocoridae (Heteroptera: Dipsocoromorpha), is described from Eocene amber of France on the basis of a single macropterous female. The specimen is very 'modern' in appearance, demonstrating the remarkable morphological stability of this family since 53 Ma. Its generic affinities are difficult to estimate because the modern genera are mostly separated by male genitalia or female internal structures.

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R É S U M É

Cryptostemma eocenica sp. nov. est le premier Dipsocoridae fossile (Heteroptera : Dipsocoromorpha) décrit de l'ambre éocène de France sur la base d'une femelle macroptère. Le spécimen est très « moderne » d'aspect, ce qui démontre la remarquable stabilité morphologique de cette famille depuis 53 Ma. Ses affinités phylogénétiques sont difficiles à établir, car les genres modernes sont discriminés sur la base des génitalia mâles ou des structures internes femelles.

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The heteropteran infraorder Dipsocoromorpha comprises only five families and harbors the smallest true bugs (average body size 1–2mm) with the fewest described species (about 350—Henry, 2009; Leon and Weirauch, 2016), although there might be hundreds or

even thousands that are still undescribed (Štys, personal communication). This infraorder is still the least known of all Heteroptera (Garrouste, 2015; Weirauch and Fernandes, 2015; Weirauch and Schuh, 2011). The monophyly of this infraorder is well established (Weirauch and Štys, 2014). Dipsocoromorpha is certainly an ancient clade dating back to the early Mesozoic (Wang et al., 2016). It remains not very well known in the fossil record. Only two Ceratocombidae are described (Azar et al., 2010; Wygodzinsky, 1959), both from Miocene Chiapas amber (the first one was originally described as a Dipsocoridae); as well as one species of Hysipterygidae from Eocene Baltic amber (Bechly and Wittmann, 2000). The most diverse dipsocoromorphan family, Schizopteridae, is represented by five fossil genera with eight species, all in amber, from the Lower Cretaceous of Lebanon (Azar and Nel, 2010), the Middle Cretaceous of France (Perrichot et al., 2007), the Early Cretaceous of Burma and the Miocene of the Dominican Republic (Poinar and Brown, 2014). Two families, the monotypic Stemmocryptidae and the cosmopolitan Dipsocoridae with three recent genera, were unknown from the fossil record until now. Here, we describe the first fossil Dipsocoridae from the lowermost Eocene amber of France.

1. Material and methods

The original external surface of the amber piece was removed by polishing; final lustration was done using diatomite powder. The specimen was examined and drawn with the camera lucida technique under Nikon SZ10 and Olympus SZX9 stereomicroscopes. Photos were taken with a Nikon D800 digital camera. Several digital pictures were reconstructed using Helicon Focus software.

Systematic palaeontology

Order HEMIPTERA Linné, 1758

Infraorder DIPSOCOROMORPHA Miyamoto, 1961

Family DIPSOCORIDAE Dohrn, 1859

Genus CRYPTOSTEMMA Herrich-Schaeffer, 1835

Cryptostemma eocenica sp. nov.

Figs. 1–5.

Derivation of name. The specific name is from the Eocene period.

Holotype. Female, MNHN.F.A53793 (PA15518), in a small piece of amber together with two thrips and a Diptera Chironomidae.

Type horizon. Lowermost Eocene, Sparnacian, level MP7 of the mammal fauna of Dormaal.

Type locality. Le Quesnoy, Chevrière, region of Creil, Oise department, France.

1.1. Diagnosis

This fossil can hardly be separated from the recent species in *Cryptostemma* and *Pachycoleus* Fieber, 1860 (see below). Nevertheless, a significant difference is the forewing marginal vein reaching wing apex, far from the apex of last entering longitudinal vein, instead of ending just behind the apex of last entering longitudinal vein. Scutellum large (0.24 mm broad and 0.14 mm long). First segment of labium very thick, more than half as thick

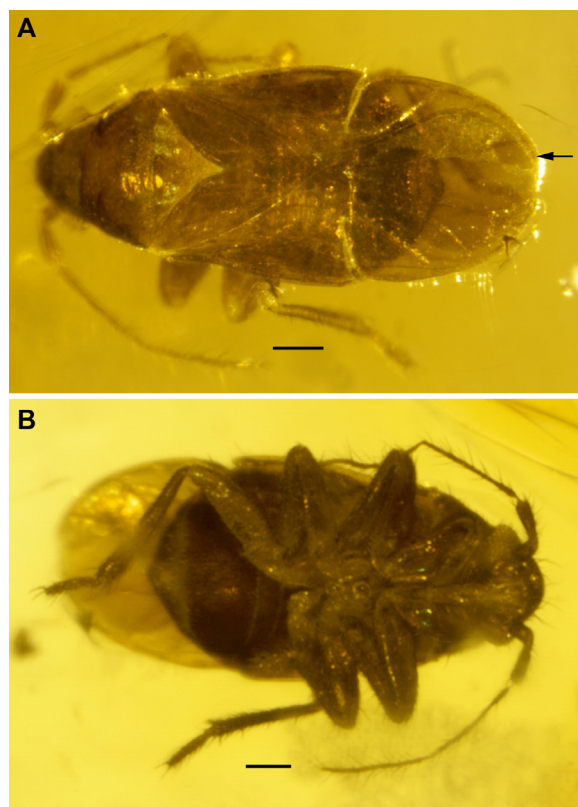


Fig. 1. *Cryptostemma eocenica* sp. nov., holotype MNHN.F.A53793, photographs of habitus. A. Dorsal view. B. Ventral view. Arrow: apex of forewing marginal vein. Scale bars represent 0.1 mm.

Fig. 1. *Cryptostemma eocenica* sp. nov. holotype MNHN.F. A53793, photographies de l'habitus. A. Vue dorsale. B. Vue ventrale. Flèche de la nervure marginale de l'aile antérieure. Les barres d'échelle représentent 0,1 mm.

as the distance between antennae, and longer than second. Bristle combs present on distal ends of all tibiae. No asymmetry of the abdomen, typical for the genus *Alpagut* Kiyak, 1995, is recognizable in dorsal or ventral view. Very small (BL ca. 1 mm), unlike most *Cryptostemma* species. Eyes large (especially in ventral view, Fig. 4A); ratio eye diameter/vertex = 1/4 (Fig. 3A), large eyes being atypical for genus *Pachycoleus*. Posterior margin of trapezoid pronotum clearly concave, which is also not found in *Pachycoleus*. Veins M and Cu not strongly approximate in distal part of tegmina.

1.2. Description

The specimen is a macropterous female (see Fig. 1A), ca. 1 mm in length (incl. tegmina), light brown to fulvous in color; membranous part of tegmina almost transparent. Head slightly wider than long. Compound eyes well developed and large, ca. 0.04 mm wide dorsally (ratio to the minimal interocular distance $\frac{1}{4}$), 0.08 mm wide ventrally; an ocellus visible on each side medially from compound eye (Figs. 2A–3A). Rostrum only reaching hind margin of fore coxae, with first segment ca. 0.1 mm long and 0.07 mm wide, second ca. 0.05 mm long and 0.05 mm wide, third ca. 0.07 mm long, 0.05 mm wide at base, tapering; last segment

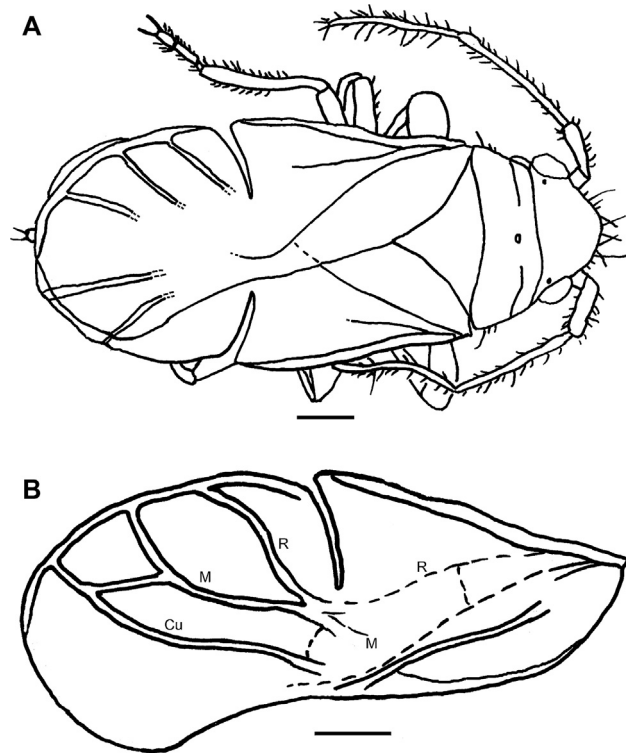


Fig. 2. *Cryptostemma eocenica* sp. nov., holotype MNHN.F.A53793, drawings. A. Dorsal view of habitus. B. Left tegmen. Scale bars represent 0.1 mm.
Fig. 2. *Cryptostemma eocenica* sp. nov., holotype MNHN F. A53793, dessins au trait. A. Vue dorsale de l'habitus. B. tegmen gauche. Les barres d'échelle représentent 0,1 mm.

ca. 0.07 mm long, even more tapering (Fig. 4A); second and third segments bear long setae on each side. First two antennal segments short and stout (first ca. 0.05 mm long and 0.03 mm wide, second ca. 0.1 mm long and 0.03 mm wide), segments three and four long and slender (third segment ca. 0.21 mm long and 0.016 mm wide, fourth ca. 0.2 mm long and 0.011 mm wide); antennae covered with setae especially long on last two segments; second antennal segment ca. 3.3 times longer than wide, third antennal segment ca. 13 times longer than wide; symmetrical pairs of long setae (most likely trichobothria for their length) present on fronto-clypeal region of head: one dorsally on each side of frons, two pairs on clypeus.

Pronotum almost three times as wide in posterior part as long in middle, trapeziform, with a large seta at each posterolateral angle and a concave posterior margin; anterior third incised on each side by a transversal furrow (not reaching each other and thus not forming a true collar), with a small dark spot in middle between them; scutellum large (ca. 0.26 mm wide and 0.1 mm long), triangular, slightly concave laterally.

Fore tibia somewhat widened distally, broad, two-segmented tarsi; middle tarsi also two-segmented, hind ones with three segments. All tibia distally with bristle combs (Figs. 3B, 4B).

Tegmina very difficult to observe because they are overlapping and the veins in the basal halves of the tegmina are phantom-like. Tegmen 0.8 mm long (Fig. 2B), exceeding body in length by ca. 0.25 mm; almost parallel in basal

fourth, but with a flattened margin, between end of basal fourth till costal fracture, making outer margin of tegmen at this part slightly convex; costal fracture very pronounced and reaching middle part of tegmen; venation obscured in basal half; a claval fold clearly seen and a Y-shaped vein present in clavus, apparently not reaching wing basis; M vein also present, looking like a fold in basal half of tegmen (before claval fracture) and becoming a true vein in apical half; in this part, R and Cu veins also well visible; R fused with M just medially from costal fracture; Cu connected with M twice: distally by a crossvein and proximally by a fold; marginal vein reaching wing apex; hind wings well developed, surpassing tip of abdomen (Figs. 1A, 2A).

Lateral tergites of abdomen flattened; abdomen symmetrical, loculus capsulae not recognizable (Fig. 1B), unlike in *Alpagut medius* and *A. maroccanus* (Pluot-Sigwalt and Péricart, 2003); externally visible genitalia similar to female parts in modern Dipsocoridae; two conspicuous long setae (trichobothria?), with a row of a shorter setae between them on tip of abdomen (Fig. 5).

2. Discussion

The small size, declivous head, antennae with short scape and pedicel and two long thin flagellomeres covered with long setae are among the characters attributing the fossil to Dipsocoromorpha, whereas the venation of tegmina (especially the costal fracture reaching very deep into the forewing) prove very convincingly that the

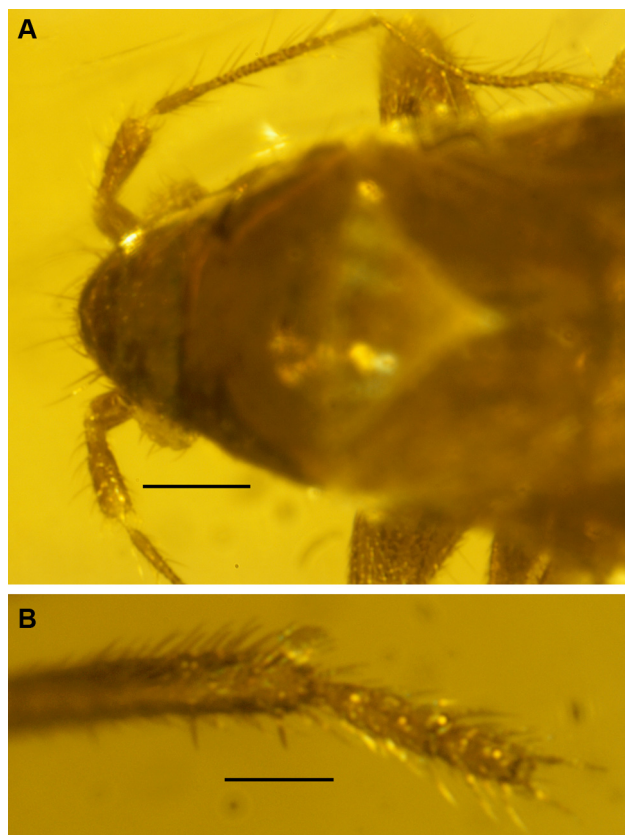


Fig. 3. *Cryptostemma eocenica* sp. nov., holotype MNHN.F.A53793, photographs. A. Dorsal view of head and antennae. Scale bar represents 0.1 mm. B. Dorsal view of left hind tarsus. Scale bar represents 0.05 mm.

Fig. 3. *Cryptostemma eocenica* sp. nov., holotype MNHN. F. A53793, photographies. A. Vue ventrale de la tête et des antennes. La barre d'échelle représente 0,1 mm. B. Vue dorsale du tarse postérieur gauche. La barre d'échelle représente 0,05 mm.

specimen belongs to the Dipsocoridae (Štys, 1995). The overall characterization of the recent family fits very finely with this 53-myr-old specimen. Since the spermatheca with loculus capsulae found in representatives of the genus *Alpagut* (synonyms *Raunocoris* Baena & Alonso-Zarazaga, 2009 and *Harpago* Linnavuori, 1951) (Pluot-Sigwalt and Péricart, 2003) is not recognizable, the specimen is not attributed to it.

The two remaining genera within Dipsocoridae, *Cryptostemma* and *Pachycoleus* are currently separated by features of the male genitalia (Heiss and Péricart, 2007), not available in our fossil. Some non-genital characters can be used, but need to be tested on both fossil and recent material, since their conditions are not always described in literature. For instance, species of *Pachycoleus* normally seem to have small eyes (large in our specimen) and straight or almost straight posterior margin of pronotum (concave in our specimen), which would exclude the specimen from it. At the same time, the very small body length of the specimen would support its separation from most of the recent *Cryptostemma* species that are normally almost twice as big, although small species are known, too (e.g., *Cryptostemma incurvatum* Štys, 1977, being only 1.13 mm long). It should be mentioned that the genus *Cryptostemma*

seems to be in need of a revision, since many species were described before modern concepts of Dipsocoridae genera emerged, the descriptions themselves often being quite scarce.

At the same time, the new specimen has one character that distinguishes it from both *Cryptostemma* and *Pachycoleus*, i.e., the forewing marginal vein reaching wing apex, far from the apex of the last entering longitudinal vein, instead of ending just behind the apex of last entering longitudinal vein, supporting an attribution to a new genus. The very wide first segment of the rostrum and large eyes (especially well seen in the ventral view) could also be used to separate this fossil from the modern species, but they cannot be adapted yet since their condition in many other species of Dipsocoridae is simply not known.

2.1. Remark

The modern Dipsocoridae live either on riverbanks inhabiting interstitial spaces formed by gravel and sand (*Cryptostemma*) or in mosses, especially those growing in bogs (*Pachycoleus*) (Heiss and Péricart, 2007; Štys, 1990). These habitats are not optimal for the embedding of a

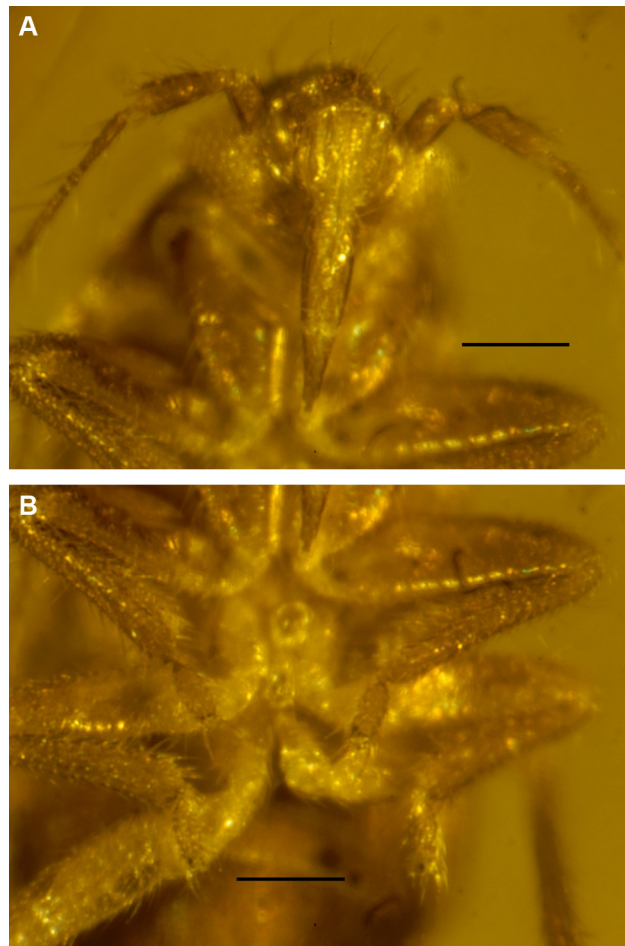


Fig. 4. *Cryptostemma eocenica* sp. nov., holotype MNHN.F. A53793, photographs. A. Ventral view of head. B. Ventral view of thorax with legs. Scale bars represent 0.1 mm.

Fig. 4. *Cryptostemma eocenica* sp. nov., holotype MNHN. F. A53793, photographies. A. Vue ventrale de la tête. B. Vue ventrale du thorax, avec les pattes. Les barres d'échelle représentent 0,1 mm.

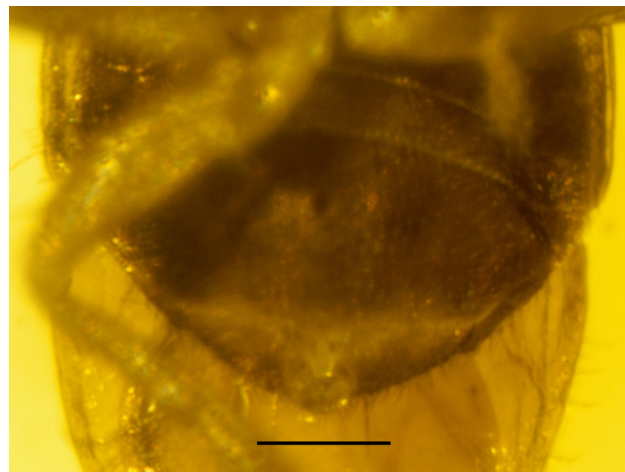


Fig. 5. *Cryptostemma eocenica* sp. nov., holotype MNHN.F. A53793, photograph. Ventral view of abdomen. Scale bar represents 0.1 mm.

Fig. 5. *Cryptostemma eocenica* sp. nov., holotype MNHN. F. A53793. Photographie en vue ventrale de l'abdomen. La barre d'échelle représente 0,1 mm.

specimen in fresh resin, which could explain, together with the very small size of these bugs, their rarity in amber.

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