

A stem-group cimicid in mid-Cretaceous amber from Myanmar (Hemiptera: Cimicoidea)

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ABSTRACT

A fossil cimicoid bug is described and figured from a single male preserved in mid-Cretaceous (latest Albian) amber from Myanmar. *Quasicimex eilapinastes* n.gen., n.sp., shares many features with the bed bug family Cimicidae (Cimicomorpha: Cimicoidea), as well as a few features of primitive cimicids such as Primicimicinae, while simultaneously retaining some significant plesiomorphies relative to crown-group cimicids. The genus is tentatively retained in Cimicidae *s. lato*, basal to all other cimicids.

KEY WORDS: Cimicomorpha. Cimicidae. Heteroptera. taxonomy. paleontology. Mesozoic.

INTRODUCTION

Bugs of the family Cimicidae are distinctive members of the cimicomorphan Heteroptera. The family includes the infamous bed bugs that have plagued humans for millennia, though most cimicids feed on bats or birds. Cimicids are temporary parasites, in that they do not reside permanently on the host between feedings, but rather locate themselves in surrounding crevices where they conceal themselves when not feeding. Bed bugs are also famous, along with all related families cimicoid families excepting Lasiochilidae, for their reproduction by means of traumatic insemination, a dramatic form of mating that has evolved in a variety of groups (*e.g.*, some Onychophora) whereby the male quickly injects the female with sperm using a hypodermic penis, which then travel through the hemolymph to the ovaries (*e.g.*, Grimaldi & Engel 2005, Reinhardt & Siva-Jothy 2007).

The fossil record of cimicids is unfortunately entirely unknown and as such their origins and divergence from related families such as Polycytenidae and Anthocoridae remains speculative. Grimaldi *et al.* (2002) reported a cimicid-like bug in mid-Cretaceous amber from Myanmar. The specimen embodies numerous features of Cimicidae such as a spine-like aedeagus and a dense vestiture of fine, long setae. Nonetheless, the fossil is notably plesiomorphic relative to true Cimicidae, particularly in the presence of fully-developed wings not differing (where evident) from a generalized anthocorid form. In addition, the legs are relatively long in comparison to most cimicids (although some derived genera such as *Leptocimex* and *Stricticimex* have legs about as long as the fossil), the elongate male genitalia (primitively similar to other cimicomorphan families), and the long rostrum extending posteriorly to the metacoxae

(the rostrum of Recent cimicids typically extends only to the procoxae at best). Thus, the fossil appears to be related to Cimicidae but is basal to all members of the family as we define it based on modern taxa. The fossil may shed considerable light on the development of true cimicid traits from groundplan features of related cimicoid bugs. Nonetheless, the fossil does have some interesting apomorphies such as the 2-segmented rostrum (3-segmented in modern Cimicidae). Herein I consider the fossil to be a stem-group member of modern Cimicidae. Morphological terminology generally follows that of Usinger (1966) as used by him for genera and subfamilies.

SYSTEMATIC PALAEOLOGY

Family: Cimicidae Latreille 1802

GENUS: *Quasicimex* gen. nov.

Type species: *Quasicimex eilapinastes* sp. nov.

Etymology. The new genus-group name is a combination of the Latin terms *quasi* (meaning, “simulating”) and *cimex* (meaning, “bug”). The name is masculine.

Diagnosis. Body generally dorsoventrally compressed, broadly oval; covered with dense vestiture of fine setae (Figs. 1–2). Head with elongate bristle behind compound eye (as in Primicimicinae) (Fig. 2); compound eyes well developed (typically reduced in Cimicidae *s. str.*); ocelli absent; antenna with four articles; labrum apparently slightly longer than wide (somewhat damaged in holotype), subtriangular; rostrum 2-segmented, elongate (3-seg-

mented and relatively short in Cimicidae *s. str.*), extending to metacoxae (Fig. 2), first segment greatly elongate (apparently resulting from the apomorphic fusion of two segments at midpoint but dorsally strongly sclerotized and united into a strengthened, single unit), second segment less than one-half length of first. Pronotum apparently slightly transverse with concave anterior border (difficult to ascertain as pronotum is partially crushed laterally and anteriorly in holotype), with numerous, fine, long setae, lateral ones particularly long, such setae simple; scutellum triangular, broad. Macropterous; forewings forming hemelytra, well developed although apparently not heavily sclerotized, with defined clavus, medial fracture, and cuneus (Fig. 2); membrane scarcely visible but apparently hyaline. Legs slender and elongate (as in some derived Cacodminae); tibiae without mottling, with short, dense vestiture intermingled with scattered, long, stout setae or spines, such spines particularly well developed on metatibiae; tarsi trimerous, first and third tarsomeres longest; tarsi with elongate setae near apices of tarsomeres, particularly on distitarsus; arolium absent. Male genitalia elongate, curved; emerging toward left (typically short in Cimicidae *s. str.*, although some slightly more elongate forms are known among cacodmines) (Fig. 2).

Quasicimex eilapinastes sp. nov.

(Figures 1–2)

2002 Near Cimicidae; Grimaldi *et al.*: 41, figs. 26a, 27.

Etymology. The specific epithet is the Greek term *eilapinastes* (meaning, “feaster”) and is a reference to the presumed parasitic habit of this bug.

Holotype. Bu-728; male (Fig. 1); Cretaceous amber; Myanmar: Kachin, Tanai Village (on Ledo Road 105 km NW Myitkyna). Deposited in the Amber Fossil Collection, Division of Invertebrate Zoology, American Museum of Natural History, New York.

Diagnosis. As for the genus (*vide supra*).

Description. As for the genus with the following additions: **Male.** Total body length 2.81 mm; maximal width of body (as preserved) 1.94 mm; rostral length 1.68 mm (first segment 1.22 mm, second segment 0.46 mm). Integument light reddish brown, legs uniformly colored (not mottled as in primicimicines); imbricate and generally impunctate. Head with scattered, short, fine setae; rostrum with scattered, moderate-length, fine setae on lateral and ventral margins (rostrum is relatively completely preserved but has the segments slightly pulled apart: Fig. 2). Setae of pronotum longest, particularly laterally where setae are greatly elongate (twice or more in length of those medially) and fine, with simple apices; medially some setae with posteriorly recurved apices, such recurved setae also present on mesoscutellum and wing base. Wing membrane hyaline.



Figure 1. Photomicrograph of holotype male of *Quasicimex eilapinastes* n.gen., n.sp. (AMNH Bu-728).

Inner apex of protibia with minute comb of setae; no distinct combs present along length of inner margins of tibiae or femora; tibiae with scattered spines intermingled among fine, subadpressed, short, simple setae.

DISCUSSION

The phylogeny of “higher” Cimicomorpha, particularly Cimicoidea, has received surprisingly little attention or critical examination given the biological significance of these bugs. Schuh & Štys (1991) provided the most comprehensive analysis and overview of cimicomorphan phylogeny. Their study identified numerous important characters for elucidating relationships among cimicomorphs, but they used familial groundplans and, as such, were unable to critically test the monophyly or composition of the constituent families and subfamilies. While they were able to confirm the close relationship of *Lyctocoris* (removed by them from subfamilial status in Anthocoridae), Anthocori-

dae, Polyctenidae, and Cimicidae (Fig. 3A), their analysis was not designed to confirm or refute the validity or composition of these families as they are conceived. Their work should now be used as the foundation for more refined analyses employing exemplar taxa to test the relative positions of these families and, more importantly, their monophyly. For instance, it is a distinct possibility that the highly autapomorphic bat bugs of the Polyctenidae actually derive from within Cimicidae, perhaps even from within one of the subfamilies such as Cacodminae or Afrocimicinae. No synapomorphies for Cimicidae that exclude polyctenids are known and all of the features used to recognize the family apply equally to polyctenids, although typically in a highly autapomorphic form for the latter. Indeed, the possibility remains that Lyctocoridae, Polyctenidae, and Cimicidae originated from Anthocoridae or a general anthocorid-type bug (Fig. 3B). Even Schuh & Štys (1991, p. 308) noted that at least Cimicidae appeared to be derived from among anthocorids. The putatively primitive male

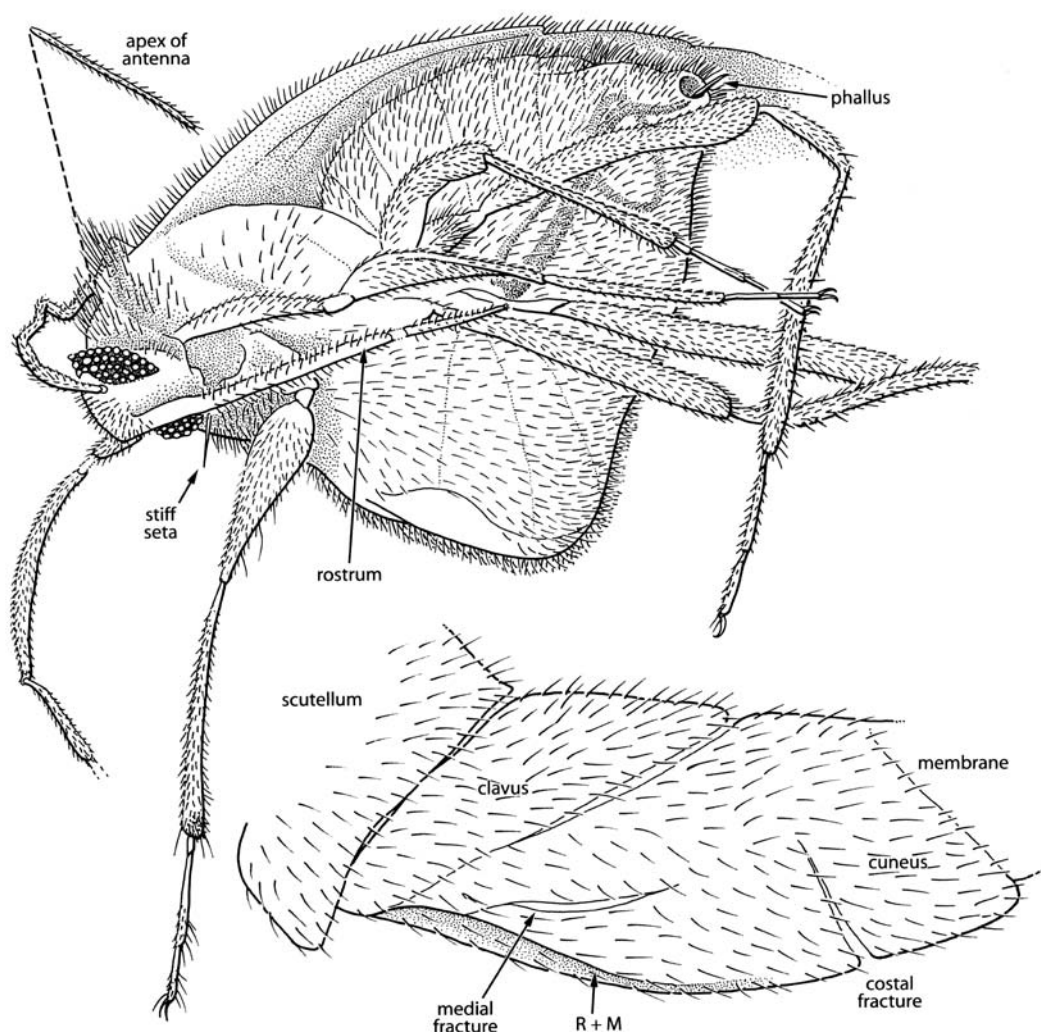


Figure 2. *Quasicimex eilapinastes* n.gen., n.sp. (AMNH Bu-728), ventral habitus and detail of forewing, both as preserved (from Grimaldi *et al.* 2002).

genital structure of *Lyctocoris*, with the left paramere not organized into a copulatory organ but the male vesica with an acus for injection during traumatic mating, could alternatively be interpreted as a specialized modification. While the formation of the seminal conceptacles from the

genital duct epithelium in *Lyctocoris* rather than from the hemochrisme in the peritoneal sheath of the ovariole in Anthocoridae, Polyctenidae, and Cimicidae is suggestive of a more distant placement for *Lyctocoris*, this condition is more apparently apomorphic for the genus and there-

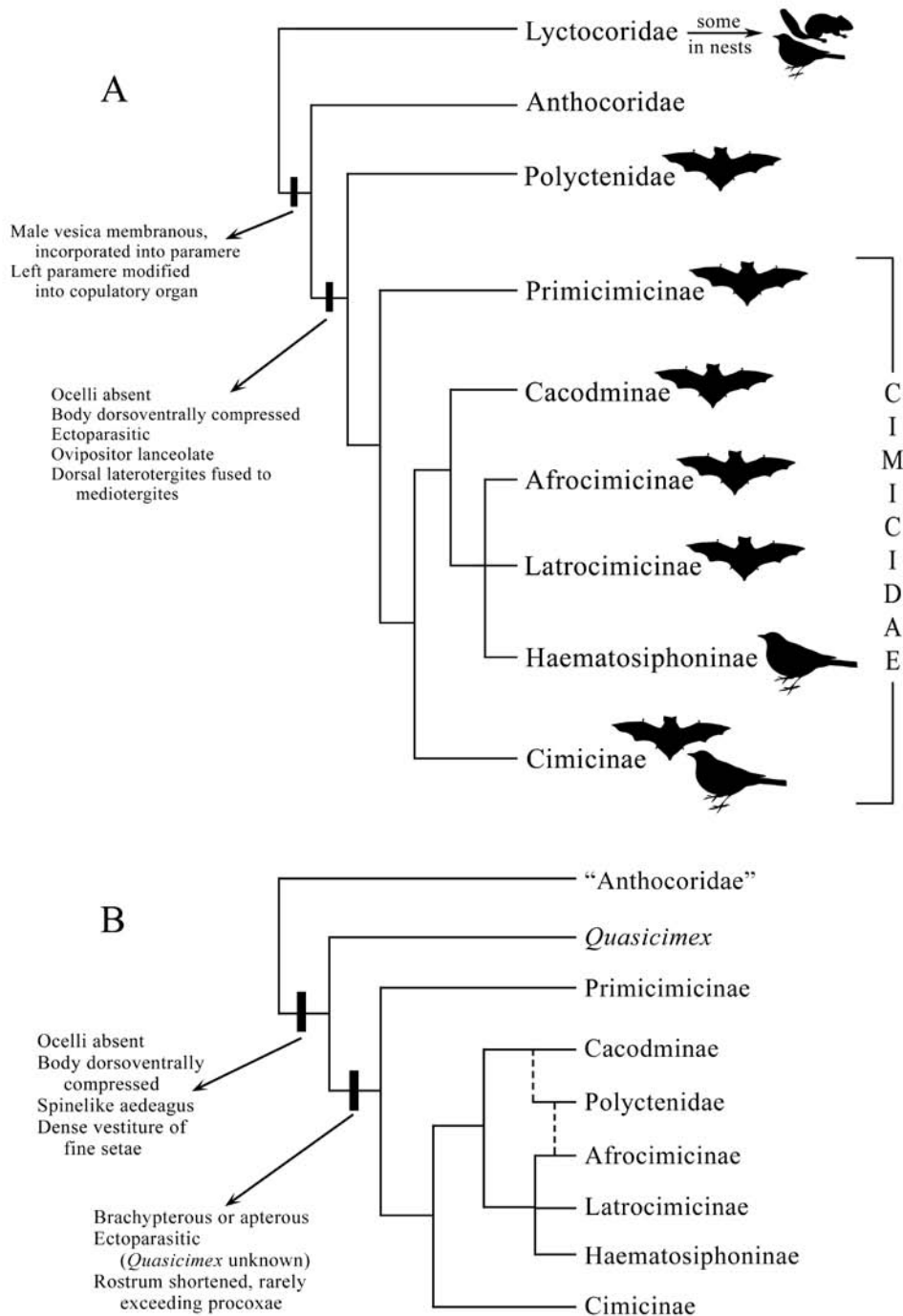


Figure 3. Phylogenies of higher Cimicoidea. **A**, Phylogenetic relationships among higher Cimicoidea, based on the familial analysis of Schuh & Štys (1991) with relationships within Cimicidae based on those hypothesized by Usinger (1966). Those studies assumed and constrained monophyly of the families [note that *Lyctocoris* is likely a modified anthocorid and that polyctenids are very likely modified cimicids (all characters designated by Schuh & Štys for Cimicidae also apply to polyctenids): refer to Discussion]. Native hosts are indicated on the phylogeny; all families except Polyctenidae (which are obligate haematophages) have species that facultatively feed on the blood of humans and other mammals (e.g., Štys & Daniel 1957, Usinger 1966, Lattin 1999, Reinhardt & Siva-Jothy 2007). **B**, Phylogeny indicating the probable paraphyly of Anthocoridae, placement of *Quasicimex*, and derivation of polyctenids from Cimicidae.

fore uninformative in regard to excluding it from the clade of other families. The possibility of a secondary reversal or specialized modification for *Lyctocoris* should be critically investigated by a finer-scale analysis of Lyctocoridae, Anthocoridae, Polycetenidae, and Cimicidae. A working hypothesis of relationships among higher Cimicoidea is depicted in figure 3B.

Where biological information is available, Lyctocoridae and Anthocoridae are predatory on small insects and mites, typically seeking their prey in detritus, although some species in Anthocorini and Oriini are phytophagous. Some species of *Lyctocoris* can be found living in the nests of small mammals and birds and both families are facultatively ectoparasitic, consuming the blood of small, feral mammals, domesticated animals, and humans (e.g., Malloch 1916, Štys & Daniel 1957, Štys 1973, Smith 1990, Lattin 1999). This is similar to Cimicidae, who while being specialized ectoparasites of birds and bats, have also famously become facultative ectoparasites of other mammals, including three species on humans. While still speculative, it is possible that crown-group Cimicidae originated in the earliest Tertiary. If parasitic, either facultatively or obligately, then stem-group cimicids, like *Quasicimex*, almost assuredly were temporary parasites on birds or small mammals, which were already diverse in the Cretaceous. Unfortunately, as noted, modern phylogenetic work on Cimicidae has been sparse and new work utilizing morphological, cytological, and molecular data is critically needed. Putatively basal cimicid subfamilies and genera are parasitic on bats (Usinger 1966, Reinhardt & Siva-Jothy 2007) (Fig. 3), a group entirely confined to the Cenozoic and that likely originated in the Paleocene (Simmons & Geisler 1998). As such, the switch to bats as hosts among stem-group cimicids was confined to a Tertiary event. The radiation of cimicids during the Tertiary perhaps was correlated with the radiation of bats. Sometime later in the Tertiary derived cimicines shifted back to birds, and three species eventually found their way to humans.

“Good night, sleep tight, don’t let the bed bugs bite!”

—Anonymous

ACKNOWLEDGEMENTS

I am grateful to David A. Grimaldi for providing a careful critique of the manuscript and for thoughtful discussion, and to Roy J. Beckemeyer and Sonja Wedmann for insightful reviews of the paper. Support was provided by National Science Foundation grant DEB-0542909 and a Guggenheim Fellowship from the John Simon Guggenheim Memorial Foundation. This is contribution No. 3485 of the Division of Entomology, University of Kansas Natural History Museum.

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Received: 31th August 2007

Accepted: 6th November 2007