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Notes on Cretaceous amber Braconidae (Hymenoptera), with descriptions of two new genera

Michael S. Engel[1,2]

Abstract. A new genus and species of basal cyclostome Braconidae is described and figured from a male preserved in mid-Cretaceous amber from northern Myanmar. ***Rhetinorhyssalus morticinus*** Engel, new genus and species, is interesting for its combination of primitive features such as a minute apical costal cell and anal stubs in the forewing, while lacking 2Cu in the hind wing, a putatively derived trait. As such, the genus may represent a lineage diverging from the braconid stem subsequent to many protorhyssalines, while remaining basal relative to generalized cyclostome groups such as Rhyssalinae. In addition, the Late Cretaceous *Diospilus allani* Brues, in Campanian Canadian amber, is transferred to ***Diorhyssalus*** Engel, new genus, and its similarity to *Rhetinorhyssalus* is discussed. This transfer results in the new combination, *Diorhyssalus allani* (Brues). Both genera are tentatively considered as subfamily *incertae sedis*.

INTRODUCTION

While braconid wasps are abundant in the modern fauna as well as diverse Cenozoic deposits throughout the world (Aguiar *et al*., 2013; Quicke, 2015), their Cretaceous record is meager. This paltry representation is interesting given the known antiquity of the group as evidenced by the general fossil history of Ichneumonoidea as well as records of basal braconids from the Early Cretaceous (*e.g*., Rasnitsyn & Sharkey, 1988; Grimaldi & Engel, 2005; Belokobylskij, 2012; Quicke, 2015). The few Mesozoic amber braconids are evidently stem groups either to the family as a whole or to subordinate

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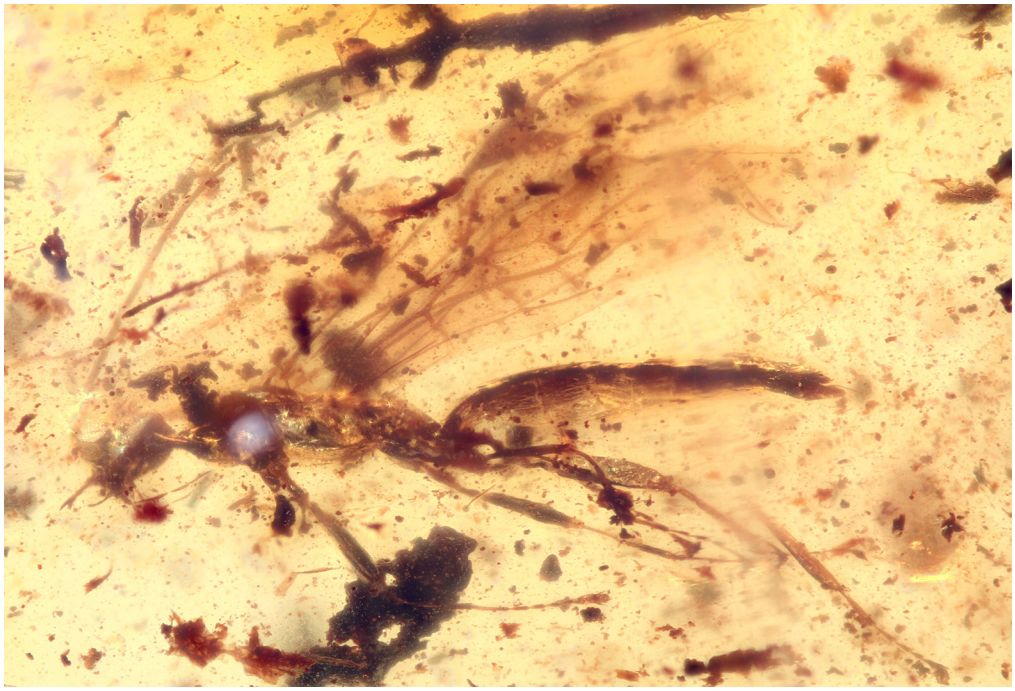

Figure 1. Left lateral habitus of holotype male (AMNH Bu-1424) of *Rhetinorhyssalus morticinus*, new genus and species, in Cretaceous Burmese amber.

clades therein (*e.g.*, Perrichot *et al.*, 2009), and the same is likely true for those ichneumonids in Cretaceous resins (McKellar *et al.*, 2013). To date, Cretaceous amber Braconidae have been formally described from the Early Cretaceous of Spain (Ortega-Blanco *et al.*, 2009, 2011) and the Late Cretaceous of Myanmar, France, New Jersey, and Canada (Brues, 1937; Basibuyuk *et al.*, 1999; Perrichot *et al.*, 2009; Engel & Wang, 2016). For a group that today has nearly 20,000 known species and perhaps over 42,000 worldwide (Quicke, 2015), it is important to ascertain when the various phases of diversification took place and for this we require a more enriched historical record. Thus, any new Mesozoic Braconidae are of considerable interest for understanding the evolution of this hyperdiverse lineage of parasitoid wasps.

Herein is provided the description of a new species of Cretaceous braconid wasp from the prolific deposits of northern Myanmar (Figs. 1, 2), as well as an alternative placement for a species described by Brues (1937) in Canadian amber. The Burmese species is the second braconid now recorded for those deposits, the other representing a distinct member of the Protorhyssalinae (Engel & Wang, 2016).

MATERIAL AND METHODS

The Burmese specimen was studied using an Olympus SZX-12 stereomicroscope and measurements made with the aid of an ocular micrometer. The piece is somewhat turbid, with abundant debris around the inclusion (Figs. 1, 2). This renders certain views impossible but overall most of the important characters can be discerned. Photographs were taken with a Canon 7D digital camera attached to an Infinity K-2 long-distance microscope lens. Morphological terminology is adapted from the work of

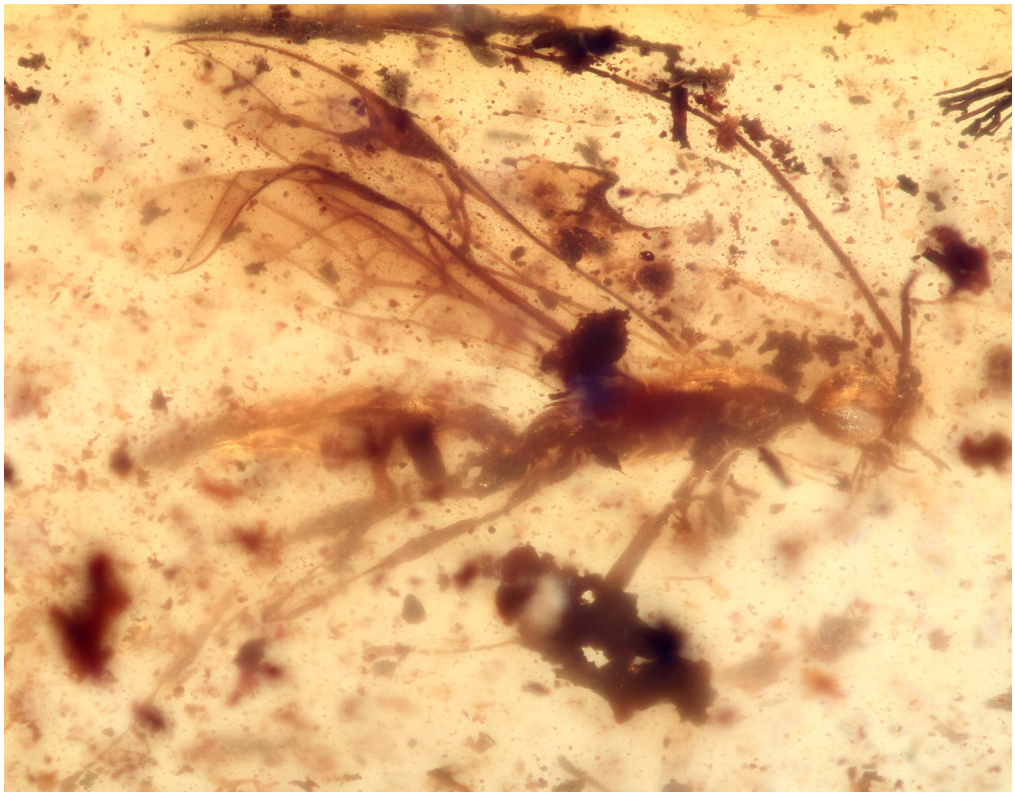

Figure 2. Right lateral habitus of holotype male (AMNH Bu-1424) of *Rhetinorhyssalus morticinus*, new genus and species, in Cretaceous Burmese amber.

Achterberg (1993), Huber & Sharkey (1993), and Sharkey & Wharton (1997). The geological setting and age of Burmese amber have been covered by Grimaldi *et al*. (2002), Cruickshank & Ko (2003), and Shi *et al*. (2012). These deposits remain one of the richest for Cretaceous amber inclusions, and have recently revealed exceptionally complete lizards (Daza *et al*., 2016), the latest occurrence of permopsocids (Huang *et al*., 2016), and the earliest microwhip scorpions and termite soldiers (Engel *et al*., 2016a, 2016b), among many other remarkable discoveries.

SYSTEMATIC PALEONTOLOGY

Family Braconidae Nees von Esenbeck
Subfamily *Incertae sedis*

Rhetinorhyssalus Engel, new genus
ZooBank: urn:lsid:zoobank.org:act:CC740B03-925F-40A1-B092-5339B16DCCAE

Type species: *Rhetinorhyssalus morticinus* Engel, new species.

Diagnosis: Head orthognathous, cyclostome; hypoclypeal depression deep; mandible long, about as long as compound eye; antenna long, with 22 flagellomeres; occipital carina absent; compound eyes not emarginate, without evident setae. Pronotal collar long; notauli shallowly impressed, percurrent, simple; mesoscutal surface com-

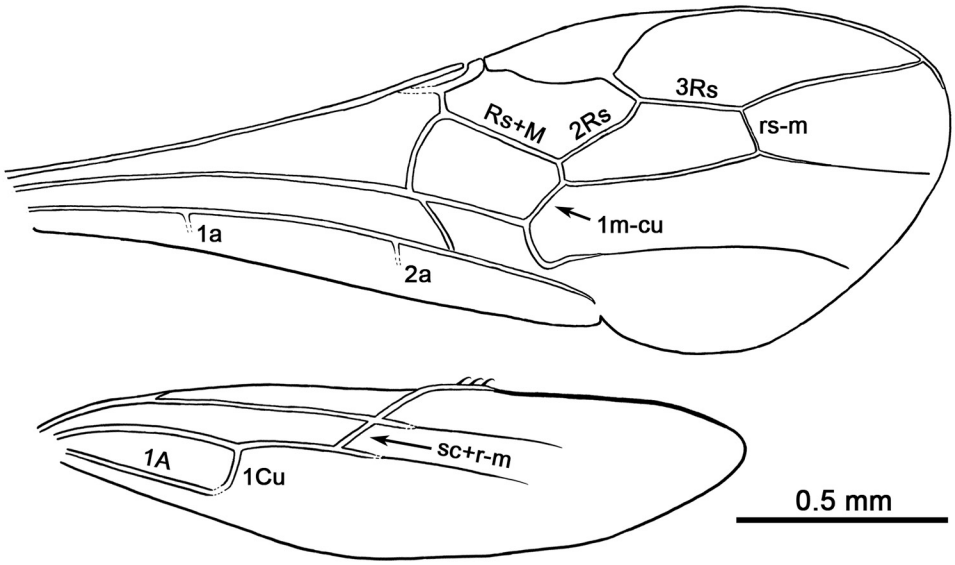

Figure 3. Wing venation of *Rhetinorhyssalus morticinus*, new genus and species, in Cretaceous Burmese amber.

paratively flat; mesoscutellum flat. Forewing (Fig. 3) with short, narrow costal cell near base of pterostigma, otherwise C+Sc+R fused along length, without indication of narrow costal cell or line of fusion; 1Rs short, separated from pterostigma by more than vein length; 1M weakly curved; Rs+M straight; rs-m present (*i.e.*, two submarginal cells present); 1m-cu meeting second submarginal cell (*i.e.*, contacting M after separation of 2Rs: Fig. 3); 2m-cu absent; 1cu-a slightly postfurcal, slanted; 2cu-a absent; stubs 1a and 2a present (Fig. 3). Hind wing with sc+r-m lacking bulla, much shorter than with 1M, confluent with R (sc+r-m, R, and Rs meet at a common point); bulla present between 1A and 1Cu; 2Cu absent (Fig. 3).

ETYMOLOGY: The new genus-group name is a combination of the Greek, *rhetine* (meaning, "resin"), and *Rhyssalus* Haliday, type genus of the primitive Rhyssalinae. The gender of the name is masculine.

COMMENTS: Overall the genus is quite similar to those wasps of the extinct stem subfamily Protorhyssalinae (*e.g.*, Perrichot *et al*., 2009; Engel & Wang, 2016). However, the distinct absence of 2Cu in the hind wing is a notably more derived feature relative to all protorhyssalines, as is the lack of 2m-cu in the forewing (its presence being a plesiomorphy of *Aenigmabracon* Perrichot *et al*. and *Apozyx* Mason). Accordingly, *Rhetinorhyssalus* are considered unplaced as to subfamily until such time as a more thorough understanding of relationships among basal Braconidae is available.

Rhetinorhyssalus morticinus Engel, new species

ZooBank: urn:lsid:zoobank.org:act:C5756F85-C31D-4A0C-97D5-F69B63FDBF99

(Figs. 1–3)

DIAGNOSIS: As for the genus (*vide supra*).

DESCRIPTION: ♂: Total length 3.10 mm; forewing length 2.25 mm, hind wing length 1.78 mm; integument generally dark brown throughout, imbricate and impunctate; wing veins brown to dark brown, membranes hyaline and faintly infumate.

Head broader than long, length 0.39 mm, width 0.65 mm, integument coarsely imbricate, with scattered, suberect, minute setae; face below antennal toruli generally flat; clypeus protruding, rounded, short; hypoclypeal depression deep and wide; mandible long, slender, prominently bidentate at apex; labial palpus short, with 3 palpomeres; maxillary palpus elongate, longer than head, with 6 palpomeres; compound eye large and glabrous, length 0.18 mm, inner margin not emarginate, much broader than gena; ocelli large, positioned on top of vertex, separated from posterior of head by one ocellar diameter, lateral ocellus separated from median ocellus by one ocellar diameter, ocellocular distance greater than two ocellar diameters; occipital carina lacking; antenna slightly longer than body length; scape twice as long as apical width, length 0.10 mm, width 0.05 mm, truncate apically; pedicel longer than wide, length 0.05 mm, width 0.04 mm; flagellum with 22 flagellomeres, individual flagellomeres distinctly longer than wide; basal flagellomeres greatly elongate, approximately 5–6.5 times as long as wide, flagellomere I length 0.20 mm, width 0.03 mm; flagellomere II length 0.16 mm, width 0.03 mm; flagellomere III length 0.16 mm, width 0.03 mm; remaining flagellomeres progressively tapering in length toward apex, apical flagellomeres about 2.75–3 times as long as wide.

Pronotal collar long; mesoscutum imbricate, comparatively flat; notauli shallowly impressed, simple, percurrent, widely separated posteriorly; mesoscutellar sulcus deeply impressed, simple; mesoscutellum flat; mesopleuron largely smooth to finely imbricate, posterior border with metanotum areolate; epicnemial carina absent; postpectal carina absent; sternaulus present, areolate; metapleuron areolate; propodeum strongly areolate. Legs slender, with scattered minute setae; tibial spurs short, protibial spur weakly curved, simple; femora slightly swollen; basitarsi longest tarsomeres, but about as long as combined lengths of second and third tarsomeres or about as long as fifth tarsomere; pretarsal claws short, simple; arolium massive. Forewing (Fig. 3) with short, narrow costal cell present apically near base of pterostigma, otherwise C+Sc+R fused along length; pterostigma large, longer than wide, with border inside marginal cell comparatively straight, anterior border comparatively straight, slightly bulging; marginal cell large, extending nearly to wing apex; R slightly extending beyond marginal cell apex along apical wing margin; 1Rs short, separated from pterostigma by more than length; 1M faintly curved; Rs+M straight, longer than 1M; 1m-cu entering second submarginal cell near base, with distinct angle in M after separation from 2Rs; r-rs arising slightly distad pterostigmal midlength, shorter than 2Rs and 3Rs; rs-m present, distinctly shorter than 3Rs; 1cu-a slightly postfurcal, slanted, long; 1Cu exceedingly short, much shorter than 1cu-a; 2Cu long, slightly longer than 1cu-a; 2cu-a absent (*i.e.*, subdiscal cell open); stubs of 1a and 2a present. Hind wing (Fig. 3) with margins finely setose, with three elongate setae on anterior margin near apex of C; 3 distal hamuli present on R; R tubular for short distance, otherwise extending along margin as dark nebulous vein to near wing apex; 2Sc+R absent owing to confluence of sc+r-m, R, and Rs; Rs tubular for short distance then extending as nebulous vein; sc+r-m without bulla, shorter than 1M; 2M tubular for short distance then nebulous; 1Cu shorter than 1M; 2Cu absent; second abscissa of A absent; bulla present between apex of 1A and 1Cu.

Metasoma length 1.60 mm; integument generally imbricate and apparently impunctate; sparsely setose; carinae of first metasomal tergum indiscernible as preserved (metasoma is partially compressed); terga wider than long; parameres projected, broad, with numerous short, erect setae; aedeagus narrow and slightly extending beyond apex of parameres.

♀: *Latet*.

HOLOTYPE: ♂, AMNH Bu-1424; mid-Cretaceous (Cenomanian) amber; Myanmar, Kachin, Tanai Village; deposited in the amber fossil collection of the Division of Invertebrate Zoology, American Museum of Natural History, New York.

ETYMOLOGY: The specific epithet is taken from the Latin *morticinus*, meaning, "dead".

Diorhyssalus Engel, new genus

ZooBank: urn:lsid:zoobank.org:act:27B5E434-AAD2-43DC-B11B-8153B7A57290

TYPE SPECIES: *Diospilus allani* Brues, 1937.

DIAGNOSIS: The wing venation of the type species (*vide* Brues, 1937) is rather similar in many respects to *Retinorhyssalus* except in the presence of the longer r-rs, longer rs-m (thus the second marginal cell is not narrowed toward the wing apex), longer 1Cu, shorter 1cu-a that is more orthogonal to Cu, presence of an occipital carina, shorter antenna (18 flagellomeres), and convex mesoscutum with deep notauli. In fact, as already noted by Belokobylskij (2012), this Canadian species is quite similar to Protorhyssalinae and the genus *Protorhyssalus* Basibuyuk *et al*. in particular. Aside from features generally similar across Protorhyssalinae such as the absence of 2m-cu and the presence of rs-m, 1a, and 2a in the forewing, *Diorhyssalus* also share with the slightly older *Protorhyssalus* the presence of only 18 flagellomeres. The new genus differs from *Protorhyssalus* in the elongate second submarginal cell which is distinctly wider than the first submarginal cell (cells about equal in *Protorhyssalus*), marginal cell not quite reaching to wing apex (reaching wing apex in *Protorhyssalus*), and the elongate r-rs that is several times longer than 2M (r-rs is only slightly longer than 2M, *i.e*., the abscissa of M between 2Rs and 1m-cu, in *Protorhyssalus*). *Diorhyssalus* are tentatively excluded from Protorhyssalinae pending determination of the presence or absence of 2Cu in the hind wing.

ETYMOLOGY: The new generic name is a combination of the Greek *dios* (meaning, "spirit" or "god", and meant as a reference to the original placement of the type species in *Diospilus* Haliday) and *Rhyssalus*. The gender of the name is masculine.

INCLUDED SPECIES: The genus presently includes only the type species, *Diorhyssalus allani* (Brues), **new combination**.

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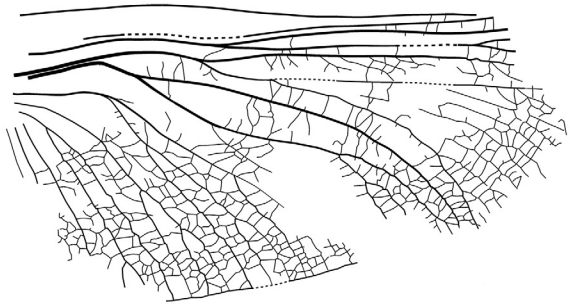

Pharciphyzelus lacefieldi Beckemeyer & Engel, 2011

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