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The first Proctotrupidae (Hymenoptera) in Burmese amber, with description of a new genus and species

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Abstract

Cresogmus grimaldii Rasnitsyn & Kolyada **gen. et sp. nov.** is described from the mid-Cretaceous Burmese amber in the tribe Disogmini (subfamily Proctotrupinae) as the first representative of the family Proctotrupidae encased in Burmese amber. This new genus is diagnosed by the occipital carina extending to the lower half of the head, the pronotum lacking an epomia, the pterostigma short, the petiole open but very short, the ovipositor wide and bent throughout, with its apex widely rounded. Diagnostic characters of Disogmini are revised.

Keywords: fossil insects, Disogmini, Burmese amber, new taxa

Introduction

The parasitoid wasps Proctotrupidae, the nominotypical family of the infraorder Proctotrupomorpha and superfamily Proctotrupeoidea, are a rather small group with 32 extant and 15 extinct genera and *ca.* 700 extant and 26 extinct species (Aguar *et al.*, 2013; He & Xu, 2015; Kolyada & Chemyreva, 2019). Most genera and species are described from the Holarctic only, because we have poor knowledge of extra-Holarctic faunas of the family. As far as we know, Proctotrupidae prefer moist temperate environments (Kolyada & Chemyreva, 2019). Most species are solitary endoparasitoids of Coleoptera larvae that live in soil litter and rotten wood, although some species parasitize larvae of Mycetophilidae, Sciaridae (Diptera) and Oecophoridae (Lepidoptera) (He & Xu, 2015).

The system of Proctotrupidae at the level of subfamily and tribe has not been discussed since Kozlov (1981) and Townes & Townes (1981), whose views are generally similar. We rely on that proposed by Kozlov (1981), with two subfamilies: the worldwide Proctotrupinae Latreille, 1802, that embraces the vast majority of the family, and the Austroserphinae Kozlov, 1970 (= Acanthoserphinae Townes & Townes, 1981) with three genera, the Australian *Acanthoserphus* Dodd, 1915, and *Austroserphus* Dodd, 1933, and the Patagonian *Austrocodr* Ogloblin, 1960. The Proctotrupinae are split into four tribes, the Holarctic Disogmini Kozlov, 1970 with the sole genus *Disogmus* Foerster, 1856, the Palearctic and Oriental Nothoserphini, also with one genus, *Nothoserphus* Brues, 1940, and the diverse and widespread Proctotrupini Latreille, 1802, and Cryptoserphini Kozlov, 1970 (Kozlov, 1981).

Living Proctotrupidae apparently represent a relict group. The paleontological record of Proctotrupidae starts in the earliest Cretaceous, with three genera and species in Berriasian of S. England (Rasnitsyn *et al.*, 1998). The family was so common during the Early Cretaceous that the above publication proposed a special ‘proctotrupid subtype’ of the baissine (Early Cretaceous) type of the Cretaceous hymenopteran assemblages. Proctotrupidae are not recorded in the Late Cretaceous probably because of a general scarcity of hymenopteran fossils in the Upper Cretaceous rock (non-amber) deposits. Despite this, the Cenozoic record of Proctotrupidae is not particularly poor, at least when compared with that of Diapriidae, a related family which is more successful now (190 genera and 2,048 species; Aguar *et al.*, 2013) and is also preferring humid environments. Nevertheless, a decline of Proctotrupidae after the Cretaceous is evident.

The present contribution describes the first proctotrupid wasp found in Cretaceous amber except for the one described from the Lebanese amber in this very issue (Engel *et al.*, 2022). Previously, the Cretaceous record of Proctotrupidae has been limited to compression fossils in sedimentary rocks.

Material and methods

The amber piece containing the fossil studied here derives from the amber mines located in the Hukawng Valley, Kachin Province, Myanmar (for locality map see Li *et al.*, 2018: fig. 1). The rock yielding the amber in this province was dated paleontologically to the late Albian (Early Cretaceous, 97–110 Ma; Cruickshank & Ko, 2003)

and later radiometrically, using U-Pb zircon dating, to 98.79 ± 0.62 Ma, therefore to the Albian/Cenomanian boundary (Shi *et al.*, 2012). The date corresponds with the early Cenomanian, being the earliest Late Cretaceous. However, since it is well known that amber easily becomes redeposited, we prefer to refer to the amber informally as being of mid-Cretaceous age.

The material is deposited at the A.A. Borissiak Palaeontological Institute, Russian Academy of Sciences, Moscow, as a part of collection donated by Dr. Christoph Öhm-Kühnle (Herrenberg, Germany). The piece of amber was polished as a parallelepiped close to the fossil and then studied using a Leica M165C stereomicroscope with a Leica DFC 420 camera. For imaging of the specimen, a compound microscope Nikon Eclipse 800 with dry (4×, 10×, 20×) and water dip optics (40× and 60×) was

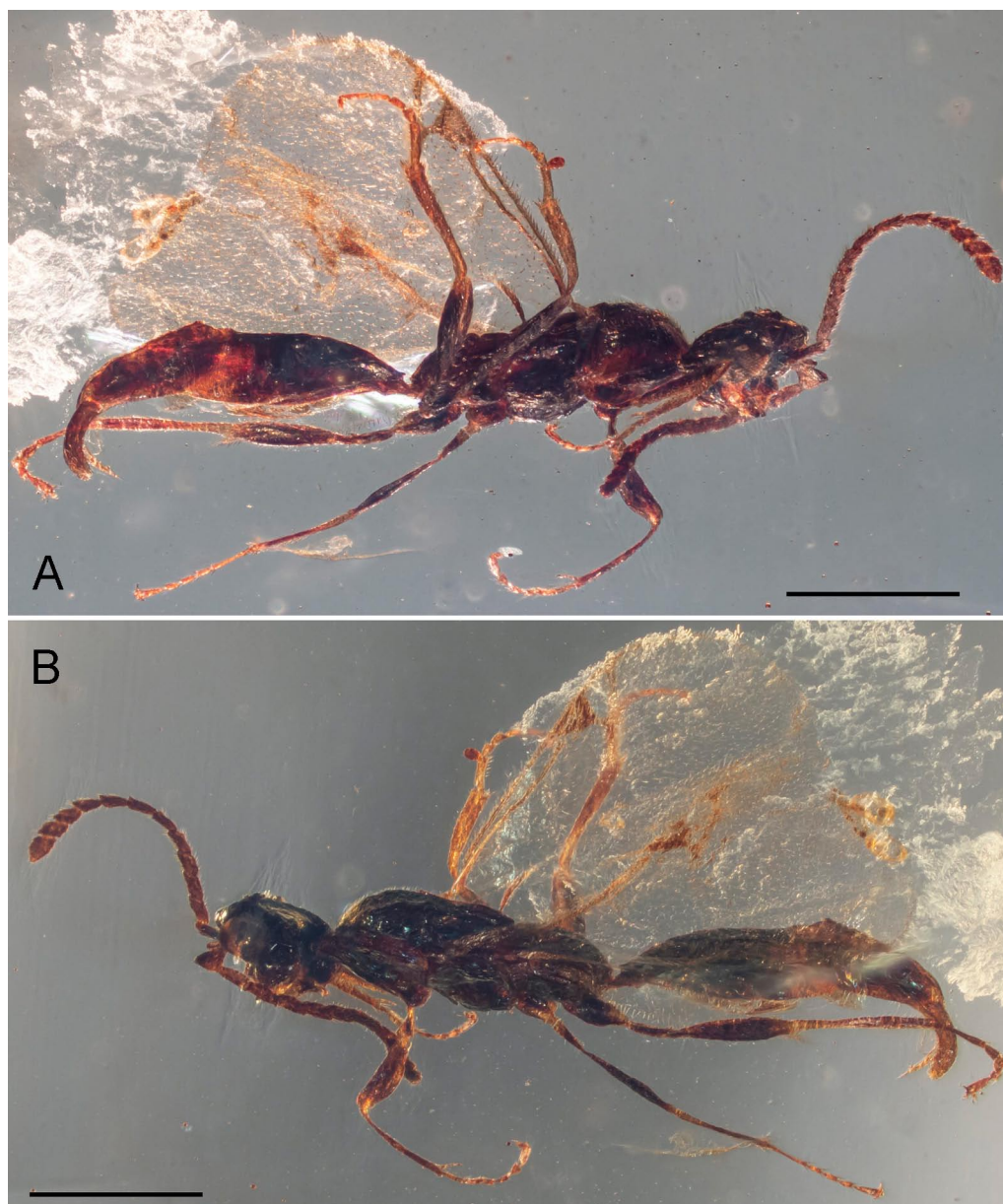


FIGURE 1. *Cresogmus grimaldii* Rasnitsyn & Kolyada **gen. et sp. nov.**, holotype. **A**, Right side view. **B**, Left side view. Scale bars = 0.5 mm.

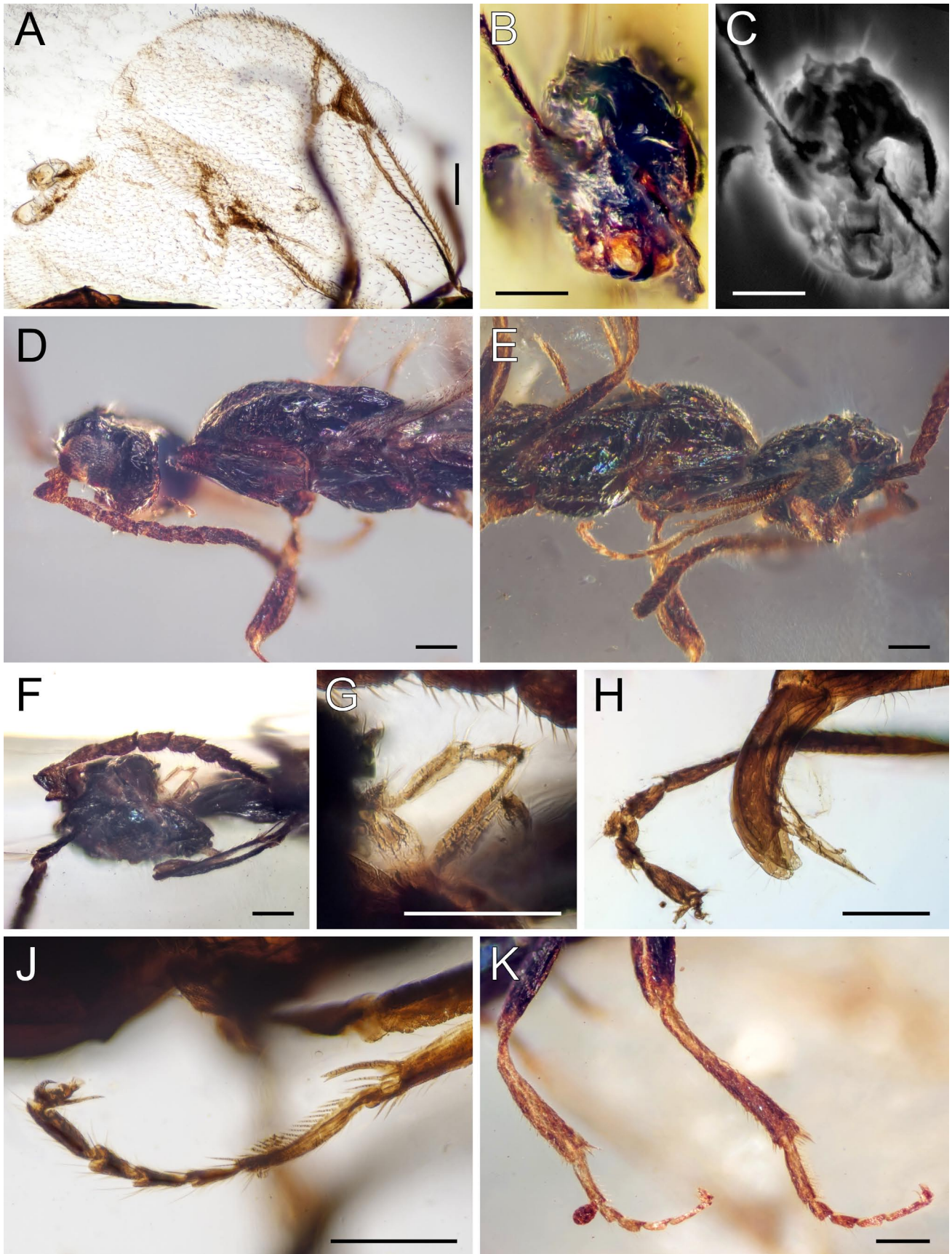


FIGURE 2. *Cresogmus grimaldii* Rasnitsyn & Kolyada **gen. et sp. nov.**, holotype. **A**, Wings. **B**, **C**, Head, frontal view (**C**: confocal scan). **D**, **E**, Lateral view of mesosoma showing pronotum with netrion. **F**, Head, ventral view. **G**, Maxillary palp. **H**, Ovipositor and hind tarsus. **J**, Fore tarsus. **K**, Mid and hind tibiae and tarsi. Scale bars = 0.1 mm.

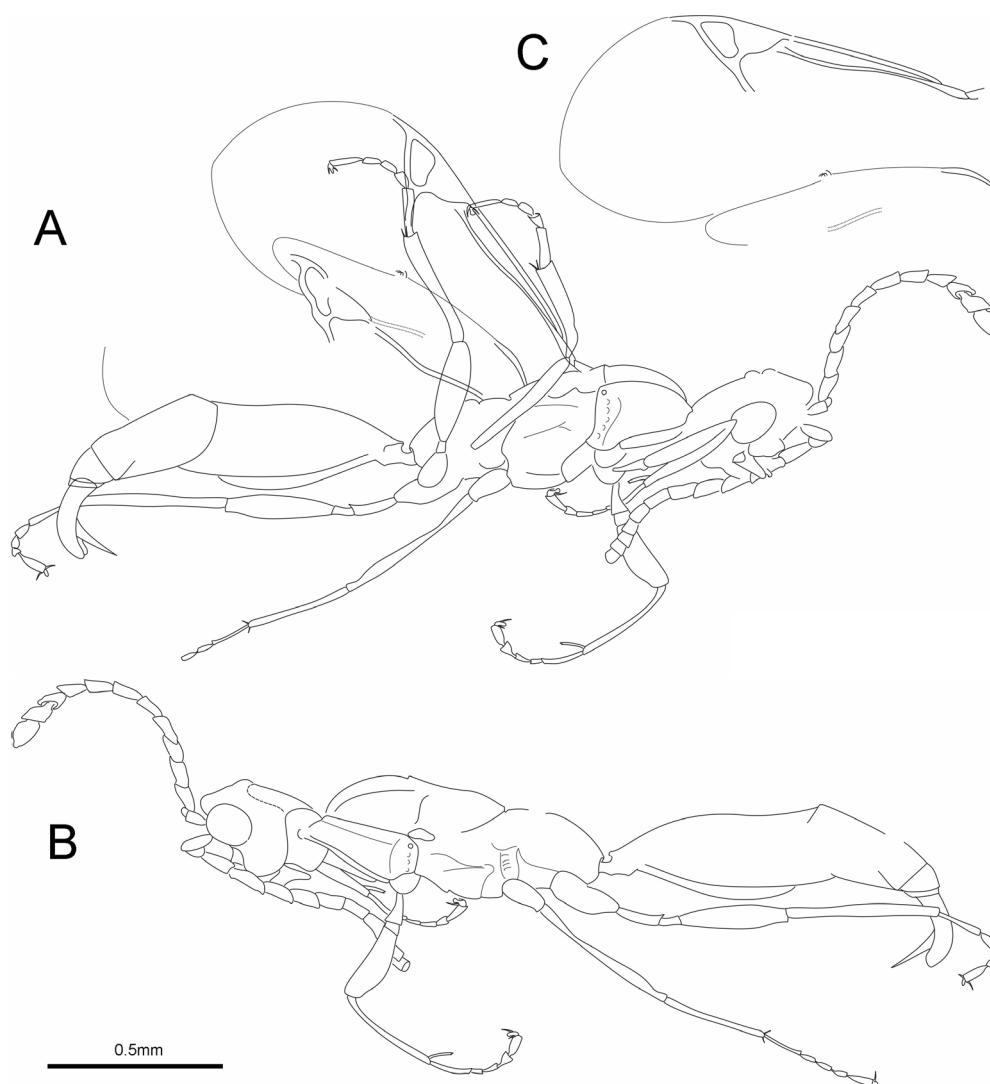


FIGURE 3. *Cresogmus grimaldii* Rasnitsyn & Kolyada **gen. et sp. nov.**, holotype, interpretation. **A**, Right aspect. **B**, Left aspect. **C**, Wings.

used. The specimen was imaged with the combination of brightfield and incident illumination. Stacks of images, comprising multiple focal planes, were obtained with Olympus OM-D E-M10II camera. To additionally resolve the details of the head a confocal scanning was performed using a Zeiss LSM-880 microscope with a 488 nm laser excitation and detection in the range 500–700 nm. However, the fossil's exoskeleton did not show significant autofluorescence. Helicon Focus Pro 64 was used to stack photos for better depth of field. Line drawings were done using image-editing software (CorelDraw, 2019 and Adobe Photoshop CS2) on the basis of digital photographs. The resulting original stacks are available through Figshare (DOI: 10.6084/m9.figshare.20056118). All taxonomic acts established in the present work have been registered in [zoobank.org:pub:858705C2-A228-4B58-BA72-2919AA741F8A](https://zoobank.org/pub:858705C2-A228-4B58-BA72-2919AA741F8A)

Systematic palaeontology

Order Hymenoptera Linnaeus, 1758

Superfamily Proctotrupeoidea Latreille, 1802

Family Proctotrupidae Latreille, 1802

Subfamily Proctotrupinae Latreille, 1802

Tribe Disogmini Kozlov, 1970

Genus *Cresogmus* Rasnitsyn & Kolyada **gen. nov.**

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Type species. *Cresogmus grimaldii* Rasnitsyn & Kolyada **sp. nov.**; by present designation.

Species included. Type species only.

Etymology. The genus name is composed from truncated Cretaceous and generic name *Disogmus*. Gender masculine.

Diagnosis. Female (male unknown). Unlike *Disogmus* Foerster, 1856 (based on its diagnosis by Townes & Townes, 1981), the type and only other genus of Disogmini, occipital carina extending to lower half of head, pronotum lacking epomia and respective tubercles, mesopleuron with horizontal groove weak, incomplete anteriorly. Pterostigma short ($1.7\times$ as long as wide), with 2r-rs only slightly behind its midlength, cell 3r along wing margin $0.75\times$ as long as pterostigma, petiole open but very short, ovipositor wide and bent throughout, with apex widely rounded.

Remarks. Because of imperfect preservation state of the only specimen available, many relevant characters are not visible, and the diagnosis is incomplete. This particularly concerns integument sculpture and vestiture, traces of syntergum segmentation, etc.

Attribution of the new genus to the subfamily Proctotrupinae (and not to Austroserphinae) is based on reduced wing venation (no M+Cu, veins M, Cu and A present) and scape lacking a dorsal, apical spine. It is further referred to Disogmini (rather than to Proctotrupini, Cryptoserphini, or Nothoserphini) because the distance of mesosomal articulation of hind coxa to that of mid coxa is three times or more as long as its distance to metasomal articulation. This is a reliable character of Disogmini to distinguish them from other tribes of Proctotrupinae that have this distance significantly shorter.

***Cresogmus grimaldii* Rasnitsyn & Kolyada sp. nov.**

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Holotype. Female, PIN no. 5620/144, complete but somewhat distorted (laterally compressed and otherwise deformed) insects with integuments degraded, surface sculpture modified and not well visible.

Etymology. The species is named to honor David Grimaldi.

Diagnosis. As for genus.

Locality and horizon. Hukawng Valley, Kachin State, Myanmar; mid-Cretaceous.

Description. General color dark fuscous, with antennae, knees, tibiae, tarsi and ovipositor sheaths less dark. Surface sculpture distorted and difficult to reliably describe.

Head form somewhat distorted, as preserved longer than high and wide, with eyes rather small, subcircular, weakly convex, in lateral view distant from hind head margin for almost eye length, with two hind ocelli visible distant from all eyes, antennal bases, hind head margin and from each other. Occipital carina low but distinct along all hind head margin visible. Antennal attachments distinctly apart from each other, margined with small ridges medioventrally, distant from both eyes and clypeus.

Clypeus rectangular, slightly wider than long, with fore and, partially, lateral sides margined, with fore margin slightly emarginate. Antenna with scape longer than other antennomeres, pedicel hardly visible, flagellum apparently widened apically (unless due to compression); length ratio of antennomeres (very tentatively because of deformation, possibly uneven, and improper position in amber) $1:0.2:0.7:0.7:0.7:0.7:0.7:0.7:0.65:0.55:0.55:0.8$. Labrum, if correctly identified, long, wide, with narrow base. Mandible of usual proctotrupine form (short sickle-like with sharp apex). Maxillary palp with five long, narrow segments visible.

Pronotum moderately long medially on fore declivity of mesosoma, with spiracle at its surface near to its upper and hind margins, with impressed posterior area with vertical row of several (apparently 5) tubercles and imperfectly visible subvertical crease outlining possible rudiment of netrion (= postspiracular sclerite *sensu* Rasnitsyn, 1980: 86 and Shcherbakov, 1980; = interpleurite, prepectus *sensu* Gibson, 1993). Notauli percurrent, wide, with no distinct signs of being transcostate; scutellum long, with prescutellar fossa(e) not well visible; metanotum long, weakly convex in side view, with slit (hidden metapostnotum) delimiting it with propodeum; propodeum evenly, gently arching down to metasomal base, extending behind hind coxal attachment for near half hind coxa length. Propleura not well visible, mesopleuron with transverse groove apparently distinct in hind half and fan-like widened before, apparently with no other gross sculpture; metapleuron apparently longitudinally costate in fore half, propodeal sculpture not clear; distance of mesosomal articulation of hind coxa to that of mid coxa three times that to metasomal articulation. Legs apparently thin (deformed by compression), with tibiae apparently subequal or slightly longer than respective femora, and tarsi apparently so in respect to their tibiae (varying at figures because of deformation and improper position in amber); trochantelli delimited, tibial spurs $1:2:2$, each pair of subequal length, basitarsus subequal to three mid tarsomeres combined, tarsomeres 3 and 4 of similar lengths, claw thin, simple, gently curved, arolium slightly longer than claw; fore tibial spur evenly slightly bent, bifid apically; fore basitarsus slightly excised almost over all its length, with row of 13 erect setae of subequal length along excision.

Forewings somewhat deformed (particularly left one), with only C, R, 2r-rs and RS behind and shortly before 2r-rs tubular, with only cells c and 3r closed, pterostigma semicircular, with 2r-rs slightly behind its middle, 2r-rs about twice as long as wide, RS before 2r-rs about as long as 2r-rs as tubular, further continuing as nebulous for similar distance; cell 3r as long as pterostigma ($0.75\times$ so along wing margin), C extending shortly behind 3r apex. Hind wing with only C+R tubular for distance equal

to length of pterostigma and with distinct but colorless section of anal vein near wing midlength, with three hamuli, one (basal) gently bent and two hook-like.

Metasoma long, with petiole short but distinct, syntergum taking half of its visible length, following three terga (one elongate, another almost as long as high, third very short in lateral view), all lacking visible sculpture, spiracles, traces of fusion and other important features; ovipositor sheaths evenly wide except apically, strongly, evenly bent down except in basal third, widely rounded apically. Ovipositor extending subapically (a deformation occurring sometimes with encasement in resin as well as with alcohol storage: normally ovipositor protrudes only between apices of sheaths; Townes & Townes, 1981: 8), with apex very thin, sharp, bearing traces of oblique notch.

Measurements (in mm, tentative because of deformations). Body length (without antennae and ovipositor) 2.15, head length 0.36, antenna length *ca.* 1, mesosoma length 0.8, height 0.31, forewing length 1.2, width 0.57, fore femur length 0.3, tibia 0.32, tarsus 0.31, mid femur 0.35, tibia 0.31, tarsus 0.36, hind femur 0.31, tibia 0.44, tarsus 0.33, dorsal length of syntergum and visible free terga 0.61, 0.33, 0.11, 0.02, length of ovipositor sheath 0.23, width at midlength 0.05.

Discussion

The most enigmatic feature of the fossil record of Proctotrupidae is their total (prior to the present exceptional find and a simultaneous record in the Lebanese amber; Engel *et al.*, 2022) absence from any Cretaceous fossil resins that yielded a rich crop of other parasitic Hymenoptera measured in hundreds or thousands of fossils ranging in age from Barremian to Campanian, that is, covering most of the Cretaceous Period except for its beginning (Berriasian–Hauterivian) and very end (Maastrichtian). The reason of this absence is totally enigmatic, for proctotrupid inclusions occur in Cenozoic ambers and in modern resins (Kolyada & Mostovski, 2007; Zherikhin *et al.*, 2009; Kolyada & Perkovsky, 2011, and references therein).

Biogeographically, the present find is not exceptional because the Cretaceous Proctotrupidae had apparently a very wide distribution, being recorded abundantly in Eurasia from England to China (Rasnitsyn *et al.*, 1998; Zhang & Zhang, 2001) and also found in Australia (Rasnitsyn & Öhm-Kühnle, 2019), and Brazil (Darling & Sharkey, 1990). Biologically, it implies little news as well for the closest living genus *Disogmus* presumably parasitizes the larvae of Sciaridae (Sciaroidea, Diptera) (Townes & Townes, 1981), a family that is widespread

as fossils and is recorded in the Burmese amber as well (Ross, 2019).

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