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An aberrant colydiine-like tenebrionoid beetle from mid-Cretaceous Burmese amber (Coleoptera: Tenebrionoidea: Zopheridae)

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Abstract

A new fossil species of the superfamily Tenebrionoidea, *Coslonatus rasnitsyni* **gen. et sp. nov.**, is described and illustrated from the mid-Cretaceous Burmese amber. The new genus is tentatively placed in the extant subfamily Colydiinae (Zopheridae) based primarily on the 4-segmented tarsi, clubbed antennae, and all freely connected abdominal ventrites. *Coslonatus* is unique in Colydiinae in having dorsally located antennal insertions and markedly long antennae, suggesting a unique ecological niche of the new species.

Keywords: Zopheridae, Colydiinae, fossil, Cretaceous, Burmese amber

Introduction

Tenebrionoidea is one of the largest superfamilies in the beetle suborder Polyphaga, with about 29 families and over 30,000 described species (McKenna *et al.*, 2019; Cai *et al.*, 2021). Tenebrionoids are basically characterised by 5-5-4 tarsal formula in both sexes, femur obliquely attached to trochanter, hind wing with no more than four veins in the medial field, and a tenebrionoid-type aedeagus, although these characters are often secondarily modified in some lineages (Lawrence & Ślipiński, 2013). Within Tenebrionoidea, Zopheridae is a moderately diverse family, with two subfamilies, Zopherinae and Colydiinae generally recognised. Historically, Colydiinae was treated as an independent family (Colydiidae). Based on a morphological phylogenetic analysis, Ślipiński & Lawrence (1999) united Colydiidae and Zopheridae, as well as Monommatidae, into a broadly defined Zopheridae.

The close relationship between the former Colydiidae and Zopheridae is further supported by molecular evidence (McKenna *et al.*, 2015, 2019; Cai *et al.*, 2021), while the Monommatidae might be an isolated group (McKenna *et al.*, 2015).

The taxonomy of Colydiinae has not been adequately explored (*e.g.*, Ivie *et al.*, 2016; Lord & Ivie, 2016; Leschen & Lord, 2017). Currently eight tribes are recognised in Colydiinae, with the majority of genera placed in the poorly defined Sychitini (Ślipiński & Burakowski, 1988; Ivie *et al.*, 2016), which is unlikely to be monophyletic and requires further revisions (Cheng *et al.*, 2020).

The fossil record of Colydiinae is relatively sparse, with all pre-Quaternary fossils discovered from amber deposits (as listed in Bullis, 2020). The earliest colydiine fossils were reported from mid-Cretaceous Burmese amber, represented by four genera and eight species (Deng *et al.*, 2017; Haiva, 2019; Bullis, 2020; Cheng *et al.*, 2020; Poinar & Vega, 2020). In this study, we report an unusual form of tenebrionoid beetles from Burmese amber, which is tentatively placed in Colydiinae.

Material and methods

The Burmese amber specimen studied herein (Figs 1–4) originated from amber mines near Noije Bum (26°20' N, 96°36' E), Hukawng Valley, Kachin State, northern Myanmar. The type specimen is deposited in the Nanjing Institute of Geology and Palaeontology (NIGP), Chinese Academy of Sciences, Nanjing, China. The amber piece was trimmed with a small table saw, ground with emery paper of different grit sizes, and finally polished with polishing powder.

Photographs under incident light were taken with a Zeiss Discovery V20 stereo microscope. Widefield fluorescence images were captured with a Zeiss Axio Imager 2 light microscope combined with a fluorescence imaging system. Confocal images were obtained with a Zeiss LSM710 confocal laser scanning microscope, using the 488 nm Argon laser excitation line. Images under incident light and widefield fluorescence were stacked in Helicon Focus 7.0.2 or Zerene Stacker 1.04. Confocal images were stacked with Helicon Focus 7.0.2. Images were further processed in Adobe Photoshop CC to enhance contrast.

Systematic palaeontology

Order Coleoptera Linnaeus, 1758

Superfamily Tenebrionoidea Latreille, 1802

Family Zopheridae Solier, 1834

Subfamily Colydiinae Erichson, 1842

Genus *Coslonatus* Li & Cai gen. nov.

Type species. *Coslonatus rasnitsyni* sp. nov.

Etymology. The generic name is an anagram of “*Lascotonus*”, a genus in Colydiinae. The name is masculine in gender.

Diagnosis. Head dorsally with a pair of longitudinal protuberances. Antennal insertions dorsally located.

Antennae 11-segmented, long, almost reach elytral apex; antennomeres 9–11 short, asymmetrical, forming a club. Pronotal disc quadrate, with a pair of longitudinal elevated platforms. Procoxae countersunk, concealed by raised prosternal process. Each elytron with five subtle carinae (including sutural carina). Tarsi 4-4-4; tarsomeres 1–3 combined shorter than tarsomere 4. Abdomen with five free ventrites, separated by deep and broad grooves.

Coslonatus rasnitsyni Li & Cai sp. nov.

(Figs 1–4)

Material. Holotype, NIGP177330, crazed and probably wrinkled during fossilisation.

Etymology. The species is named for Prof. Alexander P. Rasnitsyn, a well-known Russian palaeoentomologist.

Locality and horizon. Amber mine located near Noije Bum Village, Tanai Township, Myitkyina District, Kachin State, Myanmar; unnamed horizon, mid-Cretaceous, Upper Albian to Lower Cenomanian.

Diagnosis. As for the genus.

Description. Body elongate, parallel-sided, 1.93 mm long, 0.54 mm wide, covered with distinct setae.

Head (Fig. 4A, B) prognathous, without distinct neck; dorsal surface with a pair of longitudinal protuberances. Compound eyes lateral, entire, with short interfacetal setae. Antennal insertions dorsally located (Fig. 4A), separated by less than twice diameter of antennomere 1. Antennae 11-segmented, long, almost reaching elytral apex when posteriorly directed; antennomere 1 long and



FIGURE 1. General habitus of *Coslonatus rasnitsyni* gen. et sp. nov., holotype, NIGP177330, under incident light. A, Dorsal view. B, Ventral view. Scale bars: 500 µm.

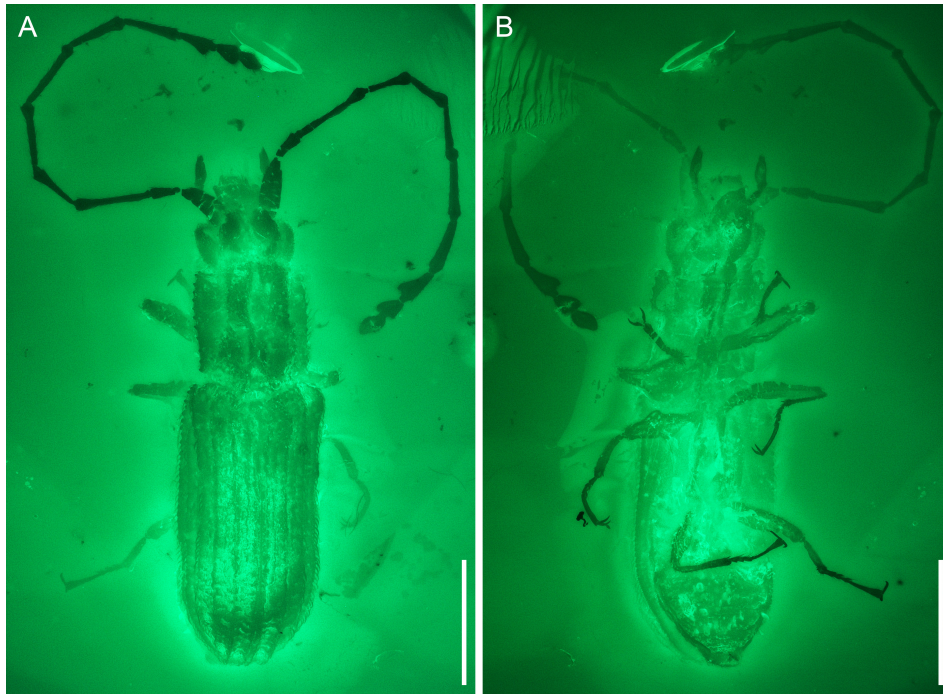


FIGURE 2. General habitus of *Coslonatus rasnitsyni* **gen. et sp. nov.**, holotype, NIGP177330, under widefield fluorescence. **A**, Dorsal view. **B**, Ventral view. Scale bars: 500 μ m.

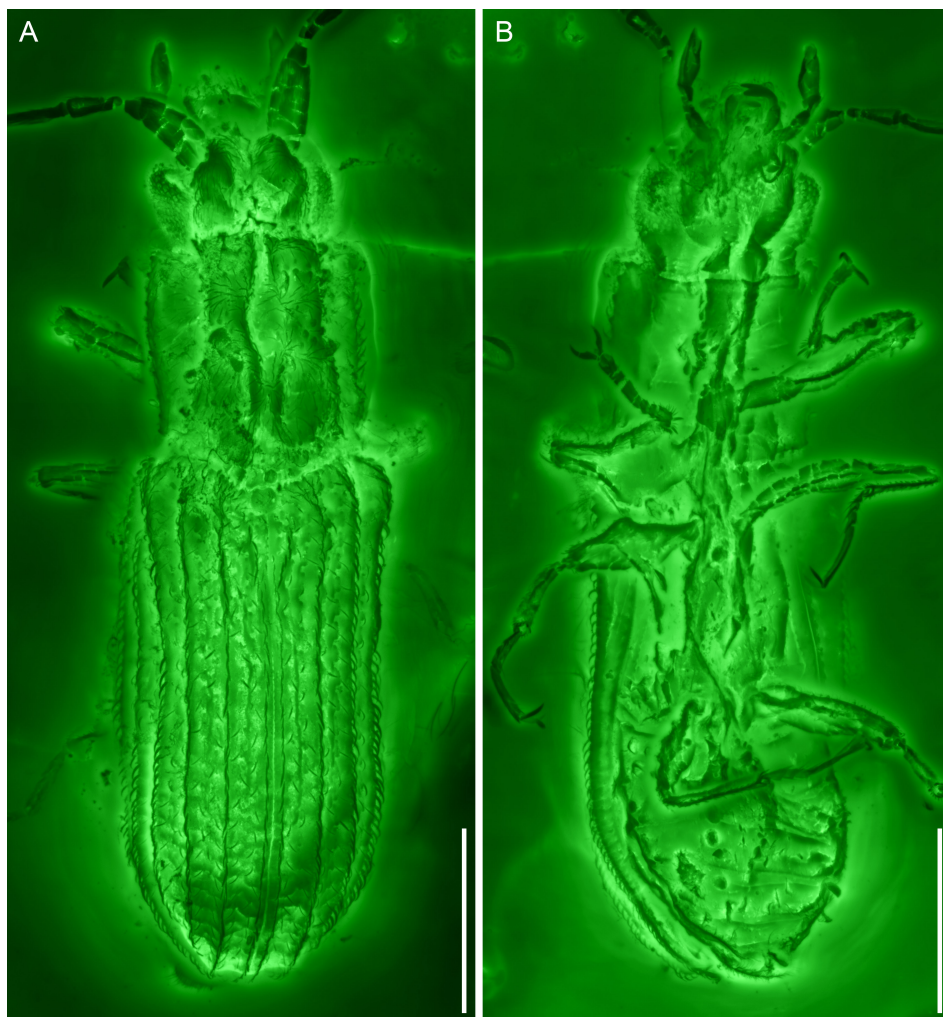


FIGURE 3. General habitus of *Coslonatus rasnitsyni* **gen. et sp. nov.**, holotype, NIGP177330, under confocal microscopy. **A**, Dorsal view. **B**, Ventral view. Scale bars: 400 μ m.

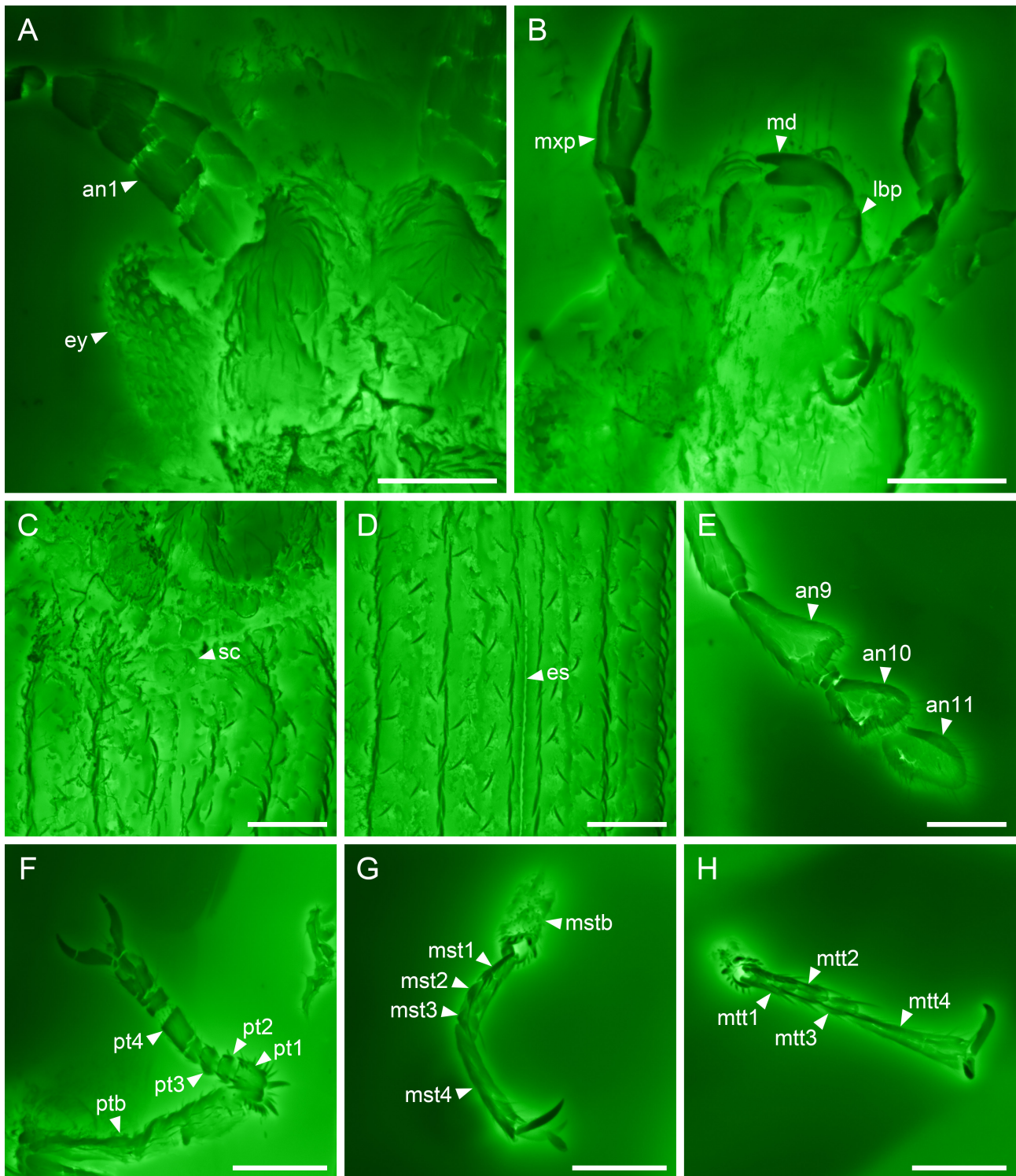


FIGURE 4. Details of *Coslonatus rasnitsyni* **gen. et sp. nov.**, holotype, NIGP177330, under confocal microscopy. **A**, Head, dorsal view. **B**, Mouthparts, ventral view. **C**, Elytral base, dorsal view. **D**, Middle portion of elytra, dorsal view. **E**, Antennal club, ventral view. **F**, Protarsus, ventral view. **G**, Mesotarsus, ventral view. **H**, Metatarsus, ventral view. Abbreviations: an1,9–11, antennomeres 1,9–11; es, elytral suture; ey, compound eye; lbp, labial palp; md, mandible; mst1–4, mesotarsomeres 1–4; mstb, mesotibia; mtt1–4, metatarsomeres 1–4; mttb, metatibia; mxp, maxillary palp; pt1–4, protarsomeres 1–4; ptb, protibia; sc, scutellum. Scale bars: 100 μ m.

wide; antennomere 2 shorter; antennomere 3–8 elongate; antennomeres 9–11 short, asymmetrical (serrate in 9–10), forming a club (Fig. 4E). Mandibles apically with two vertically arranged teeth (Fig. 4B). Maxillary palps

relatively long; apical palpomere fusiform. Labial palps present; apical palpomere cylindrical.

Pronotal disc quadrate; lateral margins straight, denticulate; anterior and posterior angles right-

angled; surface with a pair of longitudinal elevated platforms. Hypomera without antennal grooves or impressions. Notosternal sutures not evident, probably absent. Prosternal process raised. Procoxae seemingly countersunk, concealed by prosternal process.

Scutellar shield (Fig. 4C) with anterior margin slightly emarginate; posterior margin rounded. Elytra elongate, parallel-sided; each with five subtle carinae (including sutural carina); scutellar striole present. Mesocoxae longer than wide; separated by approximately width of mesocoxae. Mesocoxal cavities not evident, probably closed laterally. Metacoxae separated by intercoxal process.

Tibiae with two spurs. Tarsi 4-4-4 (Fig. 4F–H); tarsomeres 1–3 similar in form, together shorter than tarsomere 4. Pretarsal claws simple.

Abdomen with five ventrites, separated by wide and deeply impressed sutures.

Discussion

Colydiinae is a diverse and morphologically heterogeneous group, which is extremely difficult to delimit based on a fixed set of morphological characters (*e.g.*, Ślipiński & Lawrence, 1997, 1999; Lord & Leschen, 2014; Ivie *et al.*, 2016). Also, the internal relationships among subtaxa within Colydiinae are not clear, partly due to the frequent presence of convergent evolution in characters (Ślipiński & Lawrence, 1999). Some recently described colydiine (Zopheridae) fossils from Burmese amber further revealed combinations of characters unknown in any extant colydiines (Deng *et al.*, 2017; Cheng *et al.*, 2020), making the classification of zopherids more complicated.

It is even more difficult to determine the precise systematic placement of *Coslonatus*. The ventral thoracic structures, especially the prothoracic features, are crucial for the classification of Colydiinae (Ivie *et al.*, 2016), which, however, cannot be reliably determined due to the presence of creases and cracks on the specimen, which are apparently taphonomic artefacts in some amber fossils. The placement of *Coslonatus* within Colydiinae is supported by the 4-4-4 tarsal formula, clubbed antennae, and all freely connected abdominal ventrites. However, these characters have also evolved convergently in other tenebrionoid groups (Ivie *et al.*, 2016). Thus, a colydiine assignment of *Coslonatus* here largely relies on the overall habitus, which is only tentative and pending further discovery of better-preserved fossils and comprehensive phylogenetic studies.

Coslonatus is unique in Colydiinae (and in the whole Zopheridae) in having very long antennae, which extend almost to the elytral apex when posteriorly stretched. In most colydiines, the antennae do not reach

the elytral base when posteriorly directed. Though in a few cases the antennae may extend slightly beyond the elytral base (*e.g.*, *Atyscus* Pascoe), the flagellomeres are never distinctly elongate. Besides, the antennal insertions of colydiines are normally widely separated, and are concealed in dorsal view, while the antennal insertions are more dorsally located and more narrowly separated (by less than twice the diameter of antennomere 1) in *Coslonatus*. The antennal shape and length are strongly linked to the ecological and behavioural adaptation of insects (Elgar *et al.*, 2018). Therefore, if *Coslonatus* truly belongs to Colydiinae, the slender antennae may suggest that the Cretaceous colydiines had once occupied a broader ecological niche than today.

Data availability

The original confocal data are available in Zenodo repository (<https://doi.org/10.5281/zenodo.5589011>).

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