

# First fossil thaneroclerid beetle from mid-Cretaceous Burmese amber (Coleoptera: Cleroidea: Thanerocleridae)

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Thanerocleridae is a small family of Cleroidea with no fossil representatives to date. Here we describe and figure the first fossil representative of Thanerocleridae, *Cretozenodosus fossilis* gen. et sp. nov., from the mid-Cretaceous amber of northern Myanmar. *Cretozenodosus* is referred to the extant subfamily Zenodosinae as evidenced by its open procoxal cavities and transverse procoxae. *Cretozenodosus* has close affinities with the North American *Zenodosus* Wolcott, suggesting that modern Zenodosinae is probably a relict group. Our discovery of a new thaneroclerid genus from Burmese amber suggests that Thanerocleridae originated no later than the mid-Cretaceous.

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WITH THIRTY-THREE described species assigned to nine genera, the beetle family Thanerocleridae is one of the least species-rich groups of the polyphagan superfamily Cleroidea (Kolibáč & Leschen 2010, Kolibáč 2012). Although there are no autochthonous thaneroclerids known from the temperate zone of South America and Europe, their geographic distribution is more or less worldwide (Kolibáč 1992, 1998, Kolibáč & Leschen 2010). The biology of the extant Thanerocleridae is poorly known owing to their rarity, but all known thaneroclerids appear to be predatory (Kolibáč & Leschen 2010, Kolibáč 2012). The group was not assigned a family rank until Kolibáč (1992) treated Thaneroclerinae as the most advanced family within the thaneroclerid branch of Cleroidea, which also contains Chaetosomatidae and Metaxinidae (Kolibáč 2004, Kolibáč & Leschen 2010, Bouchard *et al.* 2011). However, the classification was not followed by Lawrence & Newton (1995) and Opitz (2002). Later, Opitz (2010) proved conclusively that the Thaneroclerinae is part of Cleridae. Currently, Thanerocleridae comprises two extant subfamilies: Zenodosinae Kolibáč and Thaneroclerinae Chapin (Bouchard *et al.* 2011). The latter subfamily includes two tribes as recently indicated by Kolibáč (2012): Isoclerini Kolibáč and Thaneroclerini Chapin.

To date, no fossils belonging to Thanerocleridae have been documented. The origin and early diversification of this small family remain elusive. Here, we describe a new genus and species of Thanerocleridae based on a very well-preserved adult in Upper Cretaceous Burmese amber from northern Myanmar.

## Material and methods

The new species is known from one individual (adult) preserved in a transparent piece of Burmese amber. Burmese amber has been known as a valuable source of specimens of various groups of organisms for over a century. Diverse fossilized organisms have been described, such as fungi, conifers, angiosperms, nematodes, birds, dinosaurs, onychophorans, spiders, ticks and especially insects (e.g., Grimaldi *et al.* 2002, Ross *et al.* 2010). The specimen is derived from amber deposits in the Hukawng Valley of northern Myanmar, currently considered to be earliest Cenomanian in age (*ca* 99 Ma; see details provided by Shi *et al.* 2012). The amber piece has been prepared, including cutting with a hand saw and polishing with sandpapers of various grainsizes and with polishing powder. The type specimen is housed in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China. Observations and photographs were taken using a Zeiss Axio Imager 2 compound microscope with a digital camera attached. Photomicrographs with a green background were taken using green

fluorescence as a light source attached to a Zeiss Axio Imager 2 compound microscope.

## Systematic palaeontology

Order COLEOPTERA Linnaeus 1758

Family THANEROCLERIDAE Chapin 1924

Subfamily ZENODOSINAE Kolibáč 1992

**Cretozenodosus** gen. nov.

*Type species. Cretozenodosus fossilis* sp. nov.

*Etymology.* The genus-group name is a combination of ‘Cretaceous’ and ‘Zenodosus’; it is masculine in gender.

*Diagnosis.* The new genus can be separated from other thaneroclerid genera by the following combination of characters: body small (less than 3 mm long); head strongly declined; antennae 11-segmented, with loose, 3-segmented club; pronotum constricted at base, with prebasal carina, without dorsal depressions; pronotal margins completely carinate; sides of elytra sub-parallel, elytral humeral angles sub-orthogonal; and meso- and metatarsi elongate.

*Description.* Body small (*ca.* 2.65 mm long; Fig. 1), elongate and strongly flattened (Fig. 2A), densely pubescent with long setae (Fig. 2C). Pronotum and elytra regularly punctate. Head strongly declined (Fig. 2A), without temples. Eyes located anteriorly. Antennal insertions not covered by edge of frons. Antennae 11-segmented; apical three antennomeres forming loose three-segmented club (Fig. 3A). Mandibles large and robust, apparently with two subapical teeth. Maxillary palpi with terminal palpomere elongate, with apex truncate. Pronotum elongate, constricted at base; lateral

margin of pronotum distinctly bisinuate, carinate (Fig. 2E). Prosternal process very narrow. Procoxal cavities strongly transverse, narrowly separated; externally open (Fig. 2E); postcoxal process subtriangular (Fig. 2E). Procoxae slightly transverse. Protochantans exposed. Hypomeron without transverse depression. Postcoxal process subtriangular, not meeting prosternal process. Mesocoxae projecting. Mesocoxal cavities circular and narrowly separated, closed laterally. Mesometaventral junction simple. Metaventrite flattened; discrimen present (Fig. 2D). Metacoxae narrowly separated and extending laterally to meet sides of body (Fig. 2D). Elytra elongate; anterior part of lateral margins sub-parallel (Fig. 2B). Epipleural ridges developed; epipleura narrow, narrowed in posterior half. Hind wings, if present, not visible. Legs long, setose; trochanters triangular; tibiae without marginal spines, with two spurs and numerous spines at tibial apex. Tarsal formula 5–5–5 (Figs 2F, 3B, C); protarsi with basal four tarsomeres consolidated into an oval setose ventral cluster (Fig. 2F); tarsomere 5 slightly longer than tarsomeres 1–4 combined (Figs 3B, C). Pretarsal claws simple, without teeth (Fig. 2G). Empodium bisetose, distinctly projecting (Fig. 2G). Abdomen with five visible ventrites; intercoxal process small and sharp; ventrites distinctly margined.

*Remarks.* *Cretozenodosus* can be confidently placed in the small extant cleroid family Thanerocleridae based on the following combination of morphological characters: 1, tarsal formula 5–5–5, with basal four pretarsomeres compacted and consolidated into an oval setose ventral cluster (or setal mat); and 2, the presence of a prebasal carina on the pronotum (Opitz 2010). Further, *Cretozenodosus* is tentatively attributed to the extant

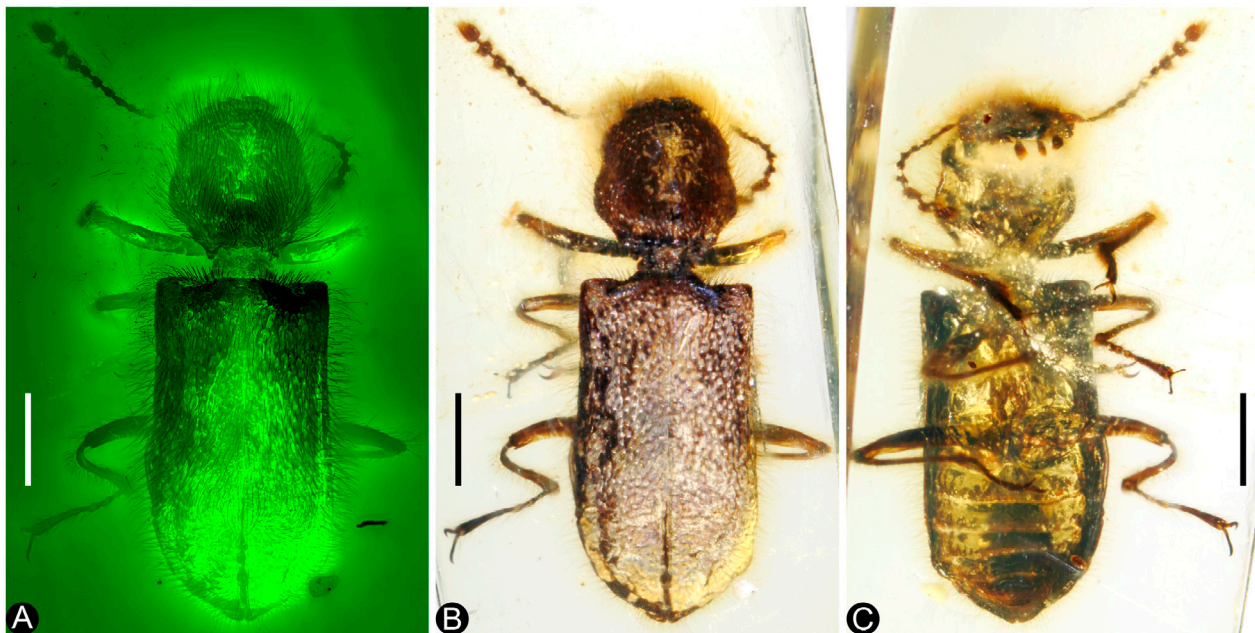


Fig. 1. Photomicrographs of holotype (NIGP166237) of *Cretozenodosus fossilis* gen. et sp. nov. in mid-Cretaceous amber from Myanmar. A, Using fluorescence microscopy; B and C, Under normal reflected light. A and B, Dorsal view; C, Ventral view. Scale bars = 500  $\mu$ m.



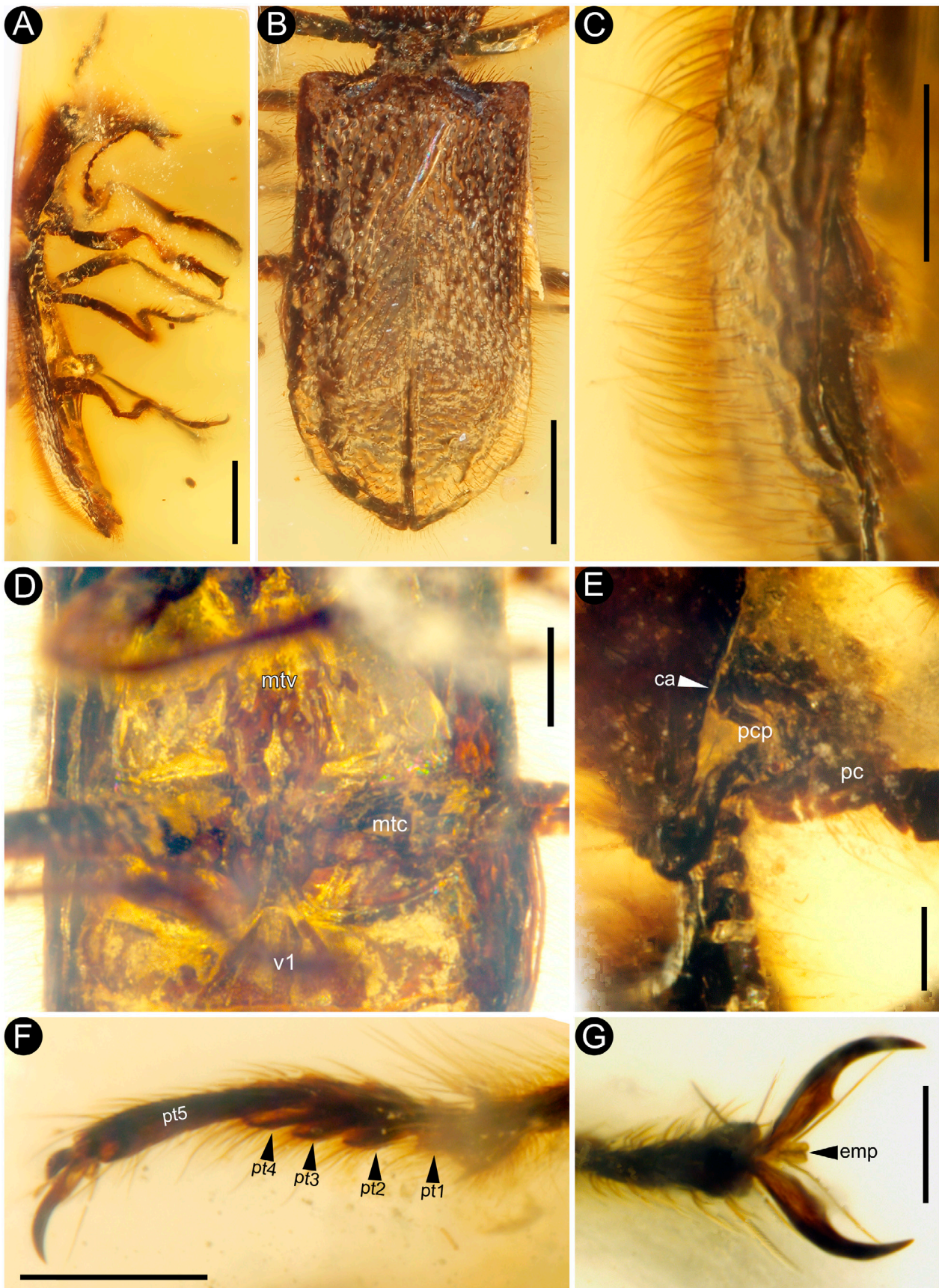


Fig. 2. Morphological details of *Cretozenodosus fossilis* gen. et sp. nov. (NIGP166237) in mid-Cretaceous amber from Myanmar, under normal reflected light. **A**, Lateral view; **B**, Elytra; **C**, Long and dense setae on right elytron, lateral view; **D**, Metathorax and base of abdomen; **E**, Lateral view of prothorax; **F**, Dorsolateral view of left protarsus; **G**, Pretarsal claw of left hind leg. ca, carina; emp, empodium; mtc, metacoxa; mtv, metaventrite; pc, procoxa; pcp, postcoxal process; pt1–5, protarsomeres 1–5; v1, ventrite 1. Scale bars = 500  $\mu$ m in **A** and **B**; 200  $\mu$ m in **C**, **D** and **F**; 100  $\mu$ m in **E** and **G**.



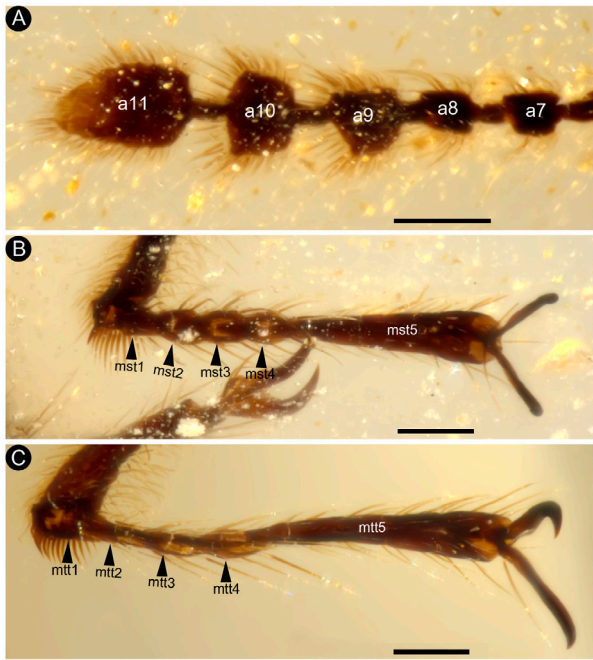


Fig. 3. Enlargements of *Cretozenodosus fossilis* gen. et sp. nov. (NIGP166237), under normal reflected light. A, Apical antennomeres of left antenna; B, Left mesotarsus, ventral view; C, Left metatarsus, ventral view. a7–11, antennomeres 7–11; mst1–5, mesotarsomeres 1–5; mtt1–5, metatarsomeres 1–5. Scale bars = 100  $\mu$ m.

small subfamily Zenodosinae as evidenced by its posteriorly open procoxal cavities and transverse procoxae (Kolibáč 1992). *Cretozenodosus* differs from *Zenodosus* by its very small body size (ca 2.7 mm in *Cretozenodosus* vs ca 5.0 mm in *Zenodosus*), loose antennal club, much longer meso- and metatarsi, pronotal shape and, more importantly, carinate pronotal margins.

#### *Cretozenodosus fossilis* sp. nov. (Figs 1–3)

**Etymology.** The specific epithet refers to the fact that it is a fossil species.

**Material.** Holotype, NIGP166237; deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China.

**Locality and stratigraphic position.** Near Tanai, Hukawng Valley, northern Myanmar; lower Upper Cretaceous (lowermost Cenomanian).

**Diagnosis.** Body small (ca 2.65 mm long); antennomere 9 subquadrate, antennomere 10 slightly transverse; pretarsal claws long.

**Description.** Body small (ca 2.65 mm long; measured from anterior margin of head to abdominal apex); unicolour, dark brown throughout the body; dorsum covered with long, dense and erect setae. Head setose; mandibles large, with wide base and sharp apex, apparently with two obtuse preapical teeth. Antennae long; antennomere 1 broad and elongate, with dense long setae; antennomere 2 much shorter and narrower than

antennomere 1; antennomere 3 longer than antennomere 2; antennomeres 3–7 each longer than wide; antennomere 8 slightly smaller than antennomeres 7 and 9; antennomere 9 much larger than antennomere 8; antennomere 10 slightly wider than antennomere 9; antennomere 11 conical. Pronotum slightly wider than head, widest at posterior third, about 0.78 mm wide and 0.76 mm long; strongly narrowed from posterior third towards pronotal base. Elytra slightly broader than pronotum, each about 0.47 mm wide and 1.71 mm long; punctures on elytra dense and coarse. Legs long, densely setose, protarsi short; mesotarsi longer than protarsi; metatarsi longest; pretarsal claws very long, curved, sharp at apex; empodium elongate, with two long setae. Abdomen with five visible ventrites; ventrite 1 longest, with sharp anterior process between metacoxae; ventrite 2 shorter than ventrite 1; ventrites 3 and 4 shorter than ventrite 2, almost in same length; ventrite 5 longer than ventrite 4, broadly rounded apically, without emargination.

## Discussion

Currently, the subfamily Zenodosinae includes a single extant genus and species, *Zenodosus sanguineus* (Say, 1835), distributed in southeastern Canada and the eastern, central and southern United States, and the species has been considered to be the plesiomorphic member of Thanerocleridae (Kolibáč 1992, Kolibáč & Leschen 2010). As in *Zenodosus*, the extinct *Cretozenodosus* has maintained many plesiomorphic features in adults, such as the open procoxal cavities and transverse procoxae. In addition, *Cretozenodosus* bears completely carinate pronotal margins, which probably represent another ancestral character for the Thanerocleridae. Our discovery of a fossil belonging to Zenodosinae from northern Myanmar suggests that the modern distribution of the subfamily is likely relictual, and Zenodosinae was probably more widespread in the mid-Cretaceous (ca 100 Ma) than it is at present.

Since no fossil Thanerocleridae were known previously, the new discovery of a 100-million-year-old thaneroclerid beetle is undoubtedly of great significance for understanding the origin and early diversification of Thanerocleridae, and even for the superfamily Cleroidea. It suggests that Thanerocleridae originated no later than the mid-Cretaceous, which is congruent with a recently published molecular-dated phylogeny of the family (Toussaint *et al.* 2017). Additionally, these data are important for age calibration of coleopteran phylogenetic trees in future.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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