

ORIGINAL RESEARCH



## A New Genus of Cylindrical Bark Beetle (Coleoptera: Zopheridae: Colydiinae) in mid-Cretaceous Burmese Amber

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### ABSTRACT

A bizarre cylindrical bark beetle from mid-Cretaceous Burmese amber is described as *Stegastochlidus saraemcheana*, a new genus and species in the subfamily Colydiinae of the family Zopheridae. The male beetle is characterized by elongate protuberances covering its entire dorsal surface, a tarsal formula of 4-4-4 and ten-segmented antennae with the terminal segment expanded into a small club. The fossil is considered to have been a possible predator that lived among moss, lichens and fungi either attached to trees trunks or on the forest floor. A close association with fungi is indicated by strands of conidia attached to the cuticle of the beetle.

### ARTICLE HISTORY

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Fossils  
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Taxonomy  
Tenebrionoidea

### Introduction

Cylindrical bark beetles in the subfamily Colydiinae of the family Zopheridae are small beetles that are rarely collected and little studied. They are associated with moss and lichens and also found in fungal fruiting bodies, decaying vegetation, leaf litter, rotting wood and under bark. Their diet can be either herbivorous or carnivorous by preying on other wood boring invertebrates, such as the larvae of Platypodinae (Coleoptera: Curculionidae) (Dillon & Dillon, 1961; Lawrence & Britton, 1991). They have had a complex systematic history, which has been well documented by Ślipiński and Lawrence (1999). Their fossil record is based almost completely on species recovered from Baltic and Burmese amber dating back to the mid-Cretaceous. These records have been updated by Bullis (2020). The present paper describes a very unusual cylindrical bark beetle in Burmese amber

with its dorsal surface covered with elongate protuberances.

### Materials and methods

The amber specimen was collected at the Noije Bum Summit Site mine in the Hukawng Valley, located southwest of Maingkhwan in Kachin State (26°20'N, 96°36'E) in northern Myanmar. Based on paleontological evidence the site was dated to the late Albian of the Early Cretaceous (Cruikshank & Ko, 2003), placing the age at 97–110 million years ago (Mya). A zircon U–Pb and trace element analyses of amber from different locations in Myanmar confirmed an age of around 100 Mya for amber from the Hukawng Valley as well as an age range of 72–110 Mya for amber from other sites in northern Myanmar (Xing & Qui, 2020).

The amber was polished close enough to the fossil to observe specific details, such as spines on the everted internal sac of the reproductive system, using a Nikon Optiphot compound microscope. Helicon Focus Pro X64 was used to stack photos for improved overall clarity and depth of field. Images of some characters in amber were difficult to photograph due to the position of the fossil and fractures in the amber, which explains why the resulting images are not as clear as corresponding photos of extant beetles.

## Results

Order: Coleoptera Linnaeus, 1758  
 Suborder: Polyphaga Emery, 1886  
 Superfamily: Tenebrionoidea Latreille, 1802  
 Family: Zopheridae Solier, 1834  
 Subfamily: Colydiinae Billberg, 1820  
 Genus: *Stegastochlidus* **gen. nov.**  
**LSID:** urn:lsid:zoobank.org:act:36CBCA00-545C-4A62-ABB3-CBC658160315

**Diagnosis:** Dorsum of head, pronotum and elytra of adult male specimen covered with long, erect protuberances. Twenty protuberances, most pointing forward, arise from the head and pronotum. Four longitudinal rows, each containing 10 protuberances, are on each elytron; head prognathous, with incised compound eyes protruding laterally; ommatidia large, with whitish microsetae between ommatidia; antennae gradual, smooth, 10-segmented with enlarged terminal segment serving as club; tarsal formula 4-4-4; claws simple, divergent; abdomen with 5 visible sternites; aedeagus, paired parameres and everted internal sac bearing an armature of spines protruding from tip of abdomen.

**Species included:** Type species only.

**Remarks:** Based on its 4-4-4 tarsal formula and 10-segmented antennae, the fossil is considered to be a highly modified member of the Colydiinae in the Zopheridae.

**Type species.** *Stegastochlidus saraemcheana* **gen. et sp. nov.** (Figs. 1–12)

*Derivation of generic name.* From the Greek “stegasos” = covered and the Greek “chlidos” = ornament.

**Derivation of species name:** Named in honor of Dr. Sarah Emche, a U. S. Department of Agriculture, Agricultural Research Service scientist and friend of the second author.

**LSID:** urn:lsid:zoobank.org:act:D92284E1-889B-45F7-BC9D-5AA5F3D907CC

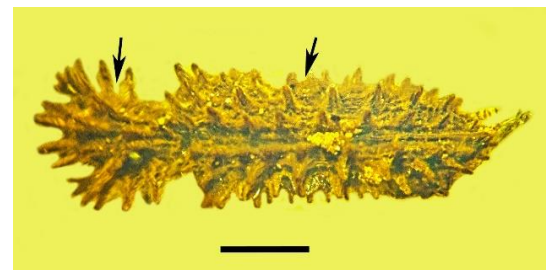
**Holotype:** Male no. B-C-55 deposited in the Poinar amber collection maintained at Oregon State University. The tibia and tarsus of the left hind leg are missing, and the right hind leg is partially torn from its socket. The head and abdomen are somewhat distorted from the fossilization process and the left labial palp is detached. The right hind leg is torn out of its socket. Two mites are attached to the body.

**Type locality:** Kachin (Hukawng Valley) of northern Myanmar.

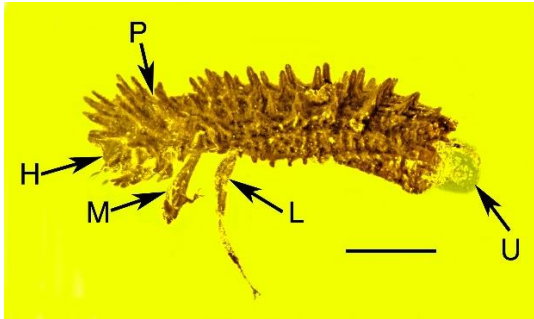
**Stratigraphic horizon:** The lowermost Cenomanian ( $98.79 \pm 0.62$  Mya) mid-Cretaceous.

**Diagnosis:** As for genus (monotypic).

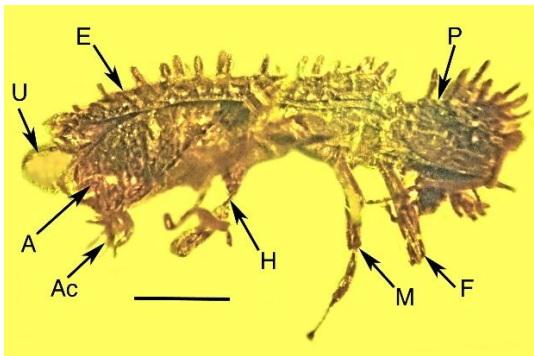
**Description:** Body uniformly brown, elongate, parallel-sided, 4.2 mm in length; 3.9 times longer than wide; entire dorsal surface covered with erect protuberances. Head prognathous, hidden from above by forward directed protuberances; width, 460  $\mu$ m, length 400  $\mu$ m (in face view); widest at level of moderately protruding, coarsely faceted eyes notched on inner surface, greatest eye diameter, 170  $\mu$ m; ommatidia relatively large, each ommatidium bordered by a ring of white microsetae; antennal grooves lacking; labial and maxillary palps short, wide, labial palps 3-segmented; mandibles long and curved, with swollen basal portion and pointed tip; labrum small, border rounded, protruding from head; antennal insertions adjacent, positioned in center of head: antennal grooves or cavities absent.



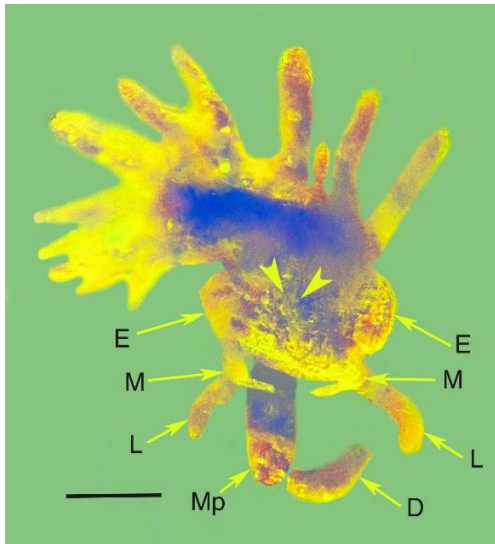
**Figure 1.** Dorsal view of *Stegastochlidus saraemcheana* gen. et sp. nov. in Burmese amber. Left arrow shows head and pronotum. Right arrow shows elytra. Scale bar = 0.8 mm.



**Figure 2.** Lateral view of *Stegastochlidus saraemcheana* gen. et sp. nov. in Burmese amber. H = head; M = middle leg; L = hind leg; P = pronotum; U = everted internal sac. Scale bar = 1.0 mm.

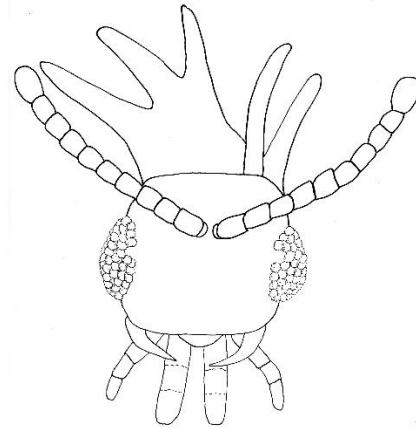


**Figure 3.** Sub-ventral view of *Stegastochlidus saraemcheana* gen. et sp. nov. in Burmese amber. A = abdomen (somewhat flattened); Ac = attached mite; E = elytrum; F = foreleg; H = hind leg; M = middle leg; P = pronotum; U = everted internal sac. Scale bar = 0.8 mm.

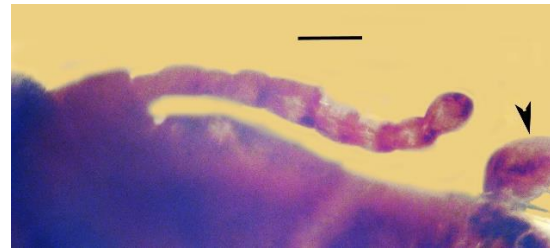


**Figure 4.** Frontal view of head of *Stegastochlidus saraemcheana* gen. et sp. nov. in Burmese amber. D = detached labial palp; E = eyes; L = flattened

labial palp; M = mandibles; Mp = maxillary palp; arrowheads show antennal insertions. Scale bar = 0.2 mm.



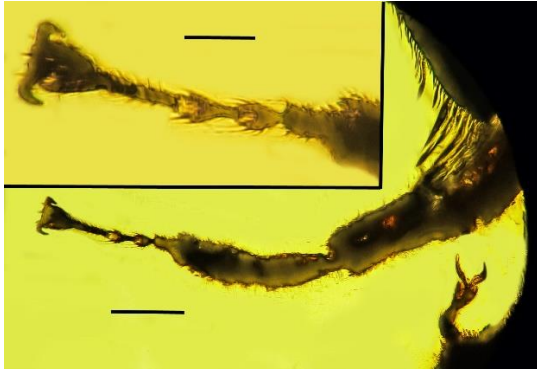
**Figure 5.** Reconstruction of face of *Stegastochlidus saraemcheana* gen. et sp. nov. in Burmese amber.



**Figure 6.** Terminal antennomeres of *Stegastochlidus saraemcheana* gen. et sp. nov. in Burmese amber. Arrowhead shows attached mite. Scale bar = 0.8 mm.



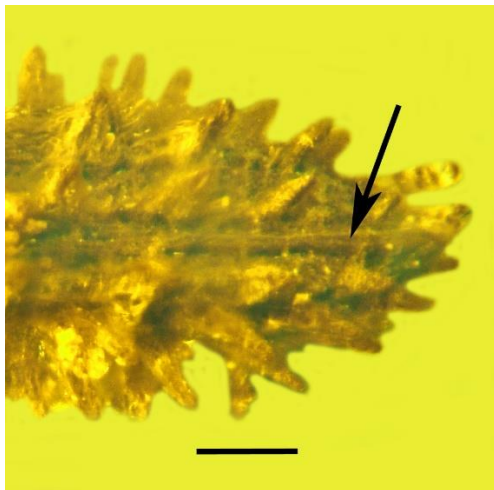
**Figure 7.** Subventral view of thorax of *Stegastochlidus saraemcheana* gen. et sp. nov. in Burmese amber showing leg insertions. Scale bar = 0.4 mm.



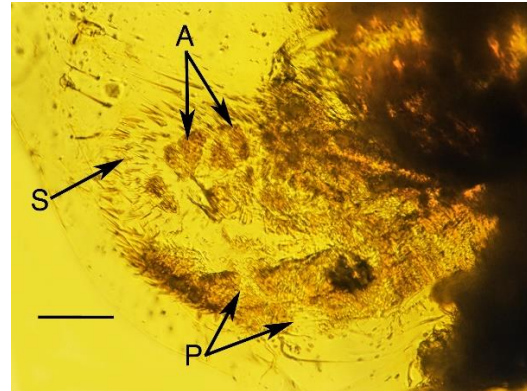
**Figure 8.** Hind leg of *Stegastochlidus saraemcheana* gen. et sp. nov. in Burmese amber showing femur, tibia and 4-segmented tarsus. Note apex of mesotarsus with claws in lower right corner. Scale bar = 0.2 mm. Insert shows detail of 4-segmented tarsus. Scale bar = 0.8 mm.



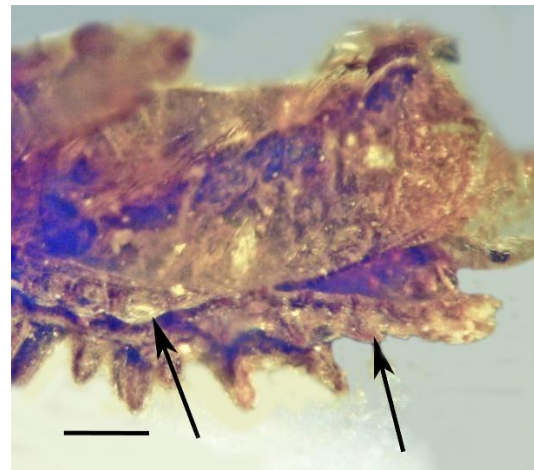
**Figure 9.** Lateral view of 4-segmented protarsus of *Stegastochlidus saraemcheana* gen. et sp. nov. in Burmese amber. Note short spine on apex of tibia. Scale bar = 0.8 mm.



**Figure 10.** Dorsal view of apex of elytra of *Stegastochlidus saraemcheana* gen. et sp. nov. in Burmese amber showing apparently fused elytral suture (arrow). Scale bar = 0.2 mm.



**Figure 11.** Tip of abdomen of *Stegastochlidus saraemcheana* gen. et sp. nov. in Burmese amber showing the extended tubular aedeagus bearing sclerites (A), two subtending parameres (P) and the everted internal sac with membranous walls bearing spines (S). Scale bar = 0.2 mm.



**Figure 12.** Apparent fungal conidia (arrows) between the elytra and abdomen of *Stegastochlidus saraemcheana* gen. et sp. nov. in Burmese amber. Scale bar = 0.1 mm.

Antenna 10-segmented, gradual, glabrous, with weak 1-segmented club; all antennomeres similar in size except for first antennomere, which is slightly longer, and the terminal antennomere, which is slightly wider than the others.

Pronotum longitudinal, covered with protuberances that mask additional details. Twenty protuberances, most pointing forward, arise from the combined head and pronotum.

Procoxal and mescoxal cavities oval, well separated; metcoxal cavities somewhat transverse, separated.

Elytra narrow and long, entire dorsal surface covered with erect protuberances ranging from 105-327  $\mu\text{m}$  in length and 28-107  $\mu\text{m}$  in width; some 80 protuberances cover the elytra with four longitudinal rows, each containing 10 protuberances, on each elytron; longest protuberances occur in the basal to mid-region of the elytra and the shortest at the tip of the elytra.

Abdomen with 5 freely articulated ventrites; tip of abdomen with everted internal sac (length, 790  $\mu\text{m}$ ), the membranous walls of which have an armature of spines. Also present is the aedeagus (length, 510  $\mu\text{m}$ ) bearing sclerites and two subtending parameres (length, 430  $\mu\text{m}$ ).

Legs relatively short, with profemur 630  $\mu\text{m}$  long, protibia 660  $\mu\text{m}$  long and protarsus 263  $\mu\text{m}$  long. The mesofemur is 630  $\mu\text{m}$  long, mesotibia 400  $\mu\text{m}$  long and the mesotarsus 355  $\mu\text{m}$  long; the metatibia is 644  $\mu\text{m}$  long, metatarsus 360  $\mu\text{m}$  long; the lengths of the metatarsomeres are (from first to fourth) 84  $\mu\text{m}$ , 84  $\mu\text{m}$ , 70  $\mu\text{m}$ , 231  $\mu\text{m}$ . On all legs, the terminal tarsomere is subequal to the combined first three.

**Remarks:** There are no extant or extinct genera of beetles in the current classification of the Zopheridae that have the type of dorsal protuberances found on *S. saraemcheana* gen. et sp. nov. (Crowson, 1956; Dillon & Dillon, 1961; Hatch, 1971; White, 1983; Borrer et al., 1989; Lawrence & Britton, 1991; Alekseev & Lord, 2014; Alekseev, 2015; Alekseev & Bukeja, 2016; Ivie et al., 2016; Lord & Ivie, 2016; Alekseev & Alekseev, 2019; Bullis, 2020). The elongate body of *S. saraemcheana* gen. et sp. nov. resembles that of the Australian *Pseudendestes australis* (Lawrence & Britton, 1991).

## Discussion

Several species of Zopheridae have been described from Burmese amber, including *Paleoendeitoma antennata* Deng, Ślipiński, Ren and Pang (2017), *P. minuta* Deng, Ślipiński, Ren and Pang (2017), *P. buryi* Háva (2019), *P. tuberculata* Bullis (2020) and *Cretomysteria burmanica* Deng, Ślipiński, Ren and Pang (2017). None of the species in the genus *Paleoendeitoma* or *C. burmanica* possess a covering of dorsal protuberances as occurs in the present fossil. In addition, the body of *S. saraemcheana* gen. et sp. nov. is quite narrow, with the pronotum shaped longitudinal, while it is transverse in *P. antennata*, *P. minuta*, *P. buryi*, *P. tuberculata* and *C.*

*burmanica* (Deng et al., 2017; Háva, 2019; Bullis, 2020). In addition, there are no antennal grooves or cavities on *S. saraemcheana* and the antennal club is one-segmented.

An inverted (or everted) type of male genitalia is one of the features of the Colydiinae (Deng et al., 2017). While it is not a unique apomorphy of colydiines, it is present on *S. saraemcheana*. Within the spiny everted internal sac is a portion of the aedeagus as well as the two parameres (Fig. 11), a condition described by Tuxen (1956) for members of this family.

Lodged between the abdomen and elytra are chains of one-celled conidia that are exposed at the posterior end of the beetle (Fig. 12). There is no mycelium protruding between the body segments of *S. saraemcheana*. Since colydiines are known to live in rotten wood, leaf litter and decaying vegetation (Dillon & Dillon, 1961; Lawrence & Britton, 1991) the conidia may represent a species detached from its habitat. There also is a possibility that this fungal-beetle association is natural. Various fungi are known to grow on the cuticle of species in the colydiine genus *Dryptops* Broun, 1882 in Papua-New Guinea (Samuelson, 1966).

The two mites (Figs. 3,6) are attached to *S. saraemcheana* gen. et sp. nov. by their mouthparts and are considered to have a parasitic, rather than a phoretic, relationship with the beetle.

The narrow body associated fungal conidia and presence of attached mites suggests that *S. saraemcheana* gen. et sp. nov. could have inhabited confined spaces, such as the galleries of bark or other beetles. The pointed mouthparts of *S. saraemcheana* gen. et sp. nov. indicates that it was carnivorous and could have preyed on stages of other invertebrates.

This discovery is interesting in several ways, not only because it presents a new morphological variation of this family of beetles, but that it also provides information about the male reproductive system of colydiines, the morphology of which was considered a valuable character for classification of Coleoptera (Crowson, 1956). The discovery of fungi attached to the body of the fossil beetle provides important information on the possible habitats (tropical moist) visited by Cretaceous cylindrical bark beetles.

## Acknowledgements

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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