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Short communication

Cockroach *Stavba jarzembowskii* sp. nov. (Blattaria: Liberiblattindae) from mid-Cretaceous Burmese amber

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ABSTRACT

The family Liberiblattinidae is a small but phylogenetically most important group of Blattaria (cockroaches), comprising 17 Mesozoic genera and 20 species. The genus *Stavba* Vršanská et Vršanský in Vršanský et al. (2019c) of this family consists of two known species. *Stavba jarzembowskii* sp. nov. is described and figured based on an exceptionally preserved male individual in mid-Cretaceous amber from Myanmar. It is distinguished from the other two species by having more round eyes, a narrower body, broader wings with broader costal area and less crossveins in the radial sector and medial field, and relatively uncurved A veins. Our new find further adds the diversity within this genus and of the cockroaches in 99 Ma tropical forests of Burmese amber.

1. Introduction

Blattaria (cockroaches) generally live amongst stones, tree bark, litter, garbage, or deadwood and in all kinds of cavities, even some species surviving in human bedrooms (Liu, 1999). They first appeared in the Pennsylvanian as Carboniferous adpressions and have been on Earth for about 320 myrs (Tan, 1980; Vršanský et al., 2002, 2017; Liang et al., 2006; Schneider and Werneburg, 2006). Cockroachoids comprise one of the most dominant insect groups in diversity in Palaeozoic and Mesozoic ecosystems, with about 1500 fossil species reported (Vršanský, 2008; Chen et al., 2019). Cockroaches are also abundant inclusions in amber, and more than 75 species have been estimated in Burmese amber (Vršanský et al., 2018).

Studies also contribute to a rapidly expanding knowledge of the cockroach fauna of burmite, with camouflaging, mimicking, poisonous, wood-boring mammals, predatory, cranefly-like, parasitic, virus infection-symptomatic, bipectinate antennae, holoptic and simply decomposing species (Vršanský and Bechly, 2015; Bai et al., 2016, 2018; Šmídová and Lei, 2017, Šmídová, 2020; Vršanský and Wang, 2017; Li and Huang, 2018; Kočárek, 2018a, b; Podstrelená and Sendi, 2018; Mlynský et al., 2019; Qiu et al., 2019a, b; Vršanský, 2019; Vršanský et al., 2018, 2019a, b, c; Hinkelman, 2019; Sendi et al., 2020).

The family Liberiblattinidae is a small cockroach group, which was established with the type species *Liberiblattina ihringovae* Vršanský (2002) from the Karabastau Formation of Kazakhstan (Vršanský, 2002). Recently, Vršanský et al. (2019a) revised this family within the superfamily Corydioidea. Now, the family comprises 17 genera and 20 species (Vršanský et al., 2019a, c; Chen et al., 2019, 2020). Among them, the genus *Stavba* Vršanský et al., 2018 from the same mid-Cretaceous Burmese amber includes a *S. babkaeva* specimen with wings showing the symptoms of infection caused by the pathogenic DWV virus (Vršanský et al., 2019c). Recently, a new species *S. vrsanskyi* was discovered in Burmese amber (Chen et al., 2020).

In this paper, we describe the third species *Stavba jarzembowskii* sp. nov. of this genus from the contemporaneous mid-Cretaceous Burmese amber. Our new find further adds the diversity of this genus and of the cockroaches in 99 Ma Burmese amber.

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2. Material and methods

The material came from an amber mine located near Noije Bum Village, Tanaing Town, Myanmar (Kania et al., 2015). The mine is rich in flora and fauna and contains the most diverse amber biota (Shi et al., 2012; Kania et al., 2015; Ross; 2015; Yu et al., 2019). The age of the amber deposit is 98.8 ± 0.6 Ma (determined by U–Pb dating of zircon) (Shi et al., 2012; Kania et al., 2015: fig. 1).

The specimen described herein is deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS). Photographs were taken using a Zeiss Stereo Discovery V16 microscope system and Zen software with incident and/or transmitted light. All images are digitally stacked photomicrographic composites of approximately 45 individual focal planes obtained using Helicon software for a better illustration of the 3D structures. Figure plates were prepared using CorelDraw X7 and Adobe Photoshop CS3. The terminology of the wing venation follows Comstock and Needham (1899).

3. Systematic paleontology

Order Blattaria Latreille, 1810
Superfamily Corydioidea Saussure, 1864
Family Liberiblattinidae Vršanský, 2002

Genus *Stavba* Vršanská et Vršanský in Vršanský et al. (2019c)

Stavba jarzembowskii sp. nov.
(urn:lsid:zoobank.org:act:4AD3B917-F5F0-4577-A92A-C1C65EA0BC37)
Figs. 1–3

Etymology. The specific name is in honour of Prof. Edmund A. Jarzembowski for his contribution to the study of fossil insects.
Holotype. NIGP173083; winded male adult housed in the Nanjing Institute of Geology and Palaeontology (NIGP), Chinese Academy of Sciences.
Locality and horizon. Burmese amber, from deposits near Tanai in the Hukawng Valley of northern Myanmar, lowermost Cenomanian, Upper Cretaceous (98.8 ± 0.6 Ma).

Differential diagnosis. Distinguished from other species of *Stavba* by having a slightly narrower body; presence of broader wings with fewer crossveins in radial sector and medial field; relatively uncurved A veins similar to *Spongistoma* Hinkelman, 2019 in Sendi et al. (2020); narrower costal field and round eyes.
Description. Body 7 mm long, 2.9 mm wide, pale and slender; head, thorax, wings and abdomen preserved, with pale brown transversal stripe on each segment (Fig. 1). Head 2 mm long, thorax 1.67 mm long, approximately half of abdomen length, abdomen 3.17 mm long. **Head:** preserved not very well, approximately circular (Fig. 2A), 1 × 1 mm, hypognathous. Antennae preserved completely (45 segments visible), but apparently rather short (ca. 5 mm long; Fig. 2B), scape sturdy, pedicel thin and long, each antennal segment with short, wide chaetica distributed in up to 9 rows. Mandible complete. **Thorax:** Foreleg raptorial preserved incompletely (Fig. 2E), coxa very long and wide, 1.36 mm long, 0.18 mm wide in centre. Trochanter curved, short. Midleg cursorial, incomplete preservation, tibia robust (1.36 × 0.36 mm) with at least 15 spurs, but with many sensillae adjacent to femur. Hindleg basically cursorial, long, strong, with numerous spurs, femur very strong and wide (1.36 × 0.45 mm) with posterior ridge with 2 rows of strong spurs alternating with smaller spurs and sensillae, tibia strong with at least 16 spurs. Coxa very long and wide, narrowing from top to bottom and alternating two slightly dark stripes. Tarsus very long with pulvilli on each other segment and small arolium among symmetrical short claws. **Wings:** Forewing elongated (right: 5.64 × 2.09 mm, left: 6 × 2.17 mm; Fig. 3B), transparent, without colouration. Anterior margin arched. Outer margin straight until apex is rounded. Intercalary veins and cross-veins distinct and numerous, especially dense in RS area, M area and CuA area. Sc in right forewing very strong, simple, short, reaching 1/3rd of costal margin, in left forewing simple. R1 with 7 veins at margin with few primary branches, veins of the wings within R1 region have some spines, RS differentiated (2 veins at margin), M with 3 straight medium sized branches, CuA branched basally with 2 extremely long branches, CuP short, probably with only 3 and relatively uncurved simple A veins. A veins deformed based on curve (Vršanský, 2005). **Abdomen:** Abdomen robust. Cercus preserved

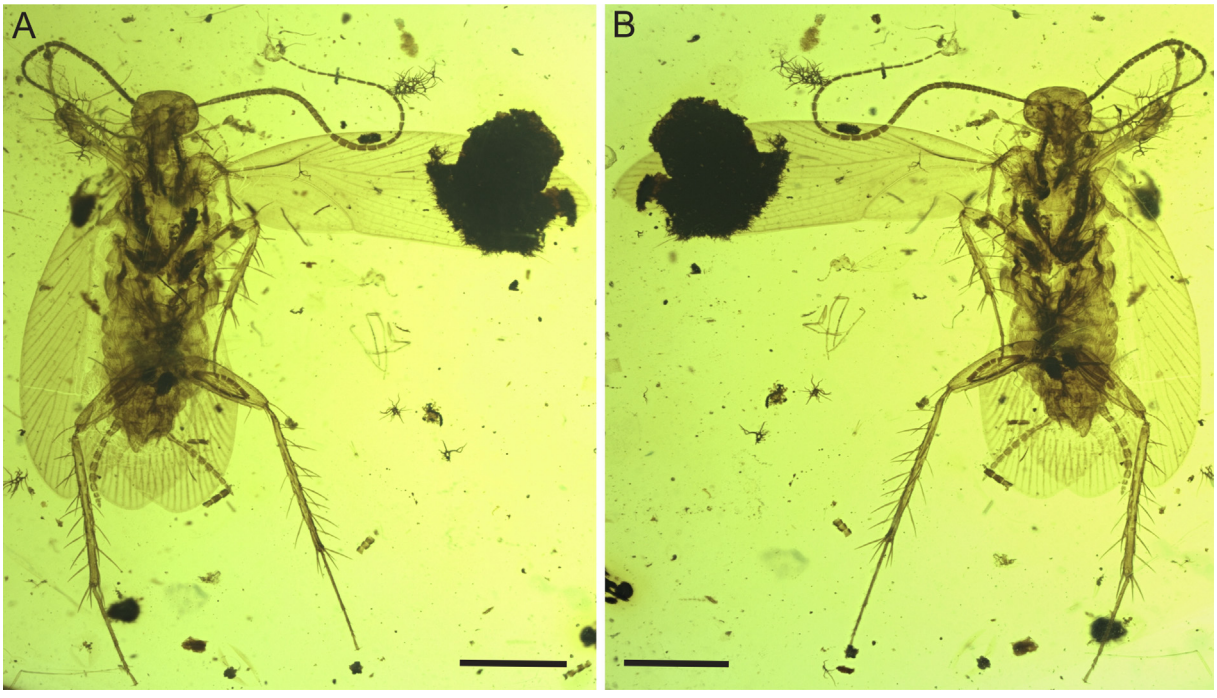

Fig. 1. Microphotographs of *Stavba jarzembowskii* sp. nov., holotype, NIGP173083. A, in dorsal view (scale bar, 2 mm); B, in ventral view (scale bar, 2 mm).

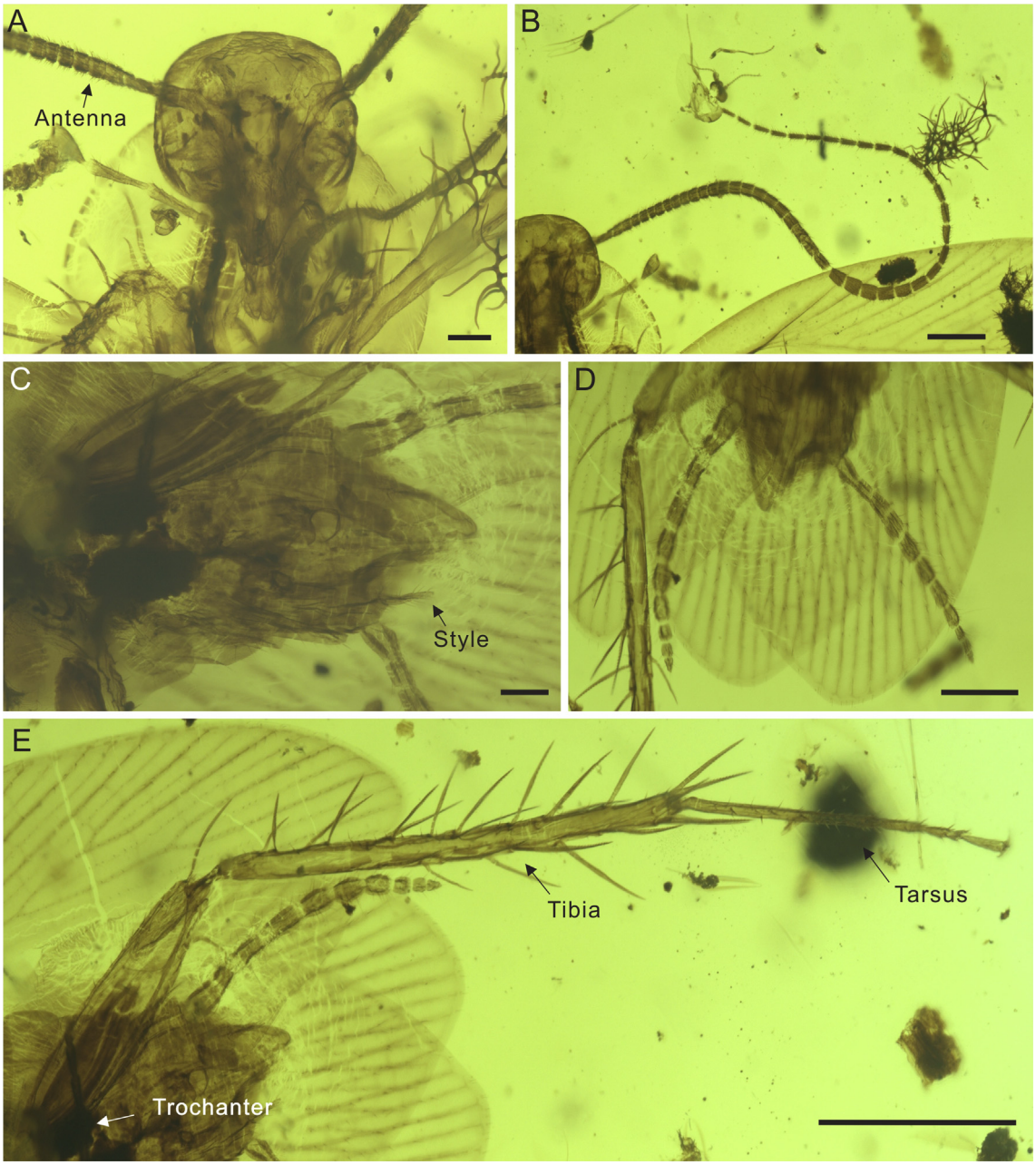

Fig. 2. Microphotographs of *Stavba jarzembowskii* sp. nov., holotype, NIGP173083. A, head (scale bar, 0.2 mm); B, antennae (scale bar, 0.5 mm); C, pygofer and genital (scale bar, 0.2 mm); D, cercus (scale bar, 0.5 mm); E, hind leg (scale bar, 1 mm).

completely with up to 0.2 mm long sensilla chaetica (Fig. 2D), divided into 10 cercomeres on left (ca. 1.67 mm) and 11 segments on right (ca. 1.33 mm), thicker basally and narrower apically. Genitals mostly covered by the ninth sternite and epiproct, with only one style. Style 0.18 mm long, with long setae (Fig. 2C).

4. Discussion

The present fossil can be categorized within the family Liberiblattindae on the basis of chaetotaxy and forewing venation scheme. The genus *Stavba* with the type species *S. babkaeva* was erected based on two specimens from Mid-Cretaceous Burmese amber (Vršanský et al., 2018), and soon another new species *S. vrsanskyi* of this genus was reported by Chen et al. (2020) from the same locality. Our new specimen belongs to the genus *Stavba* further shown by the combination of the following characters: very small size, pale colouration (except for legs with dark longitudinal stripes), form of the forewing with sharp apex and rather short and wide costal field with simplified Sc, and having primitively raptorial legs with asymmetrically distributed spines on the front femur. In addition, the new specimen is similar to *S. babkaeva* in having R1 with 8 veins at margin with few primary branches, veins of the forewings within R1 area having some spines, RS differentiated (4 veins at margin), M with 3 straight medium size branches (Fig. 3).

S. jarzembowskii sp. nov. can be distinguished from the type species *S. babkaeva* by CuA branching basally with 3 extremely long branches, CuP short, with relatively uncurved simple A veins. In

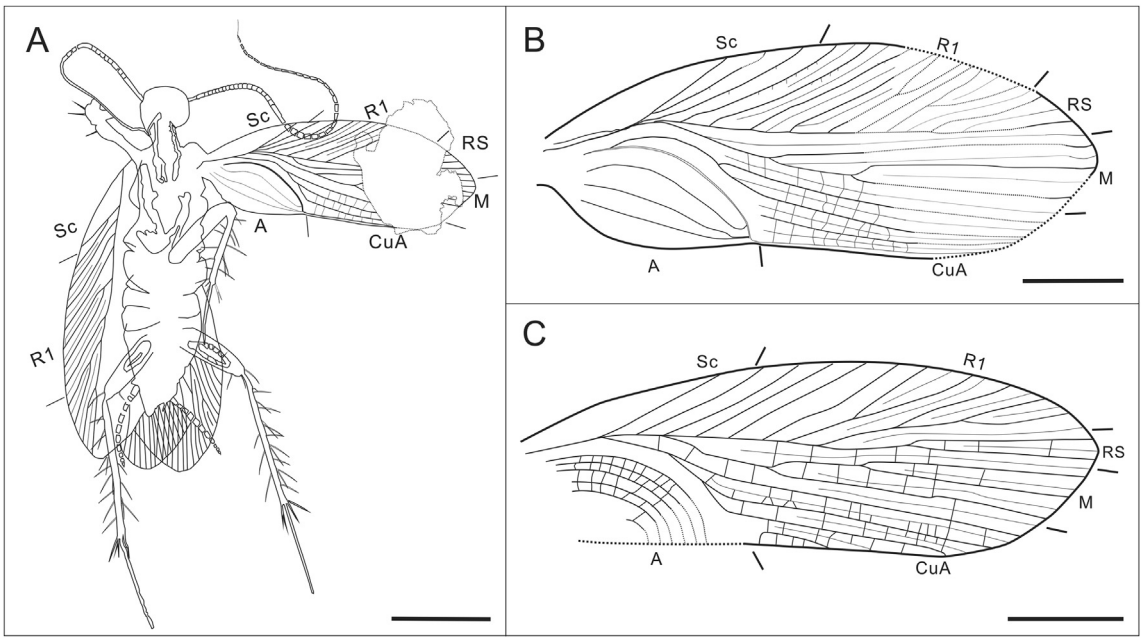

Fig. 3. Line drawings of *Stavba jarzembowskii* sp. nov. and *S. babkaeva*. A, body of *S. jarzembowskii* sp. n. in dorsal view (scale bar, 2 mm); B, forewing of *S. jarzembowskii* sp. n (scale bar, 1 mm); C, forewing of *S. babkaeva* (scale bar, 1 mm).

S. babkaeva, CuA is branched basally with 4 extremely long branches (Fig. 3C). *S. babkaeva* also has a narrower costal field and round eyes contrasting with narrow and extremely elongate. Compared with *S. vrsanskyi*, *S. jarzembowskii* has circular head (triangular head in *S. vrsanskyi*), secondary branches in R veins and more CuA veins.

The exposed body, abundant resin, and rapid embedding acted together could lead to the preservation of the fossil species in Burmese amber (Bao et al., 2017), whether this inclusion was alive or dead. If it was the former, the wrapped trapped cockroach was most likely to struggle and open its wings; however, our specimen had only the left forewing opened, and without air bubbles caused by the struggle in amber. So, we think it was most probable that the cockroach had died before the resin trapped it. The opened wing may be caused by wind transport, water transport or resin flow. Similar to *S. babkaeva*, *S. vrsanskyi* and other cockroaches, this situation is not uncommon for other insects, the reason for this phenomenon is most likely that living cockroaches could avoid the trapped of the amber through their strong legs and power of smell.

Wing deformity (Vršanský, 2005) occurs in the clavus of the right wing, but this kind of deformity, i.e., in clavus, does not counts into deformity partition in locality, due to protective character of this wing structure.

5. Concluding remarks

Stavba jarzembowskii sp. nov., a new species of Liberiblattinidae, is the third fossil species of *Stavba* from mid-Cretaceous Burmese amber. It is distinctly different from other species in the presence of broader wings with broader costal area, less cross veins in radial sector and medial field and CuA with 3 extremely long branches. Also it differs in the form of more or less rounded eyes. Our find augments the diversity of the Cretaceous cockroaches in the tropical ecosystem of late age of the dinosaurs, and enhances our understanding of the early evolution and diversification of modern cockroaches.

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