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An archaic-beetle 'Jaws' from mid-Cretaceous Burmese amber (Coleoptera: Archostemata)

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ABSTRACT

A new ommatin beetle, *Omma davidbatteni* sp. nov. (Insecta: Coleoptera: Archostemata) is described in mid-Cretaceous Burmese amber from Kachin in northern Myanmar. This is the second species of this Triassic-Recent (and now relict) genus of archaic beetles to be described from amber inclusions. This uncommon species is readily distinguished from recent and fossil congeners by its elongate mandibles (jaws).

1. Introduction

With upwards of 350,000 described species, beetles (Insecta: Coleoptera) are by far the largest order in the animal kingdom; the Cupedina, however, is the smallest and most archaic beetle suborder, totaling only about 100 living species, and now commonly split into the smaller suborders Archostemata and Myxophaga (Beutel et al., 2008; Hörnschemeyer, 2011). Several hundred fossil species have been described from the Permian onwards and archostematans are notable constituents of Mesozoic insect faunas, even occurring in regions from where they have now vanished (such as Europe and the UK; Kirejtshuk and Ponomarenko, 2015). Such finds are usually preserved as adpressions, some exceptionally well preserved as in northeastern China (Jarzembowski et al., 2013), but they have also been discovered recently as amber inclusions in northern Myanmar (Xia et al., 2015). Archostematans are, nevertheless, scarce in Burmese amber which is surprising considering that most recent archostematans are associated with wood in both active stages (larval and adult) and sometimes the adults visit flowers. There are two major extant groups of archostematan beetles, the cupedines and ommatines, the latter 'living fossils' peculiar to the modern fauna of Australia and South America. The discovery of a fossil species in Burmese amber belonging to the type genus of the ommatines, *Omma lii* Jarzembowski et al., 2017a, was therefore unpredicted especially as the genus has no Cenozoic record. *O. lii* did however, show some peculiarity of the male genitalia compared with recent species, and the elongated jaws of the new species described herein are unique. This diversity is explained by growing evidence of Cretaceous insularity from Gondwana in the Burmese archaic-beetle fauna (Jarzembowski et al., 2019), recently supported by plate tectonics (Westerweel et al., 2019).

Opinion is divided as to whether ommatines are a subfamily of cupedids *sensu lato*, the reticulated beetles (Kirejtshuk and Ponomarenko, 2015), or a separate family (Beutel et al., 2008); we have indicated the latter in Section 4. The fossil beetle described below belongs to an uncommon species, only a single specimen being available from an estimated over 100,000 inclusions extracted in this century. Extant *Omma* species are also rare insects, now only found in Australia and considered a threatened relict group (Lawrence and Ślipiński, 2013).

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2. Geological setting

Burmese amber (burmite, Kachin amber from northern Myanmar) contains the most diverse biota in fossil resin known from the Cretaceous; all the major divisions of extant insects (orders) are represented, beetles being one of the most diverse, but many species are undescribed. The amber has been dated stratigraphically from late Albian to early Cenomanian in the present century (e.g., Cruickshank and Ko, 2003; Smith and Ross, 2018). U-Pb dating of zircons from the volcanoclastic matrix gave a maximum age of 98.8 ± 0.6 Ma (Shi et al., 2012) but the date range may be up to five million years; we therefore consider the age as circa 100 Ma or mid-Cretaceous.

Amber has been found in several districts of Myanmar, notably in the northern Hukawng Valley, especially a recently closed mine (shaft-mining complex) near Noije Bum Village, Tanaing (Tanai) Township in the Myitkyina District of Kachin State (Kania et al., 2015: Fig. 1 (map); Jarzembowski et al., 2017a: Fig. S1 (view)). In recent years, ten tonnes or more of amber have been prepared for sale every year in the international jewellery trade, especially to neighbouring China, and the raw material is protected by law.

3. Material and method

The holotype is in a clear amber cabochon, pale brownish-yellow in colour, with a resin flow line and organic debris, including an overlapping small beetle elytron and sclerite; part of the left hindleg has been polished away by the jeweller (for display purposes).

The specimen was examined under a Nikon SMZ 1000 binocular microscope with camera lucida drawing tube and fibreoptic top and bottom illumination. It was photographed with a Zeiss Axiocam 512 digital camera mounted on a Zeiss Stereo Discovery V16 microscope also with fibreoptic top and bottom illumination and operated with Zen 2.3 pro software. Drawings were prepared from both photographs and specimens by hand (EAJ). Only standard degreasing and wetting of the piece were undertaken during examination to reduce surface interference. For morphology, we follow the terminology in Jarzembowski et al. (2013,2017a; Figs. S1, 2). The prefixes pro-, meso- and meta- refer to locations on the fore, middle and hind thoracic segments. Drawing conventions are: solid line, distinct margin; dashed, indistinct or damaged; dashed-and-dotted, folded. The abbreviations used are NIGP, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences. Taxonomic acts established in the present work have been registered in ZooBank (see new taxonomic LSID below) together with the electronic publication LSID: urn:lsid:zoobank.org:pub:BF34215B-E8AD-4262-9D18-58D449C0BABC.

4. Systematic palaeontology

Class: Insecta Linnaeus, 1758
Order: Coleoptera Linnaeus, 1758
Suborder: Archostemata Kolbe, 1908
Family: Ommatidae Sharp and Muir, 1912
[Cupedidae Laporte, 1836 s.l.]
Subfamily Ommatinae Sharp and Muir, 1912
Tribe: Ommatini Sharp and Muir, 1912
Genus *Omma* Newman, 1839

Type species. *Omma stanleyi* Newman, 1839 by original designation; Recent, Australia.

Diagnosis. Ommatine beetles possessing small or medium-size, moderately long elytra with comparatively well-developed tuberculation and discernible reticulation due to external cell development; epileuron with moderately wide rim widening slightly anteriorly; disc with distinct longitudinal rows of window cells.

Remarks. The above diagnosis was emended by Jarzembowski et al. (2017a) to complement that of the allied (sister) genus *Cionocoleus* Ren, 1995 which is usually distinguished by its more elongate, larger form and lack of reticulation (Jarzembowski et al., 2013).

Omma davidbatteni sp. nov.
(urn:lsid:zoobank.org:act:E5789AA6-3171-4EC2-912A-DD341843A83B)

Derivation of name. In memory of Professor David J. Batten (1943–2019), Cretaceous palynologist and editor.

Holotype. NIGP 172204, beetle body in polished amber cabochon.

Locality and horizon: probably former mine near Noije Bum Village, Tanaing Township, Myitkyina District, Kachin State, Myanmar, 26° 15′ N., 96° 33′ E.; unnamed horizon, mid-Cretaceous.

Diagnosis. Small Cretaceous species of *Omma* similar in size (about six to seven millimetres long) to mid-Cretaceous *Omma lii* Jarzembowski, Zheng and Wang, 2017a and recent *Omma rutherfordi* Lawrence, 1999 (male) but differing from both in its large elongated jaws (mandibles) and prominent subglobular eyes; body narrower than *O. lii* and nearly as narrow as *O. rutherfordi*.

Description. Small brown beetle, 6.5 mm long (from anterior end of mandibles to posterior end of folded elytra), 1.8 mm wide (across folded elytra). Cuticle generally distinctly tuberculate, sometimes visibly setose or even spiny (leg segments).

Head with well-developed neck; temples much shorter than eyes, latter prominent and subglobular. Antennae short, just reaching posterior edge of prothorax, 11-segmented, filiform, inserted on side of head; 3rd antennal segment elongate (longer than 2nd and 4th), 11th spindle-shaped. Labrum broad, fronto-clypeal area behind with slight lateral grooves. Mandibles arched forward with vertical teeth (so only two visible dorsoventrally), first anterior left elongate and overlapping. On underside of head, gular sutures not completely developed; last maxillary segment not extending beyond labrum.

Thorax. Pronotum rounded, wider than head, narrower than abdomen. Pronotopleural suture curved. Procoxae large, rounded, contiguous on posterior edge of prothorax. Profemur thickened slightly and extending beyond edge of abdomen; protibia thinner, shorter and distinctly spurred; protarsus shorter than protibia, not lobed, first and last tarsomeres (segments) more elongate than middle three. Mesoscutellum small, indistinct. Mesocoxae large, rounded and adjacent. Mesofemur long, slightly curved and extending beyond edge of body and longer than spurred mesotibia; latter about length of mesotarsus with elongated first and last segments. Metaventrite narrowed, trapezoidal with cross sutures. Metatrochantin broad, spindle-shaped. Metacoxa very large, subtriangular. Metatrochanter small. Metafemur broad, nearly as long as metatibia, not extending beyond edge of body; metatarsus longer and thinner with very elongated segments.

Elytron overlapping hindbody; base slightly curved, humerus (shoulder) rounded; apex bluntly pointed; anterior (outer) margin only slightly curved and discal (step-like) fold not pronounced; epipleural rim moderately wide, narrowing slightly posteriorly; three slightly raised veins discernible on disc and seven or eight rows of small window cells present and one or two adjacent to epipleural rim, cells appearing dotted due to maculae (about four, small, dark, lining tubercles).

Abdomen with coplanar ventrites and widest opposite 1st ventrite; 1st and 5th ventrites longer than others, 5th over 1.8 times longer than 4th (penultimate).

5. Discussion

O. lii in Burmese amber is the smallest fossil species (5.6–7.6 mm long) of its genus (Jarzembowski et al., 2017a); thenew amber

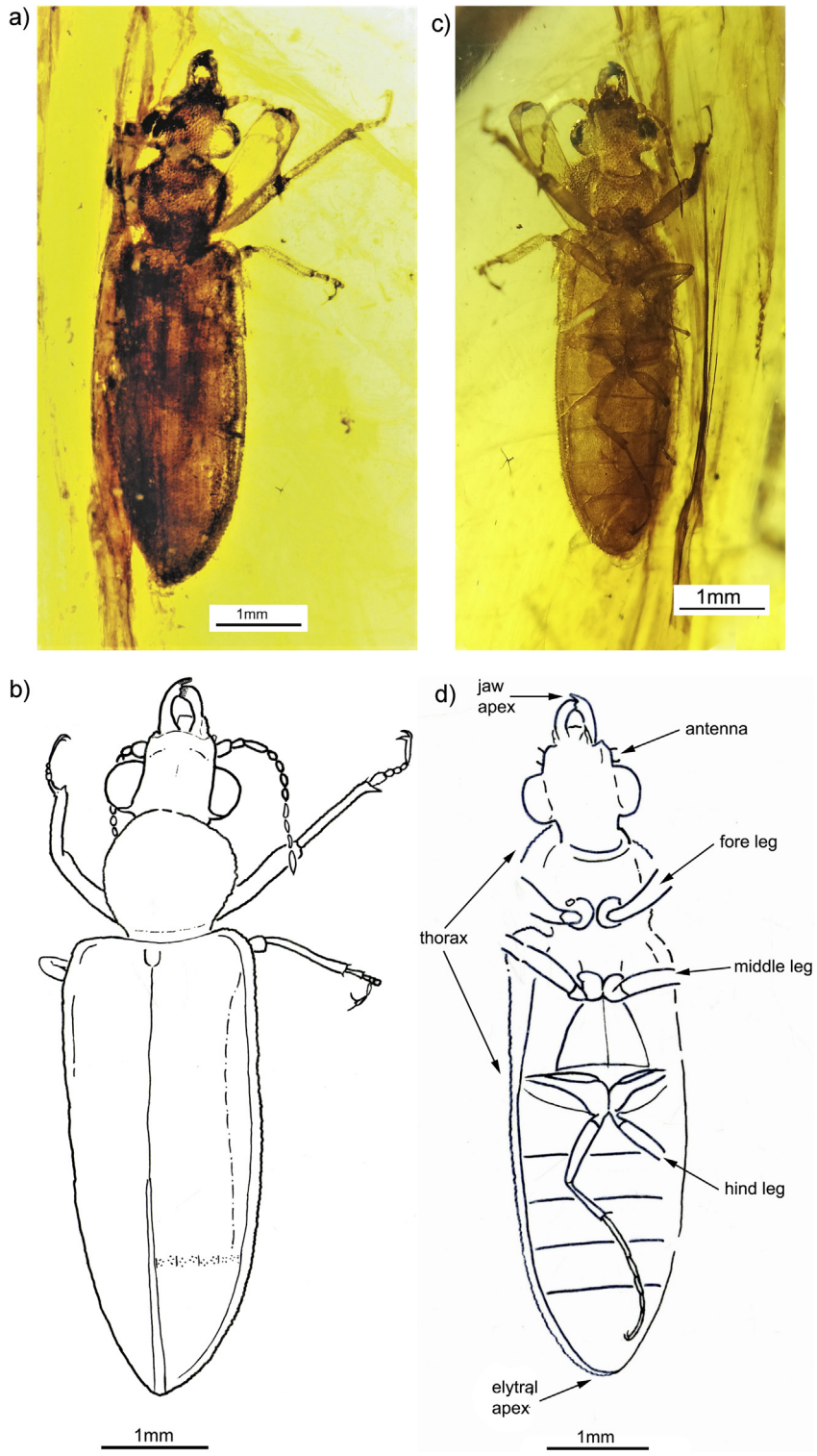

Fig. 1. *Omma davidbatteni* sp. nov., holotype NIGP 172204; probably Noije Bum, mid-Cretaceous. a, photograph of dorsal view. b, interpretive drawing of dorsal view, representative strip of window cells and veins shown in strip on right elytron. c, photograph of ventral view. d, interpretive drawing of ventral view of body.

find is the size of a medium-length *O. lii* and is similar morphologically in being distinctly tuberculate and possessing short antennae and palps, but differs in possessing a more slender body form (3.7 times longer than wide compared with 2.4 in the latter; Fig. 2) including elongate jaws, head and elytra (with correspondingly narrow metaventrite and epipleura) and distinctly spurred protibia plus more pronounced eyes (and reduced temples). The only crown-group species of similar size is *O. rutherfordi* (the micropterous male is 6–7.2 mm long) which also has a narrow body (3.9 times longer than wide) but differs in also possessing long antennae and palps, sloping (rather than short) temples, elytral tails and a distinctly spiny cuticle (Lawrence, 1999: Fig. 1). We therefore propose a new mid-Cretaceous species.

The occurrence of small beetle species in Kachin Burmese amber is not surprising and more remain to be described, but *O. davidbatteni* sp. nov. is unique to-date in possessing anteriorly elongated jaws

Fig. 2. *Omma* cf. *lii* Jarzembowski, Zheng and Wang, 2017a NIGP 172205; probably Noije Bum, mid-Cretaceous. Photograph of dorsal view in brownish yellow amber cabochon. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

(mandibles), unlike the arched jaws of other fossil and recent archaic beetles (such as the two species compared above). The elongation would have provided greater reach and the jaws are twisted apically for clasping as in recent stag beetles (Goyens et al., 2016: Fig. 1.1), but they are not grossly enlarged as in the latter for aggressive fighting. More material is needed to help determine if the jaws were a male attribute only as in the recent beetles. A slender body form with long legs has been linked with diurnal activity in *O. rutherfordi* (on shrubs; Lawrence, 1999), but *O. davidbatteni* sp. nov. has well-developed eyes unlike the smaller, beady ones in this recent species and was possibly nocturnal rather than day-active.

6. Conclusions

The ommatines are arguably the 'most ancestral' living beetles and the ommatins were only distinguished by a single non-homoplastic character by Tan et al. (2012: the absence of a median head suture). This character is accompanied in the new amber fossil by homoplastic body features shared with the fossil genus *Cionocoleus* and still extant *Omma*, including the mandibular teeth not being in the horizontal plane as in typical cupedids (Jarzembowski et al., 2017b). The presence of longitudinal rows of window cells on the elytral disc, highlighted by maculae, place our fossil in *Omma*, but the unusual elongation of the mandibles (jaws) is a potential specific autapomorphy. Readily recognised on account of the latter, *Omma davidbatteni* sp. nov. adds to the growing species diversity of archaic beetles in mid-Cretaceous Myanmar. This small beetle was probably endemic to the ancient forest as *Omma* is known from the earlier Mesozoic of China (Tan et al., 2012) and could have colonised the West Burma Terrane where the amber was mined. Belonging to a once diverse genus, it is likely that additional species will be found.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.pgeola.2020.02.003.

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