

New species of *Omma* Newman from mid-Cretaceous Burmese amber (Coleoptera, Archostemata, Ommatidae)

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Abstract

A new fossil species of the extant archostematan genus *Omma* Newman, *O. forte* **sp. nov.**, is reported from mid-Cretaceous amber from northern Myanmar. The extinct ommatid genus, *Cionocups* Kirejtshuk from the same deposit, is considered as a junior synonym of *Omma*, and *C. manukyani* is transferred to *Omma*, as *O. manukyani* **comb. nov.** A key to species of *Omma* from Burmese amber is also provided.

Key Words

Archostemata, Burmese amber, Cretaceous, *Omma*, Ommatidae

Introduction

Ommatidae is a small family in the beetle suborder Archostemata (Hörschmeyer and Beutel 2016). In a recent phylotranscriptomic study, this family has been recovered as the sister group of Micromalthidae, rather than the superficially similar-looking Cupedidae (McKenna et al. 2019), so it cannot be included in Cupedidae as a subfamily (for alternative interpretations, see Kirejtshuk 2021). Traditionally, two extant genera were recognized in Ommatidae, i.e., *Omma* Newman from Australia and *Tetraphalerus* Waterhouse from South America (Lawrence 1999). Recently, the comparatively diverse genus *Omma* was split into *Omma sensu stricto* and *Beuteli* Escalona et al. (Escalona et al. 2020), partly based on the cladistic analysis in Hörschmeyer (2009). *Omma* has relatively short maxillary and labial palps, and the gulamentum is not depressed, while *Beuteli* has

longer maxillary and labial palps, and the gulamentum is depressed anteriorly.

The fossil record of *Omma* is relatively abundant (as listed by Kirejtshuk 2020). The earliest putative *Omma* fossils date back to the Late Triassic (Crowson 1962; Fig. 1). Jurassic and Cretaceous *Omma* fossils have been reported from numerous localities across the continents of Europe and Asia (e.g., Ponomarenko 1966, 1969; Tan et al. 2012; Cai and Huang 2017). Recently, well-preserved *Omma* fossils have also been reported from the mid-Cretaceous Burmese amber. Based on our observation, *Omma* represents a relatively common genus in Burmese amber (compared with other ommatid genera). To date, three *Omma* species have been established based on fossil material from Burmese amber (Jarzembowski et al. 2017, 2020; Kirejtshuk 2020).

In this study, we describe a new species of *Omma* in mid-Cretaceous Burmese amber. The placement of some other previously published *Omma* and *Omma*-related fossils are also reviewed based on our new observations.

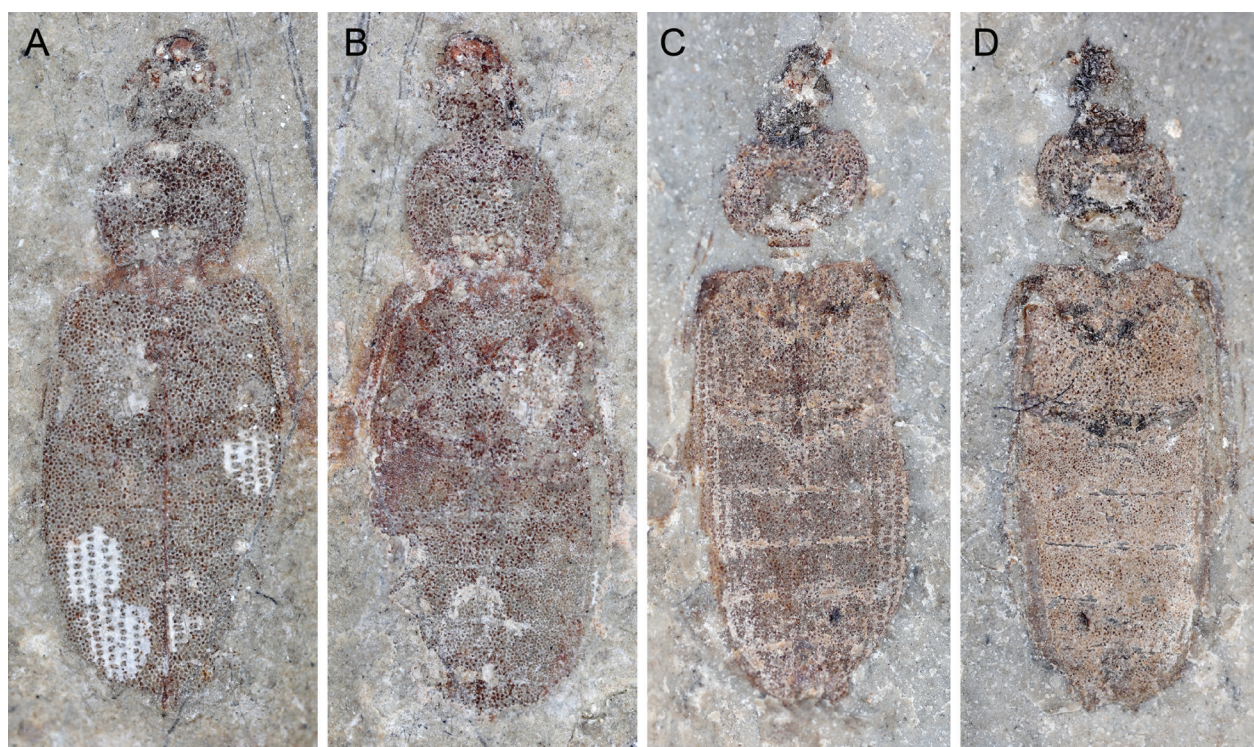


Figure 1. General habitus of *Omma liassicum* Crowson deposited at British Museum of Natural History, under incident light. **A.** Holotype, I.11095a; **B.** Holotype, I.11095b; **C.** Paratype, I.11070a; **D.** Paratype, I.11070b; The body length is about 15 mm in both specimens.

Materials and methods

The Burmese amber specimens studied herein (Figs 2–6) originated from amber mines near Noije Bum (26°20'N, 96°36'E), Hukawng Valley, Kachin State, northern Myanmar. The specimens are deposited in the Nanjing Institute of Geology and Palaeontology (NIGP), Chinese Academy of Sciences, Nanjing, China. The amber pieces were 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 mainly taken with a Zeiss Discovery V20 stereo microscope. Wide-field fluorescence images were mainly 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 (Fu et al. 2021). Images under incident light and wide-field fluorescence were stacked in Helicon Focus 7.0.2 or Zerene Stacker 1.04. Confocal images were stacked with Helicon Focus 7.0.2 and Adobe Photoshop CC. Images were further processed in Adobe Photoshop CC to enhance contrast.

Systematic palaeontology

Order Coleoptera Linnaeus, 1758

Suborder Archostemata Kolbe, 1908

Family Ommatidae Sharp & Muir, 1912

Genus *Omma* Newman, 1839

(= *Cionocups* Kirejtshuk, 2020 syn. nov.)

Type species. *Omma stanleyi* Newman, 1839.

Congeners in Burmese amber. *Omma davidbatteni* Jarzembowski et al., 2020, *Omma forte* Li & Cai sp. nov., *Omma lii* Jarzembowski et al., 2016, *Omma janetae* Kirejtshuk, 2020, and *Omma manukyani* (Kirejtshuk, 2020) comb. nov.

Diagnosis. Head without prominent posterior protuberances. Labrum with dentate anterior margin. Separate mentum absent. Anterior third of gulamentum not depressed. Pronotal disc with rounded lateral edges; dorsal surface without ridges or protuberances. Sternopleural suture absent. Prosternal process short. Punctured explanate elytral epipleura absent. CuA of hind wings forked; wedge cell present. Abdominal ventrites abutting.

Key to *Omma* species in mid-Cretaceous amber from northern Myanmar

- 1 Margins of pronotal disc and elytra without distinct tooth-like tubercles..... 2
- Margins of pronotal disc and elytra with tooth-like tubercles..... 4
- 2 Body slender; mandibles comparatively elongate, projecting more anteriorly..... *Omma davidbatteni* Jarzembowski et al.
- Body wider; mandibles curved more pronouncedly..... 3

- 3 Pronotal disc with convex anterior margin; elytra with narrow subexplanate epipleura *Omma janetae* Kirejtshuk
- Pronotal disc with relatively straight anterior margin; elytra with distinct subexplanate epipleura
..... *Omma lii* Jarzembowski et al.
- 4 Body smaller; elytral window punctures in the second outermost row not distinctly transverse
..... *Omma manukyani* (Kirejtshuk)
- Body larger; elytral window punctures in the second outermost row distinctly transverse... *Omma forte* Li & Cai, sp. nov.

***Omma forte* Li & Cai, sp. nov.**

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Figures 2–4

Material examined. Holotype, NIGP176634.

Etymology. The specific name is from the Latin ‘fortis’, meaning strong, referring to the robust appearance of the species.

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

Description. Body comparatively wide, about 9.3 mm long and 3.8 mm wide, tuberculate, with thin setae and scales.

Head (Fig. 3A, C) prognathous, seemingly wider than long. Neck region constricted, broad. Compound eyes comparatively large, protuberant. Antennal insertions located at anterior corners of head, separated by more than three diameters of antennomere 1. Subantennal grooves absent. Frontoclypeal suture absent. Labrum (Fig. 4A) transverse, with dentate anterior margin. Antenna (Fig. 3A) long, extending beyond base of prothorax when posterior-

ly directed, 11-segmented and filiform. Mandibles (Fig. 4B) tridentate with vertically aligned teeth. Maxillary and labial palps short, not reaching the level of the eyes when extending posteriorly (Figs 3C, 4C); apical maxillary and labial palpomeres probably expanded and securiform.

Pronotal disc (Fig. 3B) widest in the anterior third, slight narrowing posteriorly; anterior corners rounded; lateral edges with distinct tooth-like tubercles (dentate) (Fig. 4D).

Scutellar shield (Fig. 4E) subtrapezoidal, wider posteriorly. Elytra (Figs 2, 3E, F) with ten rows of window punctures; lateral edges with distinct tooth-like tubercles (dentate); surface with ribbed slender scales (Fig. 4G); punctures in the ninth row distinctly transverse; interspace between eighth and ninth puncture rows thickened (Fig. 2). Metaventricle narrowed anteriorly; discrimen present; metakatepisternal suture well developed (Fig. 4H). Metacoxae (Fig. 4H) strongly transverse with subconical mesal projections, contiguous, extending laterally to meet elytra, with weak coxal plates.

Hind wings (Fig. 3G, H) well developed. CuA forked; CuA₁ fused with MP₃₊₄; CuA₃₊₄ fused with CuP+AA₃; wedge cell present.

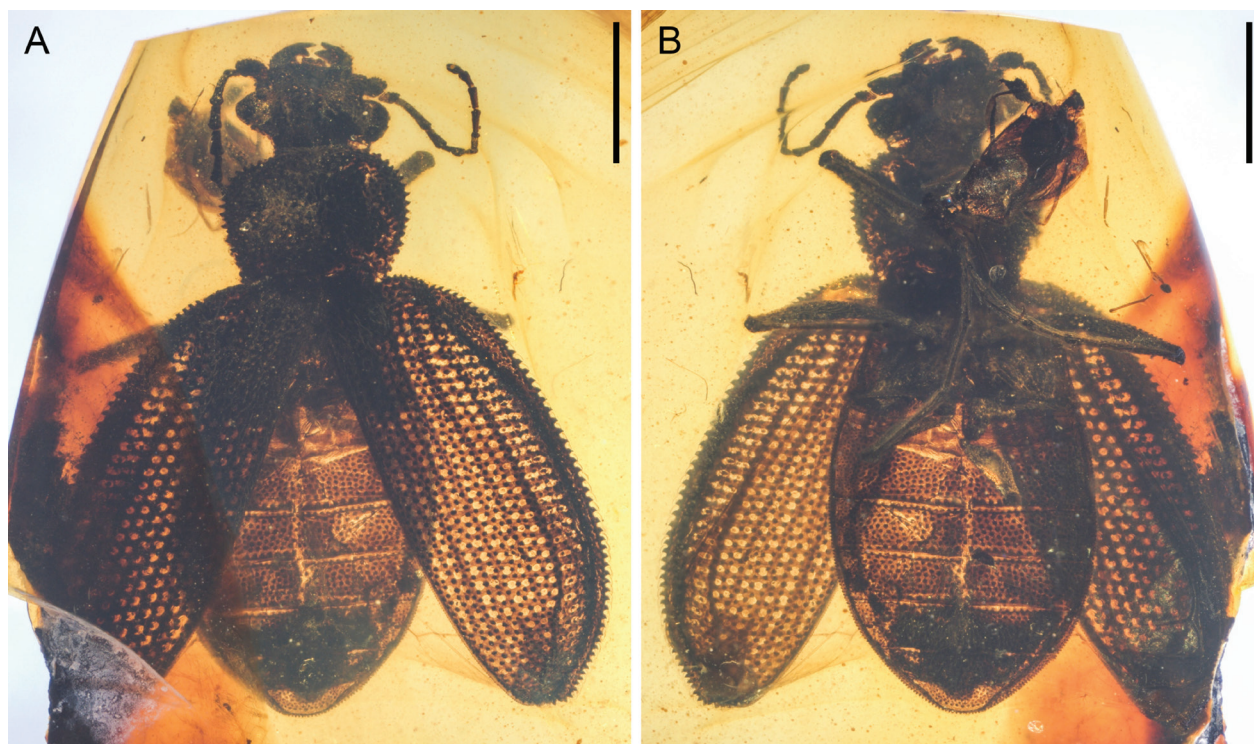


Figure 2. General habitus of *Omma forte* sp. nov., holotype, NIGP176634, under incident light. **A.** Dorsal view; **B.** Ventral view; Scale bars: 2 mm.

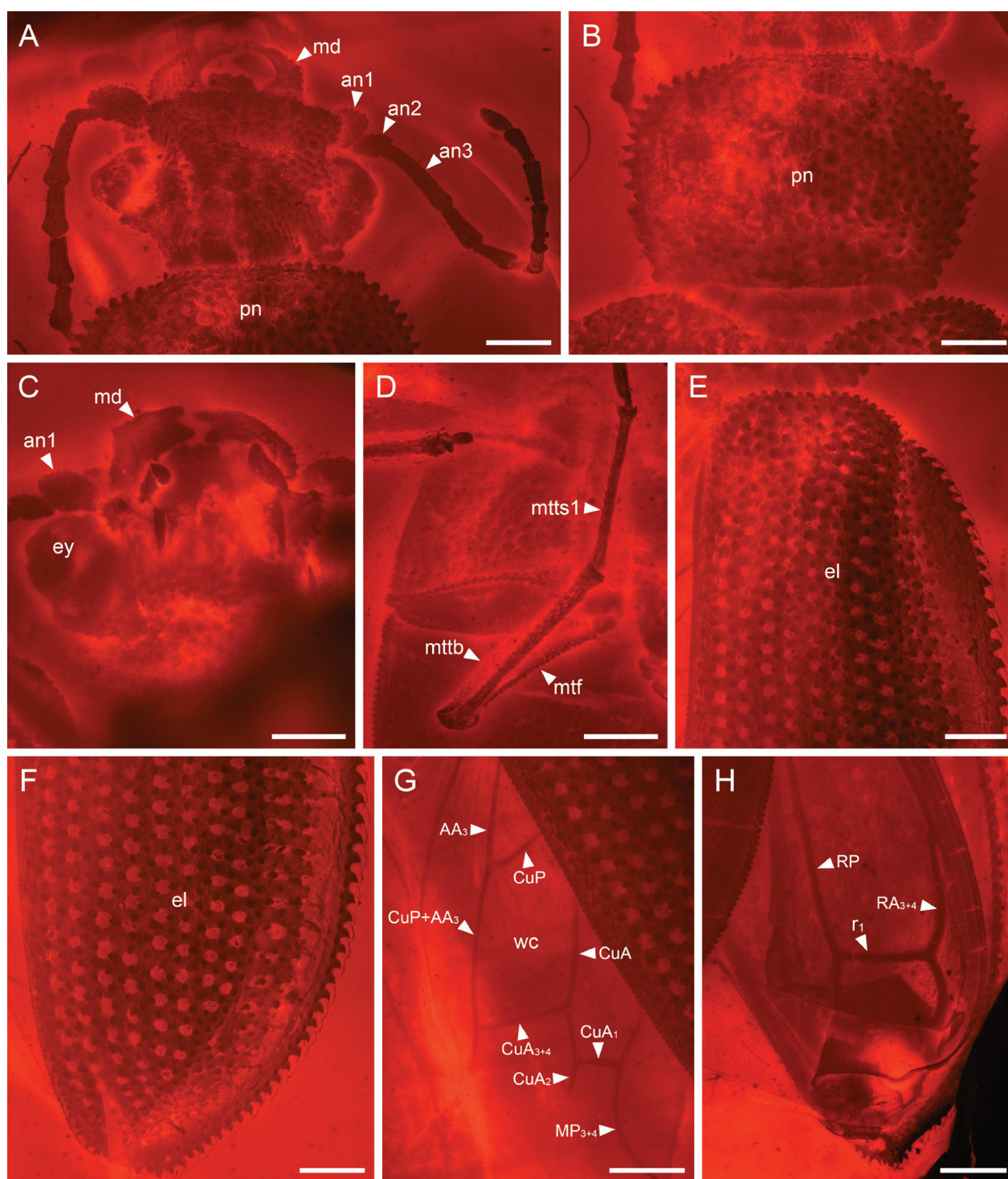


Figure 3. Details of *Omma forte* sp. nov., holotype, NIGP176634, under widefield fluorescence. **A.** Head, dorsal view; **B.** Prothorax, dorsal view; **C.** Head, ventral view; **D.** Hind leg, ventral view; **E.** Elytral base, dorsal view; **F.** Elytral apex, dorsal view; **G.** Hind wing, dorsal view; **H.** Hind wing, ventral view. Abbreviations: an1–3, antennomeres 1–3; el, elytron; ey, compound eye; md, mandible; mtf, metafemur; mttb, metatibia; mtts1, metatarsomere 1; pc, procoxa; pf, profemur; pn, pronotum; wc, wedge cell. Scale bars: 500 μ m.

Legs long and slender. Tibiae with at least one well-developed spur. Tarsi long and slender; metatarsus especially long; metatarsomere 1 about as long as metatibia (Fig. 3D). Pretarsal claws simple.

Abdomen with five coplanar ventrites, separated by distinct grooves (Fig. 4I).

Remarks. The new species can be confidently assigned to *Omma*. The length of maxillary and labial palps is a key diagnostic character separating *Beutelius* from *Omma* (Escalona et al. 2020). *Omma forte* sp. nov. has short maxillary and labial palps, not reaching the level of the eyes, which is in accordance with *Omma*. The hind

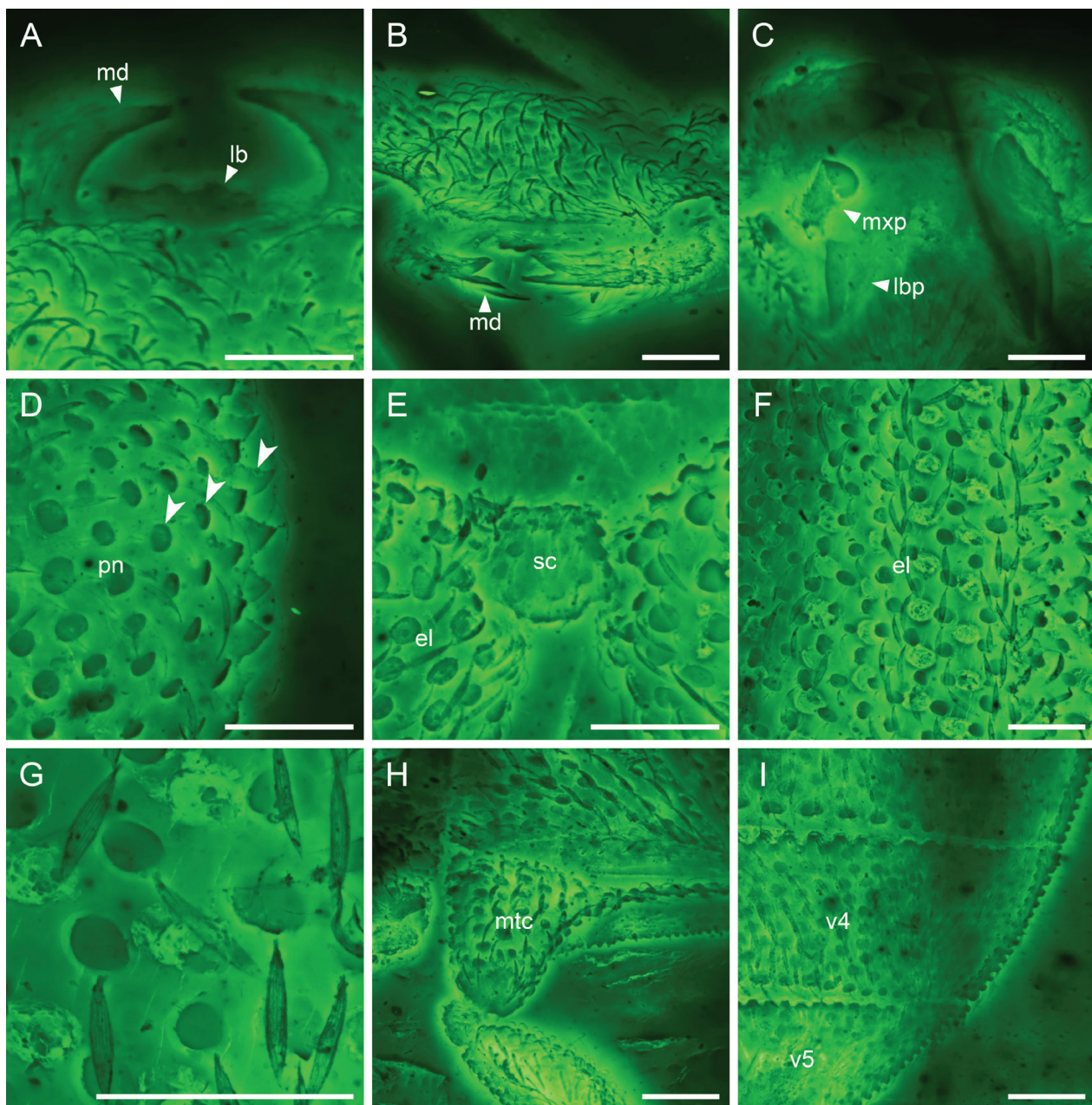


Figure 4. Details of *Omma forte* sp. nov., holotype, NIGP176634, under confocal microscopy, with the relative positions of the images labeled in Suppl. material 1. **A.** Mouthparts, posterodorsal view; **B.** Mouthparts, anterior view; **C.** Mouthparts, ventral view; **D.** Prothorax, dorsal view, showing the gradual change from rounded tubercles to teeth (arrowheads); **E.** Scutellum, dorsal view; **F.** Elytron, dorsal view; **G.** Scales, tubercles, and window punctures on elytron, dorsal view; **H.** Metacoxa, ventral view; **I.** Abdomen, ventral view. Abbreviations: el, elytron; lb, labrum; lbp, labial palp; md, mandible; mtc, metacoxa; mxp, maxillary palp; pn, pronotum; sc, scutellum; v4,5, ventrites 4,5. Scale bars: 300 μ m.

wing venation (especially the branching pattern of CuA) is another important character differentiating the two genera. In most beetle fossils preserved in amber, the hind wings are hidden by the elytra, and are thus not available for taxonomic purpose. Fortunately, the hind wings are partly exposed in the holotype of *O. forte*. In *O. forte*, the posterior branch of CuA (CuA₃₊₄) is fused with CuP+AA₃, closing the wedge cell, and the anterior branch of CuA (CuA₁) is fused with MP₃₊₄ (Fig. 3G), which matches perfectly with the venation of *Omma stanleyi* (fig. 64 in Escalona et al. 2020; fig. 4B in Lawrence et al. 2021), while

the CuA of *Beuteli* is unforked (figs 67–68 in Escalona et al. 2020) or with an incomplete anterior branch only (fig. 4A in Lawrence et al. 2021).

Discussion

Extant *Omma stanleyi* and *Omma* fossils from Burmese amber are characterized by the dentate anterior margin of labrum (Escalona et al. 2020; Figs 4A, 6C). Such a character is not detected in any other ommatids in Burmese



Figure 5. General habitus of *Omma* cf. *manukyani*, NIGP176635, under incident light. **A.** Dorsal view; **B.** Ventral view. Scale bars: 1.5 mm.

amber we examined (though it would be hard to confirm the state in other compression fossils). Thus, this character could possibly be an autapomorphy of *Omma* and the closely related *Beutelius*. The presence of scales (ribbed scale-like setae) has been suggested as a diagnostic feature separating *Beutelius* from *Omma* (Escalona et al. 2020). In the newly discovered fossil *O. forte*, the setae on elytra are relatively slender, which is kind of similar to that of extant *O. stanleyi*. However, under confocal microscopy, the ribs could be clearly seen on the flat setae of *O. forte* (Fig. 4G), suggesting the interrelationships among *Omma* and *Omma*-like species might be more complicated.

Numerous Mesozoic fossils have been assigned to the genus *Omma*. Unfortunately, as noted by Escalona et al. (2020), some key diagnostic characters (e.g., anterior de-

pression in the gulamentum) are not easily available for many compression/impression fossils, making it hard to validate their generic attribution. Escalona et al. (2020), nevertheless, confirmed the placement of several fossil *Omma* species, including the Late Triassic *O. liassicum* Crowson. However, the key characters such as mouthparts and gulamentum are not well-preserved in *O. liassicum* as well. Besides, in its holotype, the propleuron is likely to be separated from the prosternum by a distinct suture (Fig. 1B). As such, we think *O. liassicum* cannot be confidently differentiated from *Beutelius* (and even some more distantly related genera, e.g., *Bukhkalius* Kirejtshuk & Jarzembowski; Li et al. 2021).

Kirejtshuk (2020) created the genus *Cionocups* to accommodate a new species from Burmese amber, *Cionocups manukyani*. He noted that *Cionocups* is similar

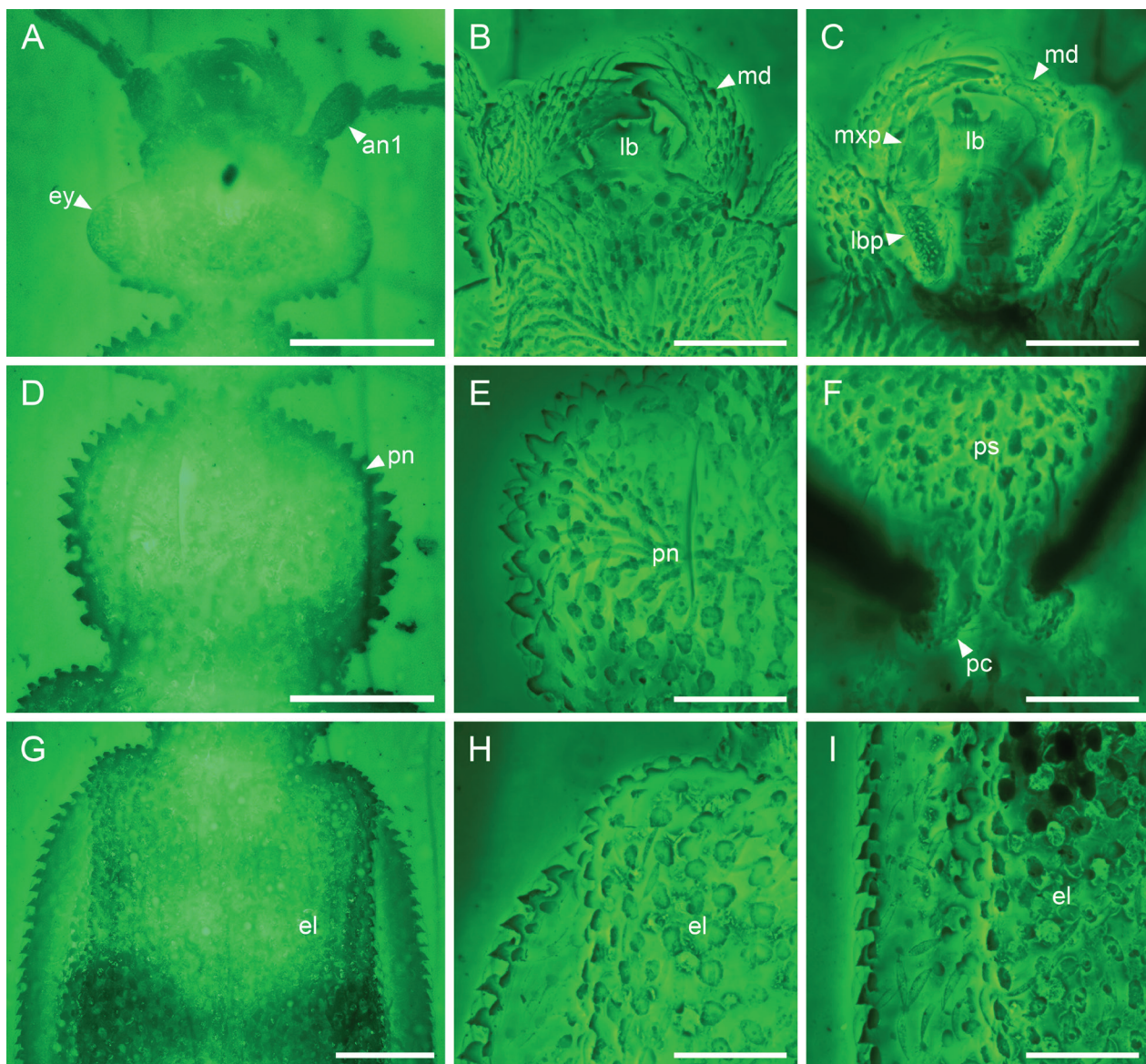


Figure 6. Details of *Omma* cf. *manukyani*, NIGP176635, under widefield fluorescence (A, D, G) or confocal microscopy (B, C, E, F, H, I), with the relative positions of the confocal images labeled in Suppl. material 1. A–C. Head, dorsal view (A, B) or ventral view (C); D–F. Prothorax, dorsal view (D, E) or ventral view (F); G–I. Elytra, dorsal view. Abbreviations: an1, antennomere 1; el, elytron; ey, compound eye; lb, labrum; lbp, labial palp; md, mandible; mxp, maxillary palp; pc, procoxa; pn, pronotum; ps, prosterum; v4,5, ventrites 4,5. Scale bars: 600 µm (A, D, G); 300 µm (B, C, E, F, H, I).

to *Cionocoleus*, an extinct genus found in the Cretaceous of Eurasia. *Cionocoleus* shares a similar morphology with extant *Omma*, except for the lack of window punctures on the elytra (Tan et al. 2007). *Cionocups*, however, is clearly different from *Cionocoleus* in having clear window punctures on the elytra, though somewhat smaller than that of *Omma*. Thus, *Cionocups* is more similar to extant *Omma*, rather than *Cionocoleus*. *Cionocups manukyani* differs from extant *O. stanleyi* in antennae longer and with serration (teeth) along the lateral sides of pronotum and elytra (Kirejtshuk 2020). However, in some fossil *Omma* species, the antennae can also be elongated. For example, the antennae of *O. lii* and *O. forte* also reach the elytral base when posteriorly directed (Fig. 2). Besides, our newly reported *O. forte* also possesses teeth along the sides of

pronotum and elytra (Fig. 3B, E, F). Detailed observations under confocal microscopy suggest that the difference between teeth and rounded tubercles is not always distinct, with a set of transitional states between the two extremes (Figs 4B, 6E). Therefore, we suggest that the character combination of *C. manukyani* is not unique enough for a separate genus. Here *Cionocups* is considered as a junior synonym of *Omma* and *C. manukyani* is transferred to the genus *Omma*, as *Omma manukyani* comb. nov.

Data availability

The original confocal data are available in the Zenodo repository (<https://doi.org/10.5281/zenodo.5693059>).

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Supplementary material 1

Habitus of *Omma forte* and *O. manukyani*, with the relative positions of confocal images in Figs 4 and 6 labeled

Authors: Yan-Da Li, Di-Ying Huang, Chen-Yang Cai
Data type: PDF file

Explanation note: Figure S1. General habitus of *Omma forte* sp. nov., holotype, NIGP176634, under widefield fluorescence. Whiterectangles indicate the regions magnified in Figure 4. Figure S2. General habitus of *Omma* cf. *manukyani*, NIGP176635, under widefield fluorescence. White rectangles indicate the regions magnified in Figure 6.

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