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# The second hemiphlebiid damselfly (Odonata: Zygoptera) from mid-Cretaceous Burmese amber

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*Burmahemiphlebia zhangii* Zheng et al., 2017 is the dominant damselfly found in Burmese amber. Here, a new hemiphlebiid damselfly, *Burmahemiphlebia hui* sp. nov., is described representing the second *Burmahemiphlebia* species discovered in Burmese amber. *Burmahemiphlebia hui* sp. nov. differs from *Burmahemiphlebia zhangii* in having more postnodal cross-veins, CuP and the separating point of AA from AP basal of  $A \times 1$ , Arc aligned with  $A \times 2$ , RP2 base closer to N than to Pt, and IR1 five cells distal of RP2 base. The new damselfly is extremely rare and the only one known from Burmese amber, unlike *Burmahemiphlebia zhangii*.

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Key words: hemiphlebiidae; zygoptera; cenomanian; cretaceous; Burmese amber

HEMIPHLEBIIDAE is sister to all other Lestoidea (Dijkstra *et al.* 2014). It comprises only one extant species *Hemiphlebia mirabilis* Selys-Longchamps, 1868 inhabiting densely vegetated wetlands of Australia (Cordero-Rivera 2015, 2016), and eight fossil genera recorded from the Late Jurassic to Late Cretaceous worldwide (Zheng *et al.* 2017, Felker & Vasilenko 2018). Only one species, *Burmahemiphlebia zhangii* Zheng *et al.* 2017, has been described previously from Burmese amber (Zheng *et al.* 2017). *Burmahemiphlebia zhangii* is the most abundant species in Burmese amber (Zheng *et al.* 2018), with over 150 species having been found based on the collections of the present authors. *Burmahemiphlebia zhangii* was probably gregarious in the tropical forest of north Myanmar, with five individuals having been found in an amber piece. It is characterized by veins MP and CuA being very short, and a rectangular discoidal cell in the hind wing. The hemiphlebiid damselflies generally have an open discoidal triangle in the forewing and a closed one in the hind wing. However, the openness of this discoidal cell varies: some *H. mirabilis* have discoidal cells closed in both pairs of wings and some have discoidal cells open in the hind wing (Cordero-Rivera 2015). Here, a new species of *Burmahemiphlebia* is described, representing the second hemiphlebiid damselfly species in Burmese amber.

## Material and methods

The specimen described herein was collected in the Hukawng Valley (26°29'N, 96°35'E) of Kachin Province, Myanmar (locality indicated by Kania *et al.* 2015, Fig. 1). This Burmese amber is radiometrically dated at  $98.79 \pm 0.62$  Ma (earliest Cenomanian; Cohen *et al.* 2013) based on U–Pb zircon dating of the volcanic host rock (Shi *et al.* 2012).

The amber containing the damselflies is yellow and transparent. Photographs were taken using a Zeiss Stereo Discovery V16 microscope system and Zen software. In most instances, incident and transmitted light were used simultaneously. All images are digitally stacked photomicrographic composites of approximately 40 individual focal planes created using the free software Combine-ZP for a better illustration of the 3D structures. Line drawings were prepared from photomicrographs using image-editing software (CorelDraw X7 and Adobe Photoshop CS6). The specimens are housed in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS). All taxonomic acts established in the present work have been registered in ZooBank (see below), together with the electronic publication LSID: urn:lsid:zoobank.org:pub:F4340336-46F4-472B-ADBF-60F232EFB242.

The dragonfly venation nomenclature used in this paper is based on the interpretations of Riek (1976) and Riek & Kukalová-Peck (1984), as modified by Nel *et al.* (1993) and Bechly (1996). The higher

classification of fossil and extant Odonatoptera followed in the present work is based on the phylogenetic system proposed by Bechly (1996). Wing abbreviations are as follows: AA, anterior anal; AP, posterior anal; Arc, arculus; Ax, primary antenodal cross-vein; Cr, nodal cross-vein; CuA, cubitus anterior; CuP, cubitus posterior; DC, discoidal cell; IR, intercalary radial vein; MA, median anterior; MP, median posterior; N, nodus; Pt, pterostigma; RA, radius anterior; RP, radius posterior; ScP, subcosta posterior; Sn, subnodal cross-vein. All measurements are given in millimetres.

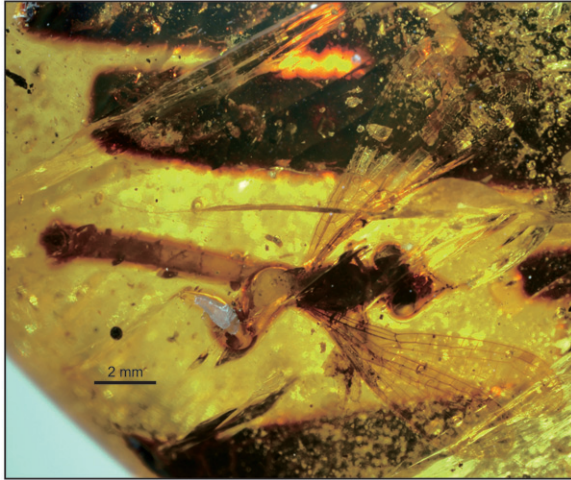


Fig. 1. *Burmahemiphlebia hui* sp. nov., holotype (NIGP168256), photomicrograph of damselfly in dorsal view.

## Systematic palaeontology

Order ODONATA Fabricius, 1793

Suborder ZYGOPTERA Selys-Longchamps, 1854

Family HEMIPHLEBIIDAE Kennedy, 1920

***Burmahemiphlebia*** Zheng *et al.*, 2017

*Type species.* *Burmahemiphlebia zhangii* Zheng *et al.* 2017; other species: *Burmahemiphlebia hui* sp. nov.

***Burmahemiphlebia hui*** sp. nov. (Figs. 1–4)

(urn:lsid:zoobank.org:act:5D6E0C99-ADF4-4CC7-B068-47E8DDA4F9A6)

*Etymology.* Named after Mr Zhengkun Hu, the donor of the type specimen.

*Diagnosis.* Six or seven postnodal cross-veins present; CuP slightly basal of Ax1; AA originating from AP slightly basal of Ax1; Arc aligned with Ax2; base of RP2 closer to N than to Pt; IR1 five cells distal of RP2 base.

*Holotype.* NIGP168256, four complete wings attached to body; head, thorax and basal abdomen present.

*Locality and age.* Hukawng Valley, Kachin Province, Myanmar; earliest Cenomanian, Late Cretaceous.

*Description.* Two pairs of hyaline wings attached to body (Fig. 1). Preserved length 12.2 mm (head, thorax and basal abdomen). Head dark, with separated eyes (Fig. 4A). Right forewing well preserved (Figs 2A, 3A). Wing length 8.6 mm, width at level of N 1.2 mm; length from wing base to Arc 1.3 mm, from Arc to N

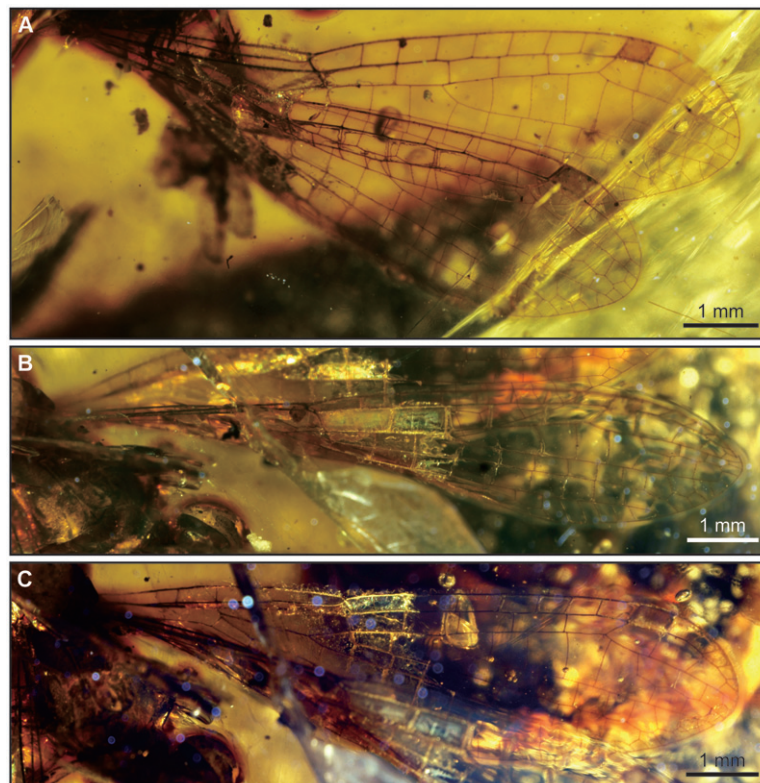


Fig. 2. *Burmahemiphlebia hui* sp. nov., holotype (NIGP168256), photomicrograph of right fore- and hind wing (A), left fore- (B) and hind wing (C).



1.7 mm, from N to Pt base 4 mm, from Pt base to wing apex 1.7 mm. Primary antenodal cross-vein Ax2 present, aligned with Arc. DC open basally (Fig. 4B). Subdiscoidal cell free and elongate. CuP ending almost on base of AA. Nodal structures well preserved, Cr and Sn obliquely arranged. Midfork (base of RP3/4) nearer to N than to Arc. IR2 base one cell distal of midfork, lying 0.6 mm distally, aligned with Sn. RP2 originating 1.5 mm distal of Sn, nearer to N than to Pt. RP1 with strong angle below pterostigmal brace. MA distally zigzagged and long, reaching posterior wing margin two cells distal of RP2 base, 5.8 mm distal of wing base. MP curved, very short, one cell long. Pt short and broad (Fig. 4C), 0.4 mm long and 0.3 mm

wide, covering one cell; pterostigmal brace strong and oblique.

Left hind wing (Figs. 2C, 3B) well preserved. Wing length 8.8 mm, width at level of N 1.7 mm; length from base to Arc 1.6 mm, from Arc to N 1.8 mm; from N to Pt base 3.9 mm, from Pt base to wing apex 1.5 mm. Primary antenodal cross-veins preserved, Ax2 0.5 mm distal of Ax1; no subantenodal cross-vein present. Arc angular and aligned with Ax2. DC closed basally (Fig. 4D), free, elongate and quadrangular, 0.5 mm long and 0.2 mm wide. Subdiscoidal cell free and elongate. CuP almost ending on base of AA. AA separated from AP 0.1 mm basal of Ax1. Nodal structures well preserved, Cr and Sn slightly obliquely aligned.

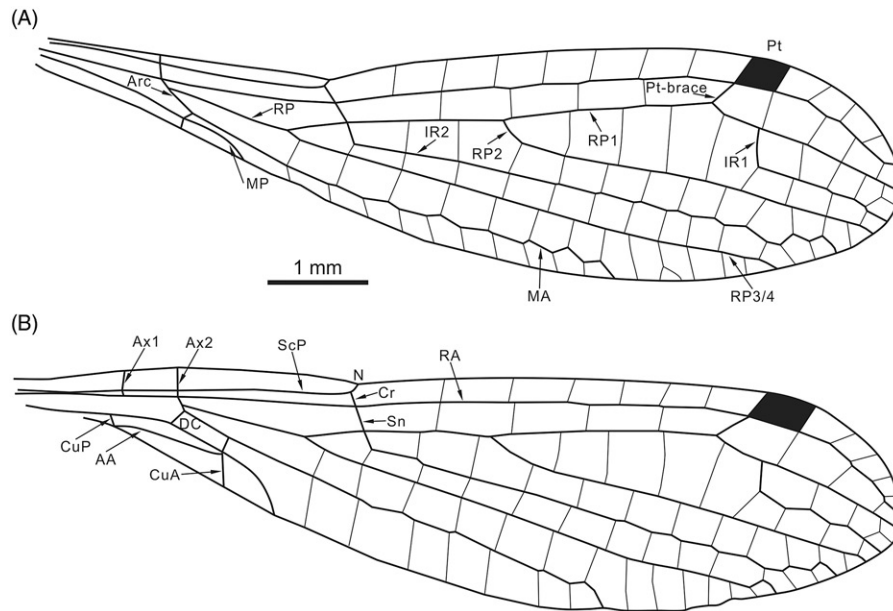


Fig. 3. *Burmahemiphlebia hui* sp. nov., holotype (NIGP168256), line drawing showing venation of right forewing (A) and left hind wing (B).

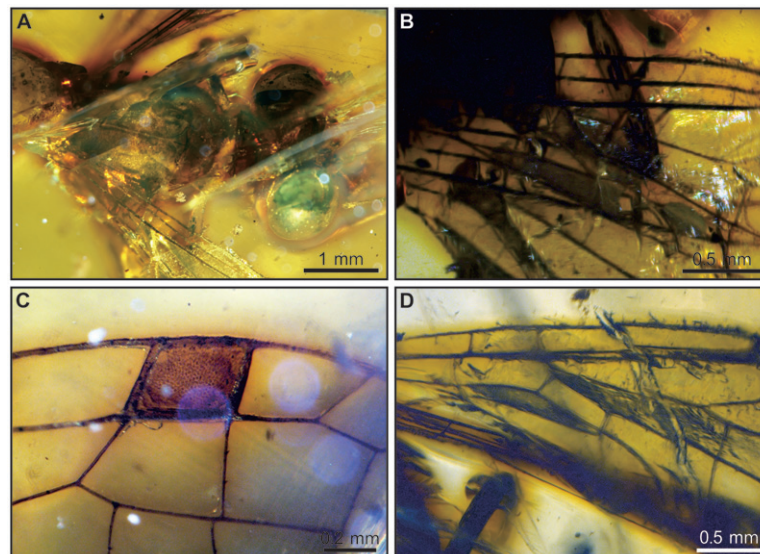


Fig. 4. *Burmahemiphlebia hui* sp. nov., holotype (NIGP168256), photomicrograph of head and thorax in dorsal view (A), discoidal (B) and pterostigmal (C) areas of right forewing, and discoidal area of left hind wing (D).

Midfork nearer to N than to DC. IR2 base aligned with Sn, 0.6 mm distal of midfork. RP2 originating 1.3 mm distal of Sn, nearer to N than to Pt. RP1 with strong angle below pterostigmal brace. MA distally zigzagged and long, reaching posterior wing margin two cells distal of RP2 base, 5.9 mm distal of wing base. MP curved, very short, one cell long. Pt short and broad, 0.5 mm long and 0.3 mm wide, and one cell long; pterostigmal brace strong and oblique.

## Discussion

The new damselfly is a member of Hemiphlebiidae based on the following characters (Bechly 1996, Zheng *et al.* 2017): discoidal triangle open in forewing but closed in hind wing, postnodal and postsubnodal cross-veins misaligned, IR2 originating one cell distal of mid-fork, lestine oblique vein secondarily absent, wing base with distinctly reduced petiolation, vein RP1 kinked at insertion of pterostigmal brace vein, all intercalary veins except IR1 and IR2 suppressed, tiny size and metallic green structural body colour.

Within Hemiphlebiidae, the new species shares all the generic characters of *Burmahemiphlebia* (Zheng *et al.* 2017): forewing DC open basally, hind wing DC closed and quadrangular, IR1 originating opposite distal end of Pt, MP extremely short and one cell long, and short CuA reduced to oblique vein. Moreover, it has a small wing size (about 9 mm long), postnodal cross-veins misaligned with postsubnodal cross-veins, the midfork basal of N, and the base of IR2 opposite Sn, being similar to *Burmahemiphlebia zhangii*; however, it differs from *B. zhangii* in having six or seven postnodal cross-veins instead of four, Arc aligned with Ax2 instead of slightly distal of Ax2 in the forewing, base of RP2 nearer to N than to Pt instead of at mid-distance between N and Pt, CuP and the separating point of AA from AP basal of Ax1 instead of distal of Ax1, and IR1 base originating five cells distal of RP2 base instead of three cells. Based on these differences, we erect a new species of *Burmahemiphlebia* for the new damselfly.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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