Downloaded from http://sp.lyellcollection.org/ by guest on February 16, 2022

New material for Peleserphidae (Proctotrupoidea, Hymenoptera) in Mid-Cretaceous Burmese (Kachin) amber

Yu Yu[1], Guifang Hu[1], Yunyang Zhu[1], Yuxiao Li[1], Wenjun Jiang[1], Alexandr P. Rasnitsyn[2,3], Haichun Zhang[4] and Qi Zhang[1,4]*

[1]School of Geography and Tourism, Qufu Normal University, Rizhao 276826, China

[2]A.A. Borissiak Palaeontological Institute, Russian Academy of Sciences, 117647 Moscow, Russia

[3]Natural History Museum, Cromwell Road, London SW7 5BD, UK

[4]State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing 210008, China

APR, 0000-0002-6350-0040; QZ, 0000-0001-5376-5961

*Correspondence: zhqi1105@126.com

Abstract: A new female wasp from Cenomanian Burmese amber was described as *Peleserphus qufuensis* sp. nov. in the proctotrupoid family Peleserphidae, which emerged in the Late Jurassic–mid-Cretaceous. It provides new data on the diversity of the family in Cenomanian Burmese amber and extends the records to five species.

Peleserphidae, a small aberrant family of basal Proctotrupomorpha, was considered to be an endemic family in Burmese (Kachin) amber (Zhang *et al.* 2018*a*) until a new basal genus and species, *Arkadyserphus leleji*, was recently described from the Upper Jurassic Karabastau Formation at the Karatau locality in southern Kazakhstan (Rasnitsyn 2021). Now, including the new species described herein, the family contains three genera and five species (Zhang *et al.* 2018*a*; Rasnitsyn 2021; also see below). Basal Proctotrupomorpha (Mesoserphidae and Peleserphidae) flourished during the Jurassic and survived up to the mid-Cretaceous (Li *et al.* 2017; Zhang *et al.* 2018*a* and references therein). Herein we describe a new specimen of Peleserphidae from Kachin amber to help in expanding our knowledge of this family.

Material and methods

The new female specimen was collected from the Hukawng Valley of Kachin State, northern Myanmar. Based on the radiometric dating of zircons, the age of the Kachin amber was established as approximately 98.79 $\pm$ 0.62 Ma (Shi *et al.* 2012) and, for the reason given in Zhang *et al.* (2018*b*), we informally referred the period to the mid-Cretaceous.

The new specimen was preserved in a clear and yellowish piece of amber, deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS), Nanjing, China. Observations and photographs were made using a Nikon SMZ-10R stereoscopic microscope and VHX 5000 digital microscope platform. Helicon Focus Pro 64 was used to stack photographs for a better depth of field. The figures were prepared using CorelDraw X7 and Adobe Photoshop CS3. All taxonomic acts established in the present work have been registered in ZooBank (http://zoobank.org/: see below), together with the electronic publication LSID: urn:lsid:zoobank.org:pub:545464C8-9472-45BC-8642-1978CD831B52.

Systematic palaeontology

Order **Hymenoptera** Linne, 1758
Suborder **Vespina** Laicharting, 1781
Superfamily **Proctotrupoidea** Latreille, 1802
Family **Peleserphidae** Zhang, Rasnitsyn, Wang and Zhang, 2018
Genus *Peleserphus* Zhang, Rasnitsyn, Wang and Zhang, 2018

Type species. *Peleserphus brachyurus* Zhang, Rasnitsyn, Wang and Zhang, 2018*a*, *P. genalis* Zhang, Rasnitsyn, Wang and Zhang, 2018*a*, and *Peleserphus qufuensis* sp. nov. described herein.

Diagnosis (emended). Head prognathous, only slightly wider than pronotum. Antenna 16–18-segmented. Forewing with 3r cell long and narrow, 1m-cu partially present. Hindwing without closed cells. Hind tibia distinctly incrassate and

From: Chang, S.-C. and Zheng, D. (eds) *Mesozoic Biological Events and Ecosystems in East Asia*. Geological Society, London, Special Publications, **521**, https://doi.org/10.1144/SP521-2021-128
© 2022 The Author(s). Published by The Geological Society of London. All rights reserved.
For permissions: http://www.geolsoc.org.uk/permissions. Publishing disclaimer: www.geolsoc.org.uk/pub_ethics

Downloaded from http://sp.lyellcollection.org/ by guest on February 16, 2022

somewhat narrowed at apex. Female hypopygium occupying most of metasomal venter. Ovipositor sheaths about 0.2 times as long as metasoma.

Remarks. The genus differs from other genera of Peleserphidae in having antenna 16–18-segmented (v. either 13 or 21 in other genera), hind tibia distinctly incrassate and somewhat narrowed at apex (v. narrow and widest apically), and ovipositor sheaths very short (one-fifth v. one-third or more as long as metasoma). *Peleserphus* is similar to the other mid-Cretaceous genus *Peleproctus* but different from the Jurassic genus *Arkadyserphus*; additionally, the genus *Peleproctus* has head prognathous, forewing with 3r cell long and narrow, 1m-cu partially present, and hypopygium very long. Further, the genus differs from *Peleproctus* in having hindwing without closed cells.

Peleserphus qufuensis Rasnitsyn, Zhang and Zhang sp. nov.

LSID: urn:lsid:zoobank.org:act:9FCC5434-4374-49F0-BA0B-83DB832EF926
(Fig. 1)

Etymology. The specific epithet is from the name of the organization of most of the authors and Qufu is also known as the birth place of Confucius.

Diagnosis. Antennae 18-segmented, attached close. Forewing with M and Cu not reaching wing margin. Hindwing with no veins coloured but R. Ovipositor sheath scarcely longer than basal vein.

Holotype. NIGP177045. The amber piece is transparent yellow, with little scattered debris. Although the amber was polished for clearer observation, it is hard to observe the wasp in the dorsal and ventral views. The specimen is well preserved and complete, with only a few small bubbles attached to body. It has almost no deformation. A few cracks exist, especially before the head and after the metasoma, which make these body structures difficult to observe.

Locality and horizon. Hukawng Valley, Kachin State, northern Myanmar; lowermost Cenomanian or uppermost Albian, mid-Cretaceous.

Description. Body and antennae dark brown with thin setae.

Head broad with shape of rounded cube, with three ocellus arranged as a triangle, with compound eyes large, elongate-oval, distant from mandibular base for about scape width, with short ridges neatly rowed along the edge of eyes and on widened lateral (lower) part of occipital carina. Occipital carina complete and apparently reaching mandibular base. Temple wider than eye. Antennae attached distant from eye margin and close to each other and to clypeus, 18-segmented. Scape almost 3 times as long as mean width, gradually narrowed basally. Pedicel thinner than and half as long as scape. All flagellomeres of same thickness. F1–F3 long and 5 times longer than width; F4–F15 getting shorter in turn, F15 still longer than wide; F16 as long as F14 + F15, with pointy end. Maxillary palps thin and long, with three visible segments 4 times longer than wide. Labial palps not visible. Mandible half as wide as long in lateral view, with cutting edge parallel to mandibular rotational axis.

Mesosoma slightly narrower than head, 2.5 times as long as high. Pronotum as long as high in lateral view, with four spines in two transverse arranged rows. Mesotergum half as long as mesosoma, mesoscutum with numerous spines and front edge arched, Pronotum and mesoscutellum about equal in length and shorter than metanotum, metanotum short. Propodeum coarsely reticulate. Legs with mid- and hind-coxae same in shape, about twice as long as wide, all trochanters cylindrical, longer than wide, all trochantelli half longer than trochanters and slightly longer than wide; fore and hind legs with tibia as long as femur, midleg with femur longer than tibia, fore–mid–hind leg with tibial spur formula 1–2–2, hind leg with tibia thicker than femur. Fore tarsus with first segment as long as the length of second and third segments combined, third shorter than second, fourth half as long as third and starts to get sharp in the middle, fifth longer than fourth and fifth with two spur in the apex. Mid and hind legs with first tarsomere half as long as the whole. Forewing with pterostigma long and gradually narrowed distally after issuing 2r-rs at its midlength, 2r-rs oblique, slightly longer than pterostigma width. Basal vein (1-RS and 1-M) reaching R before pterostigma for about length of 2r-rs, cell 3r narrow and elongate, Rs straight and reaching anterior wing margin before wing apex, 2-RS + M short but distinct with colour fading away basally, 1m-cu remnant much shorter than 2-RS + M. Distal M and Cu almost paralell and tapered off to a point not reaching outer wing margin. Cross-veins 1cu-a and 2cu-a almost coinciding with basal vein and 1m-cu, respectively. A fold-like thin and not connecting with 1cu-a and 2cu-a. Hindwing with three hamuli, with only R vein visible. Metasoma with seven segments and widest at forth segment. Segments 1–6 about same length and uniform in general shape. First tergum with anterior face vertical to both its dorsal surface and to acrotergite. Seventh sternum forming most of metasomal venter, almost reaching the level of first tergum. Cerci thin, widened distally, longer than half ovipositor sheath. Ovipositor sheaths gradually widened apically, conspicuously setose, ovipositor broken.

Dimensions. Total body length, 7.6 mm; head length, 1.2 mm; mesosomal length, 2.8 mm;

Downloaded from http://sp.lyellcollection.org/ by guest on February 16, 2022

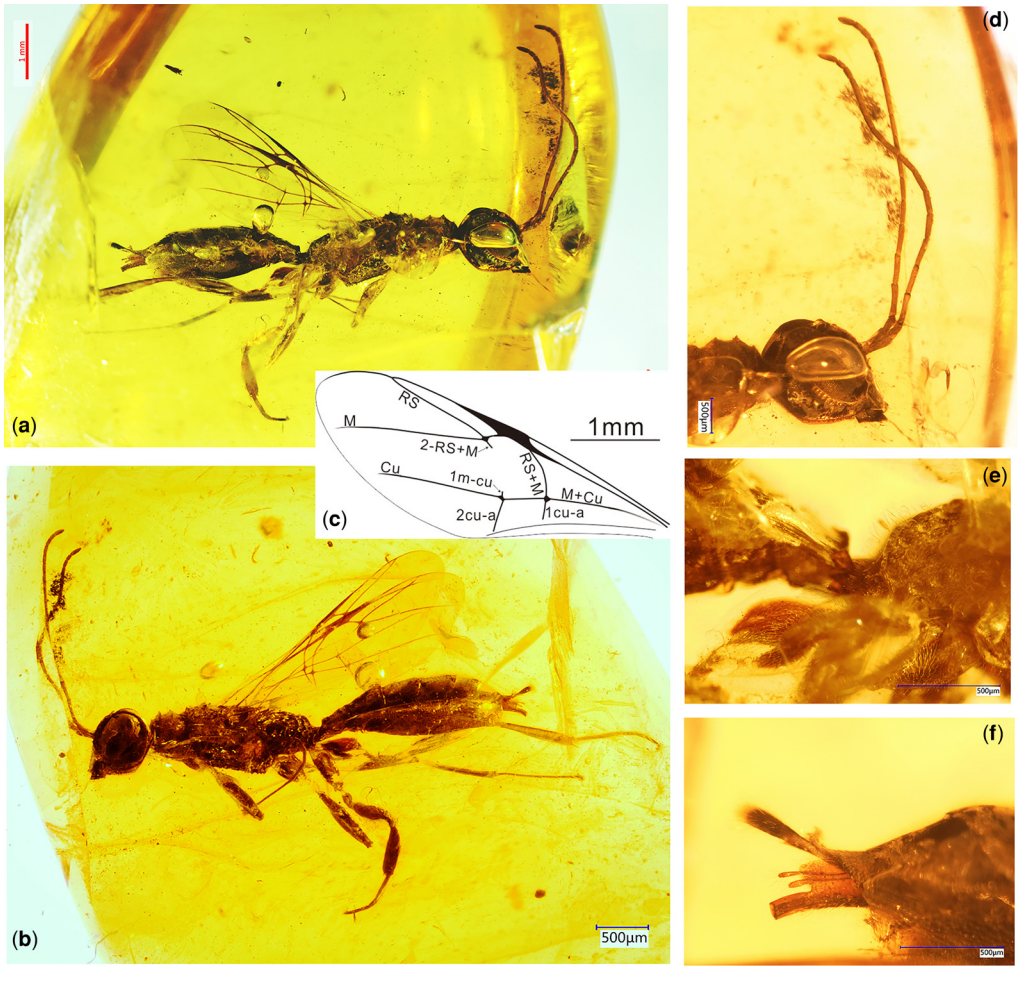


Fig. 1. (**a**) Right side; (**b**) left side; (**c**) forewing venation; (**d**) head and antenna; (**e**) propodeum; and (**f**) apex of matasoma. Note all scale bars.

metasomal length, 3.0 mm; antennal length, 4.2 mm; forewing length, 4.4 mm, width, 1.4 mm; hindwing length, 2.3 mm; cercus length 0.33 mm, ovipositor sheath length, 0.6 mm.

Remarks. The new species differs from congeners by antennae 18-segmented, longer and attached close to each other, ovipositor particularly short, and other characters mentioned in the 'Diagnosis'.

Discussion

Proctotrupoidea *s. str.* was defined (even though implicitly) as Proctotrupomorpha other than Microprocta by Rasnitsyn and Öhm-Kühnle (2020), all extant taxa of Proctotrupoidea *s. str.* was identified as a monophyletic group by Heraty *et al.* (2011) and Sharkey *et al.* (2012). The family Peleserphidae is considered to be close to the basal proctotrupomorph family Mesoserphidae (Zhang *et al.* 2018*a*) and differs from the latter by several striking apomorphies including RS + M forking as late as at cross-vein 2r-rs and so mimicking 'RS_2' of Pelecinidae. Up to now, the family contains three genera and five species recorded from the Late Jurassic to the mid-Cretaceous in Central and SE Asia (western Angaraland and the island of West Burma block of the Late Mesozoic).

The Burmese amber contains diverse Hymenoptera with a high proportion (23% of the families recorded) of endemic families (Rasnitsyn and Öhm-Kühnle 2021), which attests the fauna as highly original, even though with some roots tracing to elsewhere. Besides the present case traceable to

Downloaded from http://sp.lyellcollection.org/ by guest on February 16, 2022

western Angaraland, there are a few more groups of Hymenoptera with restricted geographical distribution in the Kachin fauna that display more or less distinct ties with remote past biotas. These are Archaeoserphitidae, known otherwise only in the Cretaceous of Gondwanaland (the Lebanese amber), Rotoitidae, the eponym of the *Baeomorpha* biota of the Cretaceous north temperate zone, and Ohlhoffiidae, recorded in Kachin amber as well as in the Lower Cretaceous of Spain (Rasnitsyn and Öhm-Kühnle 2021 and references therein). These results confirm the hypothesis of the insular nature of the West Burma Plate isolated in the midst of the Tethys Sea (Rasnitsyn and Öhm-Kühnle 2018; Zhang *et al.* 2018*b*; Westerweel *et al.* 2019). Now, this new species increases our knowledge of the unique Burmese Kachin amber.

Acknowledgements We are deeply grateful to all of the reviewers, and also thank Chunpeng Xu and Xiangdong Zhao for help in preparing the specimen.

Author contributions **YY**: writing – original draft (equal); **GH**: formal analysis (equal), software (lead); **YZ**: formal analysis (equal), software (equal); **YL**: software (supporting), visualization (equal); **WJ**: formal analysis (equal), visualization (equal); **APR**: conceptualization (equal), supervision (equal), validation (equal); **HZ**: resources (supporting), supervision (equal), writing – review & editing (equal); **QZ**: conceptualization (equal), writing – original draft (lead).

Funding The study was supported by National Training Program of Innovation and Entrepreneurship for Undergraduates (grant No. 201910446015 to Yu Yu), State Key Laboratory of Palaeobiology and Stratigraphy (Nanjing Institute of Geology and Palaeontology, CAS) (grant No.193131 to Qi Zhang) and Shandong Province Natural Science Foundation (grant No. ZR2020QD022 to Qi Zhang).

Data availability Data sharing is not applicable to this article as no datasets were generated or analysed.

References

Heraty, J., Ronquist, F. *et al*. 2011. Evolution of the hymenopteran megaradiation. *Molecular Phylogenetics and Evolution*, **60**, 73–88, https://doi.org/10.1016/j.ympev.2011.04.003

Latreille, P.A. 1802. *Histoire Naturelle. Entomologie, ou Histoire naturelle des Crustacés, des Arachnides et des Insectes*. F. Dufart, Paris, 1–467.

Laicharting, J.N. von 1781. *Verzeichniß und Beschreibung der Tyroler-Insecten*. I. Theil. Käferartige Insecten. I. Band, 1–248.

Li, L., Rasnitsyn, A.P., Shih, C. and Ren, D. 2017. The Mesozoic family Mesoserphidae and its phylogeny (Hymenoptera: Apocrita: Proctotrupoidea). *Journal of Systematic Palaeontology*, **15**, 617–639, https://doi.org/10.1080/14772019.2016.1217949

Linne, C. 1758. *Systema Naturae per Regna Tria Naturae, Secundum Classes, Ordines, Genera, Species, Cum Characteribus, Differentiis, Synonymis, Locis*. Laurentius Salvius, Stockholm, 1–824.

Rasnitsyn, A.P. 2021. First Jurassic representative of the extinct family Peleserphidae (Hymenoptera: Proctotrupoidea). *Journal of Hymenoptera Research*, **84**, 295–300, https://doi.org/10.3897/jhr.84.65493

Rasnitsyn, A.P. and Öhm-Kühnle, C. 2018. Three new female *Aptenoperissus* from mid-Cretaceous Burmese amber (Hymenoptera, Stephanoidea, Aptenoperissidae): Unexpected diversity of paradoxical wasps suggests insular features of source biome. *Cretaceous Research*, **91**, 168–175, https://doi.org/10.1016/j.cretres.2018.06.004

Rasnitsyn, A.P. and Öhm-Kühnle, C. 2020. Taxonomic revision of the infraorder Proctotrupomorpha (Hymenoptera). *Palaeoentomology*, **003**, 223–234, https://doi.org/10.11646/palaeoentomology.3.3.2

Rasnitsyn, A.P. and Öhm-Kühnle, C. 2021. Non-aculeate hymenoptera in the Cretaceous ambers of the world. *Cretaceous Research*, **124**, 104805, https://doi.org/10.1016/j.cretres.2021.104805

Sharkey, M.J., Carpenter, J.M. *et al*. 2012. Phylogenetic relationships among superfamilies of Hymenoptera. *Cladistics*, **28**, 80–112, https://doi.org/10.1111/j.1096-0031.2011.00366.x

Shi, G., Grimaldi, D.A. *et al*. 2012. Age constraint on Burmese amber based on U–Pb dating of zircons. *Cretaceous Research*, **37**, 155–163, https://doi.org/10.1016/j.cretres.2012.03.014

Westerweel, J., Roperch, P. *et al*. 2019. Burma Terrane part of the Trans-Tethyan arc during collision with India according to palaeomagnetic data. *Nature Geoscience*, **12**, 863–868, https://doi.org/10.1038/s41561-019-0443-2

Zhang, Q., Rasnitsyn, A.P., Wang, B. and Zhang, H.C. 2018*a*. Peleserphidae, a new family of basal proctotrupomorphs (Hymenoptera: Proctotrupoidea) from mid-Cretaceous Burmese amber. *Cretaceous Research*, **86**, 66–72, https://doi.org/10.1016/j.cretres.2017.12.015

Zhang, Q., Rasnitsyn, A.P., Wang, B. and Zhang, H.C. 2018*b*. Hymenoptera (wasps, bees and ants) in mid-Cretaceous Burmese amber: a review of the fauna. *Proceedings of the Geologists' Association*, **129**, 736–747, https://doi.org/10.1016/j.pgeola.2018.06.004