

Short communication

A new whip spider (Arachnida: Amblypygi) in mid-Cretaceous Kachin amber



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ABSTRACT

A new genus and species of fossil whip spider (Chelicerata: Amblypygi), *Burmacharon dunlopi* gen. et sp. nov., is described from mid-Cretaceous Kachin (Burmese) amber of Myanmar. The new genus can be distinguished from the genus *Kronocharon* by the anterior margin of the carapace being slightly procurved (projected forwards and slightly rounded), and the opisthosoma is rather elongate, almost twice as long as wide. *Burmacharon dunlopi* is the fourth species of Cretaceous amber whip spider. Our find adds some novel information to the knowledge of the morphological and taxonomic palaeodiversity of Mesozoic whip spiders.

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1. Introduction

Kachin (Burmese) amber from Myanmar hosts an abundant and diverse biota of inclusions including bryophytes, ferns, gymnosperms, angiosperms, fungi, molluscs, onychophorans, vertebrates, nematodes, and arthropods (e.g. Selden and Ren, 2017). Unusual finds in Kachin amber include an ammonite and intertidal isopods, together with diverse terrestrial arthropods, and they provide direct evidence for the age of Kachin amber and new insights into the taphonomy of the amber and the palaeoecology of Cretaceous amber forests (Yu et al., 2019).

Amblypygi (whip spiders) is an ancient order of arachnids that dates back to the Late Carboniferous Subperiod (Pocock, 1911). They are flattened with a pair of chelicerae, raptorial pedipalps and four pairs of walking legs, leg 1 being long and slender, whip shaped, acting as antennae, while the remaining legs (2–4) are used for locomotion. Amblypygi are usually found in moist tropical and

subtropical areas in tree-bark crevices, under rocks, and in caves (Weygoldt, 2000).

Amblypygi are divided into two suborders: Paleoamblypygi and Euamblypygi. The Paleoamblypygi contain only one family, Paracharontidae; Euamblypygi are further subdivided into the infraorders Charinidae (containing a family of the same name) and Neoamblypygi. Neoamblypygids are divided into the superfamilies Charontoidea (containing one family: Charontidae) and Phrynoidea (containing two families: Phrynichidae and Phrynidae) (Harvey, 2003; Prendini, 2011; Garwood et al., 2017). Importantly, the suborder Neoamblypygi also contains an extinct clade Unidistitarsata, which may be a sister group to Phrynoidea (Engel and Grimaldi, 2014). Kachin amber arachnid inclusions were first reported by Cockerell (1917a, b, 1920), and the first Kachin amber amblypygid described, *Kronocharon prendinii* Engel and Grimaldi, 2014, was considered to belong to the clade Unidistitarsata (Engel and Grimaldi, 2014). Subsequently, Wunderlich added two new species to this genus, *Kronocharon engeli* Wunderlich, 2015 and *Kronocharon longicalcaris* Wunderlich, 2015 (Wunderlich, 2015). The specimen described here in the present paper represents the

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second genus of Amblypygi found in Kachin amber, and also belongs to the clade Unidistitarsata.

2. Material and methods

The specimen described herein is from the Tanai/Danai Village in Hukawng Valley of Kachin Province, northern Myanmar (see locality in fig.1 of Yu et al., 2019). Amber from pits near Tanai/Danai in Kachin State is called as Kachin amber, or Burmese amber *sensu stricto* (Zheng et al., 2018). The geological age of Kachin amber is considered to be the earliest Cenomanian (Zherikhin and Ross, 2000; Grimaldi et al., 2002). The zircon U–Pb dating of tuffaceous siltstones in the amber-producing bed indicated an age of 98.79 ± 0.62 Ma (Shi et al., 2012), which is supported by an ammonite inclusion (Mao et al., 2018; Yu et al., 2019).

The amber piece containing the amblypygid is deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences. Observations were made using a Zeiss Stemi 508 microscope and photographs were taken with a Zeiss Stereo Discovery V16 microscope system, and measurements were obtained using Zen software. In most instances, incident and transmitted light were used simultaneously. In order to reduce the distortion caused by differential refractivity, we sandwiched the specimen between two coverslips and filled the space with glycerol. All images are digitally stacked photomicrographic composites of approximately 30 individual focal planes obtained using the software Helicon Focus 6.7.1 for a better illustration of 3D structures. Photographs and drawings were adjusted and combined into plates using CorelDraw X4 graphic software. The morphological terminology of the specimen in this paper follows Engel and Grimaldi (2014).

3. Systematic paleontology

Order Amblypygi Thorell, 1882

Suborder Euamblypygi Weygoldt, 1996

Infraorder Neoamblypygi Weygoldt, 1996

Unidistitarsata?

Family *Incertae sedis*

Genus *Burmacharon* new genus.

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Type species: *Burmacharon dunlopi* new species.

Etymology. The new genus-group name is a combination of Burma and the genus *Charon*, because the genus is found in Burmese (Kachin) amber and is similar to the extant genus *Charon*.

Diagnosis. Carapace subcircular, anterior margin of carapace projected forwards and slightly rounded, posterior border weakly concave. Pair of median eyes (set on low tubercle) and six lateral eyes present in two triads. Pedipalpal tarsus divided into the basitarsus and distitarsus, former bearing 1 curved dorsal and 1 curved ventral spine, latter bearing cleaning organ in basal part. On walking legs, tarsus divided into four tarsomere, second tarsomere divided apically to give appearance of fifth tarsomere (actually dorsal cuticle of second tarsomere divided by weakly sclerotized area and ventral sclerite undivided); oblique slit on fourth tarsomere absent and pulvilli present. Opisthosoma elongate with length-to-width ratio of about 2:1.

***Burmacharon dunlopi* sp. nov.**

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(Figs 1–4)

Etymology. The specific name is after Jason Dunlop, in recognition of his contribution to the study of fossil arachnids.

Material. Holotype (probably female). Specimen NIGP173207, stored in the Nanjing Institute of Geology and Palaeontology (NIGP), Chinese Academy of Sciences, Nanjing, China. The specimen is nearly intact in the amber piece except that the ventral side of the opisthosoma is not visible and the left walking legs are partly missing.

Locality and horizon. Kachin amber, from deposits near Tanai/Danai in the Hukawng Valley of northern Myanmar, lower Cenomanian, mid-Cretaceous (minimum 98.8 ± 0.6 Ma).

Diagnosis. As for genus.

Description. Total body length as preserved 10.3 mm (exclusive of chelicerae and pedipalps) (Fig. 1). Carapace: flattened, length (along midline) 3.5 mm, greatest width 4.1 mm; slightly wider than opisthosoma. Anterior margin of carapace relatively rounded. Median eyes present, set on low tubercle; six lateral eyes in two triads. Posterior border weakly concave. Carapace with 3 obvious depressions, round median depression with pair of shallow grooves extending from it (Fig. 2A, B).

Sternum: 3 segments visible, all segments sclerotized and convex. Tritosternum with round basis and projected anteriorly into small blunt tubercle, with two basal setae, base with traces

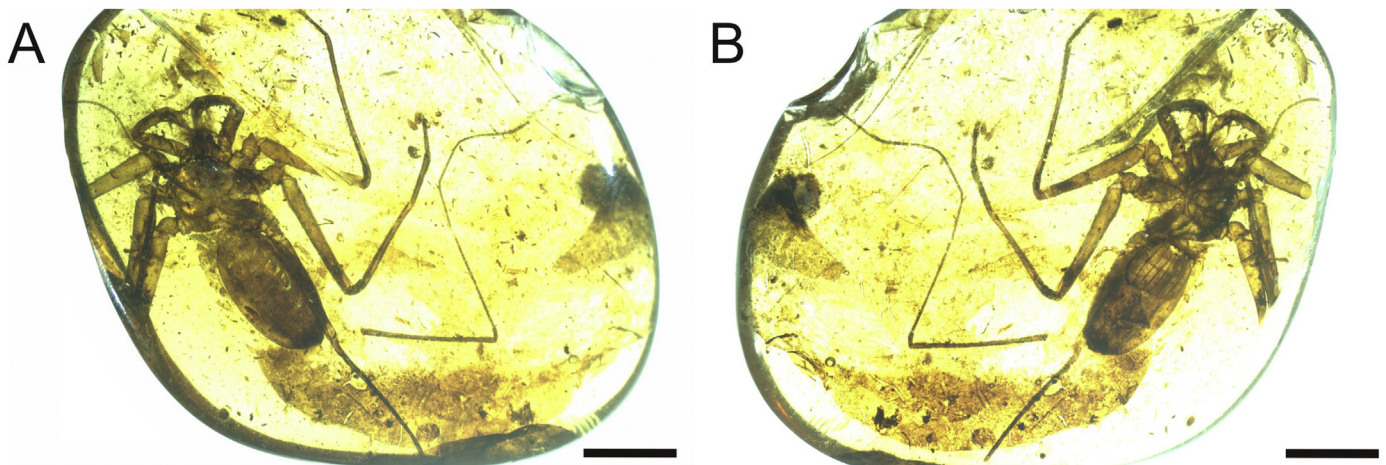


Fig. 1. Microphotographs of *Burmacharon dunlopi* gen. et sp. nov., holotype, NIGP173207. A, Microphotograph of entire specimen in dorsal view. B, Microphotograph of entire specimen in ventral view. Scale bars = 4 mm.

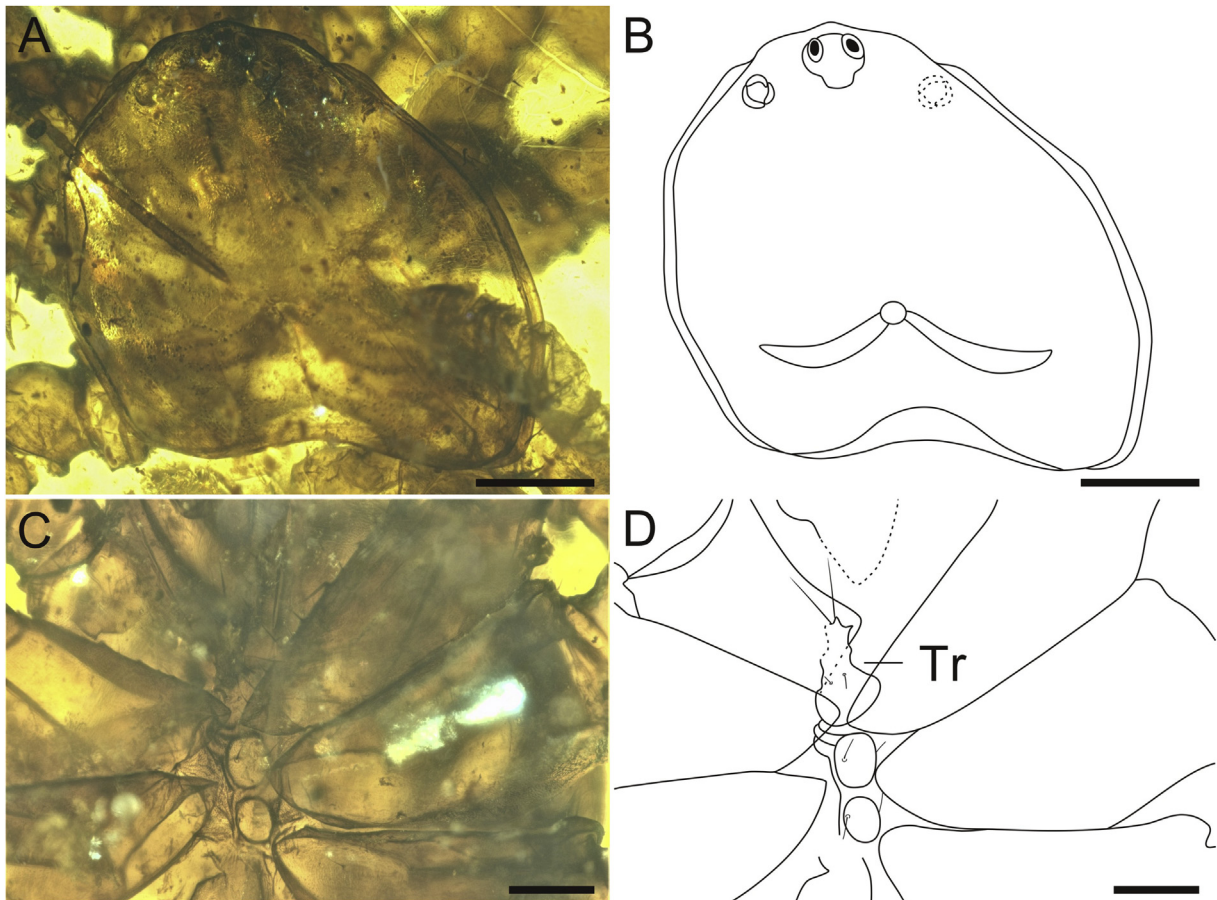


Fig. 2. Detailed line drawing and microphotographs of carapace and sternum of *Burmacharon dunlopi* gen. et sp. nov. A, Microphotograph of carapace. B, Line drawing of carapace. C, Microphotograph of sternum. D, Line drawing of sternum. Tr, tritosternum. Scale bars = 1 mm in A, B; 0.5 mm in C, D.

of compression; apical and median setae invisible. Middle part rounded, convex, with 2 setae. Third part also rounded and convex, but smaller and with smaller setae than second part (Fig. 2C, D).

Chelicerae: largely hidden from view with dorsal surface of basal article visible, surface smooth (no tubercles or rugosity), length of exposed portion of chelical base 1.1 mm.

Pedipalp stout, large, colour appears dull brown; combined length of segments nearly 6.9 mm; cuticle evenly covered with small scale-like tubercles. Coxa (along midline) 0.9 mm long. Trochanteral length 0.6 mm, bearing 5 slender setae on upper margin. Trochanter with large distal, spiniform, carina-like apophysis on dorsal and ventral surface, dorsal one bearing 3 strong setae directed anteriorly and ventral one bearing 4. Femoral length 1.6 mm, with three mainly dorsal spines (increasing in length proximally), one accessory spine anterior to proximal spine with its length similar to distal spine. Three ventral spines (increasing in length proximally) of approximately same length as dorsal ones; two spinelets placed proximally to first one, which are located more laterally than main series of spines, with a similar length to distal one. Tibial length 2.0 mm, tarsus with three ventral spines (middle spine being largest) and three dorsal spines (spine 1 (apical-most) length 0.7 mm, spine 2 length 0.6 mm, spine 3 (proximal-most) 0.2 mm). Tarsus divided into basitarsus and distitarsus, latter divided into basal part and terminal claw (apotele). Basitarsal length 0.8 mm, with 1 curved dorsal and 1 curved ventral spine in basal half of basitarsus, length of both spine A and spine B about

0.8 mm. Distitarsus length ca. 1.0 mm, shallow and short cleaning organ present proximally (Fig. 3).

Walking legs: largely preserved on right half of specimen; on all preserved legs apotele with pair of large claws and pulvillus. *Leg 1*: most of femur and portions of whip apparently preserved in amber piece, but disarticulated and scattered (number of articles cannot be determined). *Leg 2*: coxal length 1.4 mm; trochanteral length 0.9 mm; femoral length 4.9 mm; patellar length 0.9 mm; tibial length 6.2 mm, and tibia divided into basitibia and distitibia (distitibia also termed metatarsus in Dunlop, 1994). Tarsus with 4 tarsomeres, dorsal cuticle of second tarsomere divided by weakly sclerotized area, but ventral sclerite undivided (Weygoldt, 1996). *Leg 3*: trochanteral length 0.9 mm; femoral length 5.8 mm; patellar length 0.9 mm; tibial length 6.3 mm. *Leg 4*: trochanteral length 0.8 mm; femoral length 5.3 mm, patellar length 0.9 mm; the terminal of tibia and tarsus not preserved (Fig. 4).

Opisthosoma: length (along midline) 6.8 mm, greatest width 3.4 mm; dorsal surface curved slightly, ventral surface not visible; seven segments visible dorsally (pygidium at posterior end of opisthosoma covered with debris).

4. Discussion

The new genus belongs to the suborder Euamblypygi, infraorder Neoamblypygi. With the discovery of *Burmacharon dunlopi* gen. et sp. nov., the Cretaceous Kachin amber now yields two genera and

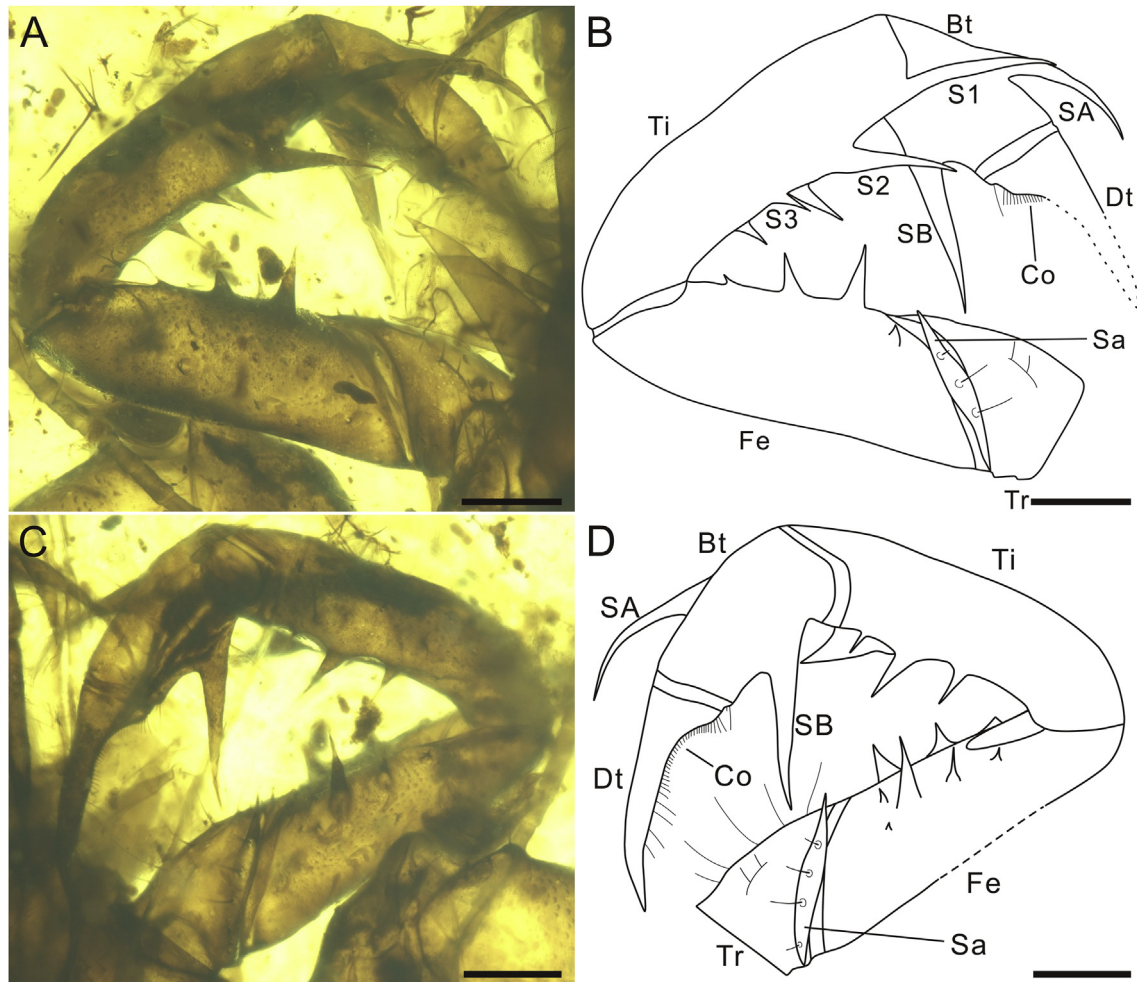


Fig. 3. Detailed line drawing and microphotographs of left pedipalp of *Burmacharon dunlopi* gen. et sp. nov. A, Microphotograph of left pedipalp in dorsal view. B, Line drawing of left pedipalp of in dorsal view. C, Microphotograph of left pedipalp in ventral view. D, Line drawing of left pedipalp in ventral view. Tr, trochanter; Fe, femur; Ti, tibia; Bt, basitarsus; Dt, distitarsus; Ta, tarsus. S1-3, spines 1-3, numbered proximal to distal; SA, spine A; SB, spine B; Sa, palpal spiniform anterior apophysis; Co, cleaning organ. Scale bars = 0.5 mm.

four species of whip spiders. Although the pedipalpal tibia of *B. dunlopi* has one small and two larger tibial spines like the *Kronocharon* species, there are some obvious differences between the two genera.

The carapace of *B. dunlopi* is wider than long, which is different from that of *Kronocharon longicalcaris*, which is as wide as long. Because the carapace in these two specimens are deformed, this is not a very clear distinction. The margin of the carapace in the genus

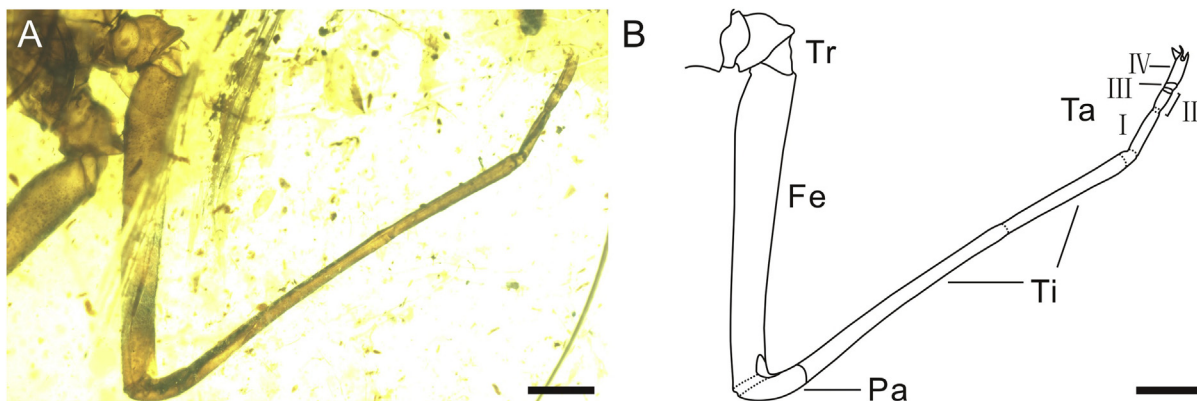


Fig. 4. Detailed line drawing and microphotographs of walking leg 2 of *Burmacharon dunlopi* gen. et sp. nov. A, Microphotograph of walking leg 2 in dorsal view. B, Line drawing of walking leg 2 in dorsal view. Tr, trochanter; Fe, femur; Bti, basitibia; Dti, distitibia; Pa, patella; Ta, tarsus. I, tarsomere I; II, tarsomere II; III, tarsomere III; IV, tarsomere IV. Scale bars = 1 mm.

Kronocharon is, however, relatively straight and transverse (Engel and Grimaldi, 2014), but in *B. dunlopi* the margin of the carapace is rounded, and the width of the margin of the new genus is narrower than that of *Kronocharon*. As for the distance between the outer margin of the median eyes and inner margin of the lateral eyes, the average in *B. dunlopi* is about 0.6 mm (the left side is 0.51, the right side is 0.69), which is shorter than in *Kronocharon prendinii* (the same distance is 0.68 mm). The length of the opisthosoma of *B. dunlopi* is twice the width, which is distinctly different from the three species of the genus *Kronocharon*. In the genus *Kronocharon*, *K. prendinii* has an opisthosomal length-to-width ratio of 1.1:1, while *K. engeli* and *K. longicalcaris* have an opisthosomal length-to-width ratio of about 1.3:1. In addition, the new genus probably has a distinct outer margin covering the sternum, which is absent in the genus *Kronocharon*.

There is a longitudinal row of 5 small, tubercle-like dorsal spines and a row of 7 ventral spines (3 large spines, 4 small spines) arming the femur in *Kronocharon prendinii*, but in *B. dunlopi* the femur is furnished with 4 dorsal spines and 5 ventral ones (3 principal spines and 2 proximal, small spines). The femur of *K. engeli* has a distinct, large distal tooth. Regarding the tibial spines, *B. dunlopi* has three principal dorsal spines on the tibia and spine 1 is longer than spine 2, which is similar to *K. longicalcaris* and *K. engeli*; in *K. prendinii*, spine 1 is slightly shorter than spine 2, and the tibia has an extra single small spinelet proximally. Remarkably, the dorsal and ventral spines of the new species are not symmetrical. The species of the genus *Kronocharon* previously described all have nine opisthosomal segments visible dorsally, but the end of the opisthosoma of *B. dunlopi* is not visible and the number of segments cannot be distinguished.

According to previous studies of living Amblypygi, in many species there is no sexual dimorphism. Except for the genitalia, the male and female are similar. But in others, sexual dimorphism is apparent or even prominent. In these species, the pedipalps of the male are longer and in some they are even extremely elongate (Weygoldt, 2000). Consider the length of the pedipalp of *B. dunlopi*, this specimen probably belongs to the female.

5. Concluding remarks

Burmacharon dunlopi gen. et sp. nov. is described from mid-Cretaceous Kachin amber. It represents the second fossil genus of Amblypygi from this deposit and belongs to the clade Unidistitarsata. This discovery augments the fossil record of Amblypygi and increases the diversity of the Amblypygi in the mid-Cretaceous. *B. dunlopi* is only known from Kachin amber, highlighting unidistitarsatan antiquity.

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