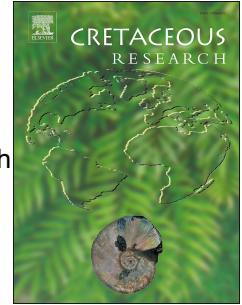


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The oonopid spiders from mid-Cretaceous Burmese amber of northern Myanmar, with descriptions on three new species

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Abstract

Three new species belonging to genera †*Burmorchestina* Wunderlich, 2008 (2 species) and *Orchestina* Simon, 1882 (1 species) are described from mid-Cretaceous Burmese amber: *Burmorchestina bo* Jiang and Li sp. nov., *B. convexa* Jiang and Li sp. nov., *Orchestina globus* Jiang and Li sp. nov. In addition, photos of *Burmorchestina acuminata* Wunderlich, 2017, *B. biangulata* Wunderlich, 2017, *B. circular* Wunderlich, 2020, *B. plana* Wunderlich, 2017, *B. pulcher* Wunderlich, 2008 and *B. pulcheroides* Wunderlich, 2017 are provided.

Key words: Mesozoic, new record, Orchestininae.

1. Introduction

Burmese amber, also named “burmite”, comes from northern Myanmar and is a famous Lagerstätte with a huge number of extremely well preserved invertebrates, contains probably the most diverse palaeobiota (Jiang *et al.* 2020; Huang *et al.* 2018). For example, approximately 228 families of organisms (primarily arthropods) have been reported (Shi *et al.*, 2012), including 55 spider families (35 extinct families, 20 extant families). The age of Burmese amber is mid-Cretaceous and a precise age requires further biostratigraphic and chronological studies.

The spider family Oonopidae Simon, 1890 is distributed worldwide. According to Platnick *et al.* (2012), Oonopidae can be subdivided into three subfamilies: Oonopinae Simon 1890, Orchestininae Chamberlin and Ivie, 1942 and Sulsulinae Platnick, 2012 (Henrard and Jocqué, 2012; Platnick *et al.* 2012; Tong *et al.* 2018). Extant Oonopidae includes 1,872 named species placed in 114 genera and is the sixth most speciose spider family (WSC 2021). The fossil oonopids in Burmese amber is also relatively well represented, including one extinct genus, namely †*Burmorchestina* Wunderlich, 2008 (Dunlop *et al.*, 2020). †*Burmorchestina* is a small genus of Orchestininae that includes eight species found in Burmese amber exclusively (Wunderlich, 2008; Dunlop *et al.*, 2020). †*Burmorchestina* has swollen femora of leg IV and H-shaped eye arrangement with a recurved PER (Wunderlich, 2008), which is similar to the extant genus *Orchestina*. According to the swollen femora, they should have the ability to jump (Izquierdo and Ramírez, 2017). The relatively high frequency and the high percentage of adult specimens of †*Burmorchestina* indicate that members

of this genus were dwellers of higher strata of the vegetation (Wunderlich, 2008), similar to their modern relatives. *Orchestina* is one of the oldest known lineages among extant spiders (Marusik and Wunderlich, 2008; Wunderlich, 2004) and the most abundant oonopids in amber, with formally 33 named fossil species and a pair of copulating spiders (Dunlop *et al.*, 2020; Wunderlich, 1981).

Here, we describe three new species of the Orchestininae from mid-Cretaceous Burmese amber and provide new photos of six previously known species in Burmese amber based on our material. The first definitive fossil species of *Orchestina* from Burmese amber is described.

2. Materials and methods

All materials comes from Kachin (Hukawng Valley) of northern Myanmar, approximately 100 km southwest of the Village of Tanai (Dong *et al.*, 2015: fig.1). Kachin ambers were excavated in Kachin State, Myanmar. U–Pb dating indicates a maximum age of 98.79 ± 0.62 Ma (earliest Cenomanian, mid-Cretaceous) for amber from Hukawng Valley of Kachin State, northern Myanmar (Shi *et al.*, 2012). However, the actual age might be slightly older (Mao *et al.*, 2018) and a juvenile *Puzosia* ammonite trapped in the amber provides supporting evidence for a Late Albian–Early Cenomanian age. (Yu *et al.*, 2019).

All specimens were examined and measured with a Leica M205C stereomicroscope. Photos of amber pieces and spider bodies were either taken with a Canon EOS 60D digital camera with Canon EF 100 mm f/2.8L IS USM Macro lens or with an Olympus C7070 digital camera mounted on an Olympus SZX12 dissecting microscope. Details of specimens were taken with an Olympus C7070 camera mounted on an Olympus BX51 compound light microscope. Photos were stacked using Helicon Focus 7.6.1 and processed using Adobe Photoshop CC 2020.

All measurements are in millimeters (mm). Measurements of appendages of both sides are given as follows: for legs: total length (femur + patella + tibia + metatarsus + tarsus); for palps: total length (femur + patella + tibia). Leg podomeres were measured on their dorsal side. Terminology and taxonomic descriptions follow Wunderlich (2008), Saupe *et al.* (2012) and Tong and Li (2011). If the left palp is strongly deformed or not observable in particular views, the images of the right palp will be taken instead but horizontally flipped for the sake of comparison.

All specimens are deposited in the Institute of Zoology, Chinese Academy of Sciences (IZCAS) in Beijing, China.

3. Abbreviations

ALE: anterior lateral eyes

ALS: anterior lateral spinnerets

B: bulb

BE: basal part of embolus

BEL/BL: basal part of embolus length/bulb length

BI: bulb index (ratio of bulb width to its length)

CH: clypeal height
 CL: carapace length
 CW: carapace width
 Cy: cymbium
 DE: distal part of embolus
 En: endite
 Fe: femur
 Fg: fang
 Lb: labium
 MS: median spinnerets
 Pa: patella
 PER: posterior eye row
 PI: patella index (ratio of male palpal patella width to its length)
 PLE: posterior lateral eyes
 PLS: posterior lateral spinnerets
 PME: posterior median eyes
 T: tegulum
 Ti: tibia

4. Systematic palaeontology

Order Araneae Clerck, 1757

Family Oonopidae Simon, 1890

Subfamily Orchestininae Chamberlin & Ivie, 1942

Diagnosis. Orchestinines are easily recognized by their enlarged femora IV.

Comments. Orchestininae have 1 extant genus and 2 extinct genera: *Orchestina*; †*Burmorchestina*; †*Canadaorchestina* Wunderlich, 2008. The differences between the genitals of extant species are greater than among extinct species. Saaristo and Marusik (2004) proposed that nearly 55% of extant oonopids are assigned to five widely distributed genera (*Dysderina* Simon, 1891, *Gamasomorpha* Karsch, 1881, *Oonops* Templeton, 1835, *Opopaea* Simon and *Orchestina* Simon, 1882). Thus, they postulate that the five genera are more or less polyphyletic. However, Platnick *et al.* (2012) disagreed with this opinion. They think that only synapomorphic characters and distribution among taxa can be used to evaluate polyphyly.

Genus †*Burmorchestina* Wunderlich, 2008

Burmorchestina Wunderlich, 2008: 68. Type species: *B. pulcher* Wunderlich, 2008.

Diagnosis. The genus †*Burmorchestina* resembles *Orchestina* by having an enlarged fourth femur, a near H-shaped arrangement of the eye group and lacking spines on all the legs, but distinguished by the elevated carapace in lateral view, the elongated basal part of embolus and a sclerotized and undivided distal part of embolus.

Comments. According to drawings, photos and original descriptions of Wunderlich (2008, 2017), we found six known species from our materials. Hence, we provide new photos of six previously known species base on our material and summarize diagnosis of six known species. Diagnosis and description of the six known species see Wunderlich (2008, 2017, 2020).

Burmorchestina acuminata Wunderlich, 2017

Figures 1A, 2A

Burmorchestina acuminata Wunderlich, 2017: 110, figures 28, 29, photo 45. Only male known.

Material. Two male specimens (IZCAS-Ar41890Fo–Ar41891Fo) from our materials. Mid-Cretaceous amber from Myanmar, Kachin State, Hukawng Valley.

Comments. In the lateral view the shape of carapace (Fig. 1A) is flat. Carapace in the dorsal view with a distally pointed process. The shape of the bulb (Fig. 2A) is oval in the dorsal view. A slender basal part of embolus. BEL/BL: *c.* 0.55. Distal part of embolus is not visible.

Burmorchestina biangulata Wunderlich, 2017

Figures 1E, 2E

Burmorchestina biangulata Wunderlich, 2017: 111, figures 30, 31, photo 46. Only male known.

Material. Male specimen (IZCAS-Ar41892Fo) from IZCAS. Mid-Cretaceous amber from Myanmar, Kachin State, Hukawng Valley.

Comments. In the lateral view, the shape of carapace (Fig. 1E) is triangle. The shape of bulb (Fig. 2E) is globular and the length of the basal part of embolus is about two times the width. BEL/BL: *c.* 0.32. Basal part of embolus narrowed between bulb and distal part of embolus. Distal part of embolus (Fig. 2E) bend twice right angle from different direction.

Burmorchestina circular Wunderlich, 2020

Figures 1D, 2F

Burmorchestina circular Wunderlich, 2020: 78, figure 66, photo 10. Only male known.

Material. Male specimen (IZCAS-Ar41893Fo) from our materials. Mid-Cretaceous amber from Myanmar, Kachin State, Hukawng Valley.

Comments. In the lateral view, the shape of carapace (Fig. 1D) is triangular. The shape of bulb (Fig. 2F) is slightly pyriform, abruptly narrowed between basal part of embolus and distal part of embolus. BEL/BL: *c.*0.50. Distal part of embolus strongly

bend (Fig. 2F) fishhook-shaped, tip with a little hook.

Burmorchestina plana Wunderlich, 2017

Figures 1F, 2B

Burmorchestina plana Wunderlich, 2017: 112, figures 32–34, photos 47–49. Only male known.

Material. Two male specimens (IZCAS-Ar41894Fo–Ar41895Fo) from our materials. Mid-Cretaceous amber from Myanmar, Kachin State, Hukawng Valley.

Comments. In the lateral view, the shape of carapace (Fig. 2B) is flat. The bulb (Fig. 1F) is globular with strongly elongated basal part of embolus and the length of the basal part of embolus is about six times the width. BEL/BL: *c.* 0.45. The distal part of embolus (Fig. 1F) bend into an acute angle.

Burmorchestina pulcher Wunderlich, 2008

Figures 1B, 2D

Burmorchestina pulcher Wunderlich, 2008: 69, figures 34–46, photos 66–69.

Burmorchestina pulcher Wunderlich, 2017: 113, figures 35–39.

Only male known.

Material. Male specimen (IZCAS-Ar41896Fo) from our materials. Mid-Cretaceous amber from Myanmar, Kachin State, Hukawng Valley.

Comments. In the dorsal view, the shape of carapace (Fig. 2D) is elevated. The shape of basal part of embolus (Fig. 1B) is slender with a thickened distal ending. BEL/BL: *c.* 0.61. Distal part of embolus (Fig. 1B) is thin with a bend into a right angle.

Burmorchestina pulcheroides Wunderlich, 2017

Figures 1C, 2C

Burmorchestina pulcheroides Wunderlich, 2017: 113, figures 40–42, photo 51. Only male known.

Material. Male specimen (IZCAS-Ar41897Fo) from our materials. Mid-Cretaceous amber from Myanmar, Kachin State, Hukawng Valley.

Comments. In the dorsal view, the shape of carapace (Fig. 2C) is oval. The shape of bulb (Fig. 1C) is elongate oval and the length of the basal part of embolus is about four times the width. BEL/BL: *c.* 0.32. Distal part of embolus (Fig. 1C) bend into a hook.

Burmorchestina bo Jiang and Li sp. nov.

Figures 3–5

LSID: urn:lsid:zoobank.org:act:B8F928EB-5753-468A-94B0-F2EDE52BBAF8

Holotype: male (IZCAS-Ar41898Fo), mid-Cretaceous amber from Myanmar, Kachin State, Hukawng Valley. No syninclusions.

Etymology. The specific name is derived from the Chinese pinyin word for “wave” (bō), referring to the S-shaped bulb. It is a noun in apposition.

Diagnosis. *Burmorchestina bo* sp. nov. can be easily distinguished from all known congeners by the S-shaped bulb in the dorsal view (Fig. 3). *B. bo* sp. nov. resembles *B. acuminata* by oval-shaped tegulum in the dorsal view (Figs 1A, 3C), but can be distinguished by the carapace without apophysis in the dorsal view (Figs 2A, 4D).

Description. Male. Total length 1.03, carapace 0.56 long, 0.44 wide (CW/CL \approx 0.78), abdomen 0.47 long, 0.32 wide. Left palp: 0.30 (0.15 + 0.08 + 0.07), left leg I: 1.81 (0.47 + 0.14 + 0.44 + 0.47 + 0.29), leg II: 1.79 (0.50 + 0.16 + 0.41 + 0.45 + 0.27), leg III: 1.39 (0.41 + 0.09 + 0.31 + 0.35 + 0.23), leg IV: 1.89 (0.59 + 0.15 + 0.38 + 0.52 + 0.25); right palp: 0.29 (0.14 + 0.06 + 0.09), right leg I: 1.80 (0.51 + 0.14 + 0.42 + 0.46 + 0.27), leg II: 1.88 (0.54 + 0.13 + 0.50 + 0.45 + 0.26), leg III: 1.51 (0.47 + 0.08 + 0.31 + 0.39 + 0.26), leg IV: 1.96 (0.60 + 0.14 + 0.42 + 0.53 + 0.27). Eye sizes and interdistance: ALE 0.03, PLE 0.05, PME 0.04, PME-PLE 0.05. Habitus as in Figs 4A, B. Cephalothorax: carapace (Fig. 4D) elongated hexagonal, surface smooth, with some long setae on top surface, strongly elevated in lateral view, with angular posterolateral corners, pars cephalica narrowed to more than 0.75 times carapace maximum width, lateral margin smooth. Clypeus (Fig. 5B) sloping forward in lateral view, 0.03 high; height is equal to the width of ALE; no indentations or projections present, distance ALE to clypeus margin about equal to ALE diameter. Eyes (Fig. 5C): PER recurved from above; ALE-ALE separated by more than their diameter, ALE-PLE touching, PLE-PME separated by more than PME diameter, PME touching for less than half their length. Sternum (Fig. 4A) fairly convex, without radial furrows between coxae, surface smooth; setae sparse, needle-like, evenly scattered. Mouthparts: chelicerae slightly divergent, anterior face unmodified, distal region abruptly narrowed, posterior surface with crown-shaped setal bases and a pair of bow-shaped setae (Figs 4C, 5B), *c.* 0.19 long, *c.* 0.11 wide at base; fang shape normal, tip unmodified, directed medially; labium and endites not visible. Leg long and rather slender, *c.* 6.00 times longer than wide; claws + onychium 0.05 long. Legs clothed in setae, elongated setae present on distal part of all femur; serrate setae present on metatarsal and tarsal, serration more apparent in tarsal. Left ALS 0.16 long, 0.01 wide; right ALS 0.13 long; PLS, MS not visible. Male palp (Fig. 3): femur 2 (or over 2) times longer than trochanter, patella about as long as tibia, PI: *c.* 0.38, the lengths of cymbium and tibia are approximately equal. The distal part of embolus bend into a small half-round hook. S-shaped bulb more than 2 times longer than cymbium, *c.* 0.18 long, *c.* 0.04 wide, BI: *c.* 0.22. BEL/BL: *c.* 0.56. Distal part of embolus bend into a small half-round hook, *c.* 0.05 long.

Burmorchestina convexa Jiang and Li sp. nov.

Figures 6–8

LSID: urn:lsid:zoobank.org:act:2A357935-0F27-4A93-9656-9BD158D449B2

Holotype: male (IZCAS-Ar41899Fo), mid-Cretaceous amber from Myanmar, Kachin State, Hukawng Valley. No syninclusions.

Etymology. The specific name is derived from Latin word “convexa” that means “bow” and refers to shape of carapace. It is an adjective in apposition.

Diagnosis. *Burmorchestina convexa* sp. nov. resembles *B. pulcher* by triangular tegulum, but can be distinguished by the bulge on tegulum much less obvious (Figs 1B, 6D).

Description. Male. Total length 0.81, carapace 0.45 long, 0.39 wide (CW/CL \approx 0.87), abdomen 0.36 long, 0.45 wide. Left palp: 0.22 (0.09 + 0.06 + 0.07), left leg I: 1.49 (0.43 + 0.13 + 0.39 + 0.33 + 0.21), leg II: 1.53 (0.43 + 0.14 + 0.38 + 0.33 + 0.25), leg III: 1.24 (0.32 + 0.11 + 0.29 + 0.32 + 0.20), leg IV: 1.63 (0.48 + 0.15 + 0.36 + 0.43 + 0.21); right palp: 0.23 (0.12 + 0.05 + 0.06), right leg I: 1.50 (0.46 + 0.12 + 0.34 + 0.35 + 0.23), leg II: 1.57 (0.45 + 0.16 + 0.35 + 0.36 + 0.25), leg III: 1.25 (0.37 + 0.14 + 0.27 + 0.28 + 0.19), leg IV: 1.61 (0.52 + 0.16 + 0.36 + 0.37 + 0.20). Eye sizes and interdistance: ALE 0.03, PLE 0.04, PME 0.04, PME-PLE 0.06. Habitus as in Figs 7A, B. Cephalothorax: carapace (Figs 7B, 8A) oval, surface smooth, with some long setae on top surface, strongly elevated in lateral view, with rounded lateral corners. Pars cephalica narrowed to more than 0.75 times carapace maximum width, lateral margin smooth. Clypeus (Fig. 8B) sloping forward in lateral view, 0.04 high; height is equal to the width of PME; no indentations or projections present, distance ALE to clypeus margin about equal to ALE diameter. Eyes (Fig. 8C): PER recurved from above; ALE-ALE separated by more than their diameter, ALE-PLE touching, PLE-PME separated by more than PME diameter, PME touching for less than half their length. Sternum (Fig. 7A): fairly convex, without radial furrows between coxae, surface smooth; setae sparse, needle-like, evenly scattered. Mouthparts: chelicerae widely divergent, anterior face unmodified, distal region abruptly narrowed, posterior surface with crown-shaped setal bases and a pair of bow-shaped setae (Figs 7C, 8B), *c.* 0.17 long, *c.* 0.12 wide at base; fang shape normal, tip unmodified; labium triangular, wider than long, 0.09 wide at the widest point, not fused to sternum, anterior margin not indented at middle, with apical bristles; endites (Fig. 7C) cone-like and slender; *c.* 0.13 long, *c.* 0.04 wide, distally not excavated. Leg long and rather slender, *c.* 6.25 times longer than wide; tarsal claws on pronounced onychium; claws + onychium 0.04 long. Legs clothed in setae, elongated setae present on distal part of all femur; serrate setae present on metatarsal and tarsal, serration more apparent in tarsal. Spinnerets (Fig. 7D): left ALS 0.13 long, 0.02 wide; right ALS 0.11 long, 0.03 wide; left PLS 0.08 long, 0.02 wide; right PLS 0.07 long, 0.02 wide; left MS 0.05 long, 0.01 wide; right MS not visible. Male palp (Fig. 6): femur 2 (or over 2) times longer than trochanter, patella length about as long as tibia, PI: *c.* 0.89. Bulb stout, elongated, more than 2 times as long as cymbium, *c.* 0.21 long, *c.* 0.07 wide, BI: *c.* 0.33. An abruptly narrowed needle-shaped basal part of embolus, distal part of embolus bent, distal undivided. BEL/BL: *c.* 0.58; distal part of embolus *c.* 0.05 long.

Genus *Orchestina* Simon, 1882

Orchestina Simon, 1882: 237. Type species: *Schoenobates pavesii* Simon, 1873.

Diagnosis. See diagnosis of †*Burmorchestina*.

Comments. *Orchestina* has abundant species (162 extant species + 33 extinct species, including the new species described here), and they rather represent a tribe or at least a genus group than a single genus (Platnick *et al.*, 2012; Saaristo, 2001). The monophyly of *Orchestina* requires further studies. The relative proportions of the palpal segments and the embolus shape are considered useful in distinguishing species of *Orchestina* (Wunderlich, 2004). This new species possess spherical-shaped tegulum, placing them within the genus *Orchestina*.

Orchestina globus Jiang and Li sp. nov.

Figures 9–11

LSID: urn:lsid:zoobank.org:act:B2979408-E3A8-45BE-8B5C-7E3456DD11E5

Holotype: male (IZCAS-Ar41900Fo), mid-Cretaceous amber from Myanmar, Kachin State, Hukawng Valley. No syninclusions.

Etymology. The specific name is derived from Latin word “globus” that means “globe” and refers to the shape of the bulb. It is a noun in apposition.

Diagnosis. *Orchestina globus* sp. nov. resembles *O. breviembolus* Wunderlich, 1981 by the spherical-shaped bulb and the embolus tapering distally (Fig. 9), but distinguished by the undivided tip of the embolus. *O. globus* sp. nov. resembles *O. fushunensis* Wunderlich, 2004 by ovoid tegulum and embolus, but distinguished by unmodified tibia (swollen tibia in *O. fushunensis*).

Description. Male. Total length 1.17, carapace 0.44 long, abdomen 0.73 long. Left palp: 0.27 (0.12 + 0.06 + 0.09), left leg I: 1.32 (0.42 + 0.14 + 0.36 + 0.21 + 0.19), leg II: 1.20 (0.35 + 0.11 + 0.31 + 0.24 + 0.19), leg III: 1.03 (0.30 + 0.10 + 0.25 + 0.21 + 0.17), leg IV: 1.50 (0.48 + 0.12 + 0.32 + 0.36 + 0.22); right palp: 0.34 (0.14 + 0.07 + 0.13), right leg I absent, leg II: 1.26 (0.38 + 0.12 + 0.31 + 0.27 + 0.18), leg III: 1.04 (0.27 + 0.11 + 0.24 + 0.26 + 0.16), leg IV: – (0.46 + 0.14 + 0.36 + 0.30 + –). Eye sizes and interdistance: ALE 0.03, PLE 0.03, PME 0.04, PME-PLE 0.04. Habitus as in Fig. 10. Cephalothorax: carapace (Fig. 10A) not visible. Clypeus (Fig. 11D): sloping forward in lateral view, 0.03 high; height equal to ALE width; no indentations or projections present. Eyes (Fig. 11C): ALE-ALE separated by more than their diameter, ALE-PLE touching, PME touching for less than half their length. Sternum (Fig. 10B) slight deformed. Mouthparts (Fig. 11D): chelicerae deformed, *c.* 0.17 long, fang not visible. labium triangular, longer than wider, *c.* 0.12 long, 0.08 wide at the widest point, not fused to sternum, anterior margin not indented at middle, with apical bristles; endites (Fig. 11B) band-like and slender; *c.* 0.16 long, *c.* 0.05 wide, distally not excavated. Leg stout and thick, *c.* 3.06 times longer than wide, larger than femora I–III; claws + onychium 0.04 long. Legs clothed in setae, elongated setae present on distal part of all femur; serrate setae present on metatarsus and tarsus, serration more apparent on tarsus. Spinnerets (Fig. 11A): left ALS 0.21 long, 0.05 wide; right ALS 0.23 long, 0.06 wide; left PLS 0.16 long, 0.01 wide; right PLS 0.16 long, 0.02 wide;

MS not visible. Male palp (Fig. 9): femur 2 (or over 2) times longer than trochanter, patella length shorter than tibia, PI: *c.* 0.66. Bulb simple, broadly attached to the cymbium, the tegulum spherical-shaped in dorsal view, with a tapered embolus. The bulb more than 2 times as long as cymbium, *c.* 0.15 long, *c.* 0.14 wide, BI: 0.91, bulb wider than tibia length, embolus *c.* 0.13, long, BEL/BL: *c.*0.33.

5. Discussion

In Oonopidae, there are 38 extinct species in 4 extant genera and 12 extinct species in 3 extinct genera (including new species described here). The extant cosmopolitan *Orchestina* is the most abundant genus among extinct oonopids. 33 fossil species of *Orchestina* are known so far. A juvenile specimen from Burmese amber was reported as a member of *Orchestina* (Penney, 2006), but it's hard to confirm its true placement. In this paper, we identified and examined six out of eight known species of †*Burmorchestina* in our own material. The embolus of *Orchestina* is often a stubby tube that attach to the bulb medially, unlike the long basal part of embolus and the slender, sclerotized distal part of embolus in †*Burmorchestina*. However, according to descriptions of the extant *Orchestina* spp., we find that male palp and the carapace of *Orchestina* are diverse (Henrard and Jocqué, 2012; Saaristo and van Harten, 2006; Tong and Li, 2011). The emboli of some *Orchestina* species (e.g. *Orchestina curico* Izquierdo, 2017 and *O. imperialis* Wunderlich, 1981) are also slender, similar to some species of †*Burmorchestina*.

The genus *Orchestina* (as well as the subfamily Orchestininae) is supported by a single synapomorphy, the swollen femur IV, evidence for monophyly (Platnick *et al.*, 2012). However, the disparity of palp and carapace morphology of *Orchestina* seems to be unusual, indicating a possibility to further divide the genus. Since we cannot confidently split the genus *Orchestina* base on our current material, we decide to retain the current status of †*Burmorchestina*, *Orchestina* and other related genera. Both molecular and morphological phylogenetic analysis will be necessary to elucidate the relationship between fossil and extant *Orchestina* and closely related genera. So far, we consider *O. globus* sp. nov. as the first described *Orchestina* species in Burmese amber base on its similarity of morphology with extant congeners.

6. Conclusion

This paper describes three new species: *Burmorchestina bo* sp. nov., *B. convexa* sp. nov. and *Orchestina globus* sp. nov., meanwhile examines six known species from mid-Cretaceous Burmese amber. Our discovery of *O. globus* sp. nov. represents the first *Orchestina* species found in Burmese amber. *O. globus* sp. nov. fills a gap in the fossil record of Burmese amber and will be important for dating the oonopid spider tree of life. To better understand the phylogenetic placement of fossils and extant taxa, we need further and deeper morphological investigations at the higher levels of the goblin spider classification.

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Figure legends

Figure 1. Male pedipalp of †*Burmorchestina* species. Specimens are from Burmese amber (Myanmar, Kachin State), deposited in the Institute of Zoology, Chinese Academy of Sciences (IZCAS) in Beijing, China. A. *B. acuminata* (IZCAS-Ar41890Fo), left palp, dorsal view, horizontally flipped; B. *B. pulcher* (IZCAS-Ar41896Fo), left palp, retrolateral view; C. *B. pulcheroides* (IZCAS-Ar41897Fo), right palp, dorsal view; D. *B. circular* (IZCAS-Ar41893Fo), left palp, dorsal view; E. *B. biangulata* (IZCAS-Ar41892Fo), right palp, retrolateral view; F. *B. plana* (IZCAS-Ar41894Fo) left palp, prolateral view, horizontally flipped. Scale bars: A–F = 0.10 mm.

Figure 2. Male carapace of †*Burmorchestina* species. Specimens are from Burmese amber (Myanmar, Kachin State), deposited in the Institute of Zoology, Chinese Academy of Sciences (IZCAS) in Beijing, China. A. *B. acuminata* (IZCAS-Ar41891Fo), dorsal view arrow points at a process; B. *B. plana* (IZCAS-Ar41895Fo), lateral view; C. *B. pulcheroides* (IZCAS-Ar41897Fo), dorsal view; D. *B. pulcher* (IZCAS-Ar41896Fo), dorsal view; E. *B. biangulata* (IZCAS-Ar41892Fo), lateral view; F. *B. circular* (IZCAS-Ar41893Fo), lateral view. Scale bars: A–D = 0.10 mm.

Figure 3. *Burmorchestina bo* sp. nov. (IZCAS-Ar41898Fo), holotype male. A, B. Left palp (A. Prolateral view, B. Retrolateral view); C, D. Right palp (C. Dorsal view; D. Prolateral view). Scale bars: A–D = 0.10 mm.

Figure 4. *Burmorchestina bo* sp. nov. (IZCAS-Ar41898Fo), holotype male. A, B. Habitus (A. Ventral view; B. Dorsal view); C. Mouthparts, ventral view, arrow points at a pair of bow-shaped setae; D. Spinnerets, ventral view. Scale bars: A, B = 1 mm; C, D = 0.10 mm.

Figure 5. *Burmorchestina bo* sp. nov. (IZCAS-Ar41898Fo), holotype male. A. Carapace, lateral view; B. Chelicerae, front view, arrow points at a pair of bow-shaped setae; C. Ocular area, dorsal view. D. Claw, lateral view, note the serrate setae present on metatarsal and tarsal. Scale bars: A–D = 0.10 mm.

Figure 6. *Burmorchestina convexa* sp. nov. (IZCAS-Ar41899Fo), holotype male. A, B. Right palp (A. Retrolateral view, B. Prolateral view); C, D. Left palp (C. Prolateral view; D. Retrolateral view). Scale bars: A–D = 0.10 mm.

Figure 7. *Burmorchestina convexa* sp. nov. (IZCAS-Ar41899Fo), holotype male. A, B. Habitus (A. Ventral view; B. Dorsal view); C. Mouthparts, ventral view, arrow points at a pair of bow-shaped setae; D. Spinnerets, ventral view. Scale bars: A, B = 1 mm; C, D = 0.10 mm.

Figure 8. *Burmorchestina convexa* sp. nov. (IZCAS-Ar41899Fo), holotype male. A. Carapace, lateral view; B. Chelicerae, front view, arrow points at a pair of bow-shaped setae; C. Ocular area, dorsal view; D. Claw, lateral view, note the serrate setae present on metatarsal and tarsal. Scale bars: A–D = 0.10 mm.

Figure 9. *Orchestina globus* sp. nov. (IZCAS-Ar41900Fo), holotype male. A–C. Right palp (A. Front view, B. Ventral view, C. Prolateral view); D. Left palp, prolateral view. Scale bars: A–D = 0.10 mm.

Figure 10. *Orchestina globus* sp. nov. (IZCAS-Ar41900Fo), holotype male. A, B. Habitus (A. Ventral view; B. Dorsal view). Scale bars: A, B = 1 mm.

Figure 11. *Orchestina globus* sp. nov. (IZCAS-Ar41900Fo), holotype male. A. Spinnerets, ventral view; B. Mouthparts, ventral view; C. Ocular area, dorsal view; D. Mouthparts, ventral view; E. Claw, lateral view, note the serrate setae present on metatarsal and tarsal. Scale bars: A–D = 0.10 mm.

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