African Invertebrates Vol. 48 (1) Pages 145–152 Pietermaritzburg April, 2007

A new hangingfly (Insecta: Mecoptera: Bittacidae) from the Middle Jurassic of Inner Mongolia, China

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ABSTRACT

A new genus of Bittacidae, *Mongolbittacus* gen. n., based on *Mongolbittacus daohugouensis* sp. n., is described from the Middle Jurassic of Inner Mongolia, China. The presence of a four-winged specimen enables documentation of the intraspecimen variation of wing venation. *Mongolbittacus* appears to be related to the genera *Orobittacus*, *Microbittacus*, *Mesobittacus*, *Preanabittacus*, *Anabittacus*, *Baissobittacus*, *Liaobittacus*, *Jichoristella* and *Antiquanabittacus* because of the presence of three synapomorphies, i.e. MP4+CuA1+2 simple; *Kreuz der Bittaciden* (rp3+4 + ma–mp1+2 and mp1+2–mp3 crossveins) not aligned; and crossvein c–sp absent.

KEY WORDS: Mecoptera, Bittacidae, hangingflies, Jurassic, China, new taxa, wing venation.

INTRODUCTION

Bittacidae is a small family of insects, but a major family of mecopterans, with more than half of its genera known from the Mesozoic (Handlirsch 1939; Sukatsheva 1990; Novokschonov 1993, 1997*a*, *b*; Ren 1993, 1997; Zhang 1993; Ansorge 1996; Petrulevičius & Martins-Neto 2001; Petrulevičius & Jarzembowski 2004). Cenozoic records are scarce and in most cases are assigned to extant genera (Jarzembowski 1980; Novokschonov 1993; Petrulevičius 1998, 1999, 2001, 2003).

Living bittacids are widespread in both temperate and tropical climates. Their wings are distinctly elongate and slender in their basal third. They are called hangingflies because they often hang by their fore legs or fore and middle legs from branches within low vegetation. They are predacious, being able to catch up to five insects at a time (Londt, review comment). Hangingflies usually occur in mesic habitats, including stream margins; slowly flying short distances and occasionally extracting nectar from blossoms. Larvae are terrestrial and detritivorous (Byers 1991).

MATERIAL

Mecoptera, particularly Bittacidae, are numerous in the Jurassic–Cretaceous of China. The material described herein was found by one of the authors (DYH), at Daohugou, Ningcheng County, Inner Mongolia, China, in the Jiulongshan Formation, Middle Jurassic (Aalenian–Bajocian) age. The specimen is a bi-dimensional impression. The matrix is a well cemented calcareous grey siltstone. The fossil is in association with

valves of Conchostraca. The material has been deposited in the Nanjing Institute of Geology and Palaeontology, Academia Sinica, Nanjing (NIGPAS).

TAXONOMY

In the present study, we use the wing-venation nomenclature of Kukalová-Peck (1983, 1991) and the phylogenetic classification of Bittacidae proposed by Novokschonov (1993). For discussion regarding the recent phylogenetic classifications of Bechly and Schweigert (2000) and Ansorge (1996), see Petrulevičius and Jarzembowski (2004).

Order Mecoptera Packard, 1886
Infraorder Raptipedia Willmann, 1987
Family Bittacidae Handlirsch, 1906
Genus **Mongolbittacus** gen. n.

Etymology: From the locality of origin of the specimen.

Type species: *Mongolbittacus daohugoensis* sp. n., by present designation.

Diagnosis: The main venational characters of the genus are as follows: (1) basal part of wing narrow; (2) RP3+4 + MA plus RP3+4 distinctively curved; (3) MP4+CuA1+2 simple; (4) *Kreuz der Bittaciden* [rp3+4 + ma–mp1+2, mp1+2–mp3 crossveins] not aligned; (5) crossvein c–sp absent; (6) RA simple; (7) wide posterior anal field; (8) AA3+4 strongly curved posteriorly and linked to AP1+2 by a short crossvein.

Comparison: Characters 1 and 2 are synapomorphies of Bittacidae *sensu* Novokschonov (1993). Characters 3, 4 and 5 are synapomorphies of the new genus and *Orobittacus* Villegas and Byers, 1981, *Microbittacus* Novokschonov, 1993, *Mesobittacus* Handlirsch, 1939, *Preanabittacus* Novokschonov, 1993, *Anabittacus* Kimmins, 1929, *Antiquanabittacus* Petrulevičius & Jarzembowski, 2004, *Baissobittacus* Novokschonov, 1997, *Liaobittacus* Ren, 1993, and *Jichoristella* Ren, 1994.

Character 6 seems to be a synapomorphy of *Anabittacus*, *Mesobittacus*, *Jichoristella*, *Liaobittacus*, *Antiquanabittacus* and *Mongolbittacus* gen. n. This character was considered a symplesiomorphy by Petrulevičius and Jarzembowski (2004), but the most basal bittacid genus *Orthobittacus* has an RA bifurcated as do the rest of the genera of the family. Thus, it is more parsimonious to consider that this character is an acquisition of these genera.

Character 7 is shared by *Anabittacus*, *Jichoristella*, *Liaobittacus*, *Antiquanabittacus*, *Orobittacus* and *Mongolbittacus* gen. n.

Character 8 is shared by *Antiquanabittacus* and *Orobittacus obscurus* Villegas & Byers, 1981. This character is in conflict with two synapomorphies which strongly support the group formed by *Antiquanabittacus*, *Anabittacus* and *Jichoristella* i.e. RP bifurcating more basally than MP1+2, and MP3 + MP4 + CuA1+2 short (Petrulevičius & Jarzembowski 2004).

Discussion: The genera *Orthobittacus* Willmann, 1989 and *Plessiobittacus* Novokschonov, 1997 are readily distinguished from the new genus by their supernumerary MP veins. The absence in the new genus of the apomorphic state RA3+4, which is convex posteriorly, separates it from the fossil genera *Asiobittacus* Novokshonov, 1993, *Scharabittacus* Novokshonov, 1993, *Probittacus* Martynov, 1927, *Sibirobittacus*

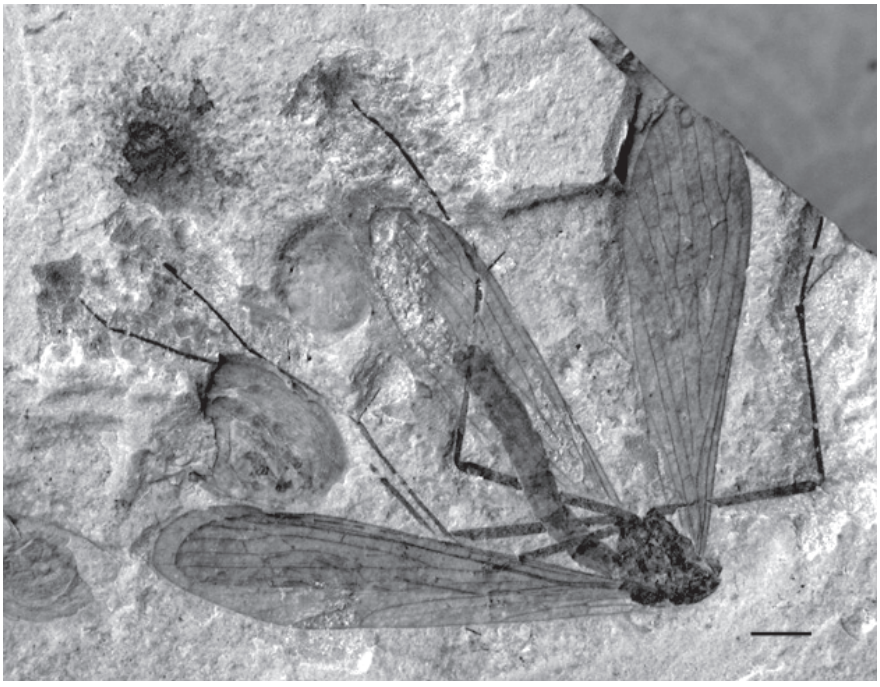

Fig. 1. *Mongolbittacus daohugouensis* gen. et sp. n., holotype. Scale bar = 2 mm.

Sukatcheva, 1990, *Telobittacus* Zhang, 1993, *Megabittacus* Ren, 1997, *Cretobittacus* Novokshonov, 1993, *Prohylobittacus* Novokshonov, 1993, *Palaeobittacus* Carpenter, 1928, and all recent genera except *Orobittacus* and *Anabittacus*. *Mongolbittacus* gen. n. is included in a possibly monophyletic group formed by *Orobittacus*, *Microbittacus*, *Mesobittacus*, *Preanabittacus*, *Anabittacus*, *Baissobittacus*, *Liaobittacus*, *Jichoristella* and *Antiquanabittacus*. In these genera, MP4+CuA is simple, *Kreuz der Bittaciden* is not aligned, and the crossvein c–sp is absent. *Orobittacus* and *Jichoristella* differ from *Mongolbittacus* gen. n. in that their RP1+2 is simple.

Simple RA is shared by *Anabittacus*, *Antiquanabittacus* (Petrulevičius & Jarzembowski 2004), *Jichoristella*, *Liaobittacus*, *Mesobittacus*, and *Mongolbittacus* gen. n. A wide posterior anal field is shared by *Anabittacus*, *Antiquanabittacus*, *Jichoristella*, *Liaobittacus*, *Mongolbittacus* gen. n. and *Orobittacus*. The last two characters are in conflict as *Orobittacus obscurus* has a bifurcated RA and *Mesobittacus* has a normal development of the posterior anal field. *Orobittacus* can be excluded for placement of the new species since it has a simple RP1+2. *Jichoristella*, *Anabittacus* and *Antiquanabittacus* can be excluded since RP bifurcates more basally than MP1+2 and the MP3+MP4+CuA1+2 is short in these genera. *Anabittacus* is also excluded by its highly specialised wing venation with many autapomorphies, viz. strongly curved RP–RP1, and loss of a common branch MP3+4 + CuA1 (because MP4+CuA arises at the same level as MP1+MP2 (Willmann 1989, fig. 93)). *Mesobittacus* is similar to the new genus but can be excluded because it has a CuA arising from Cu at a right angle in the fore wings and has shorter anal veins.

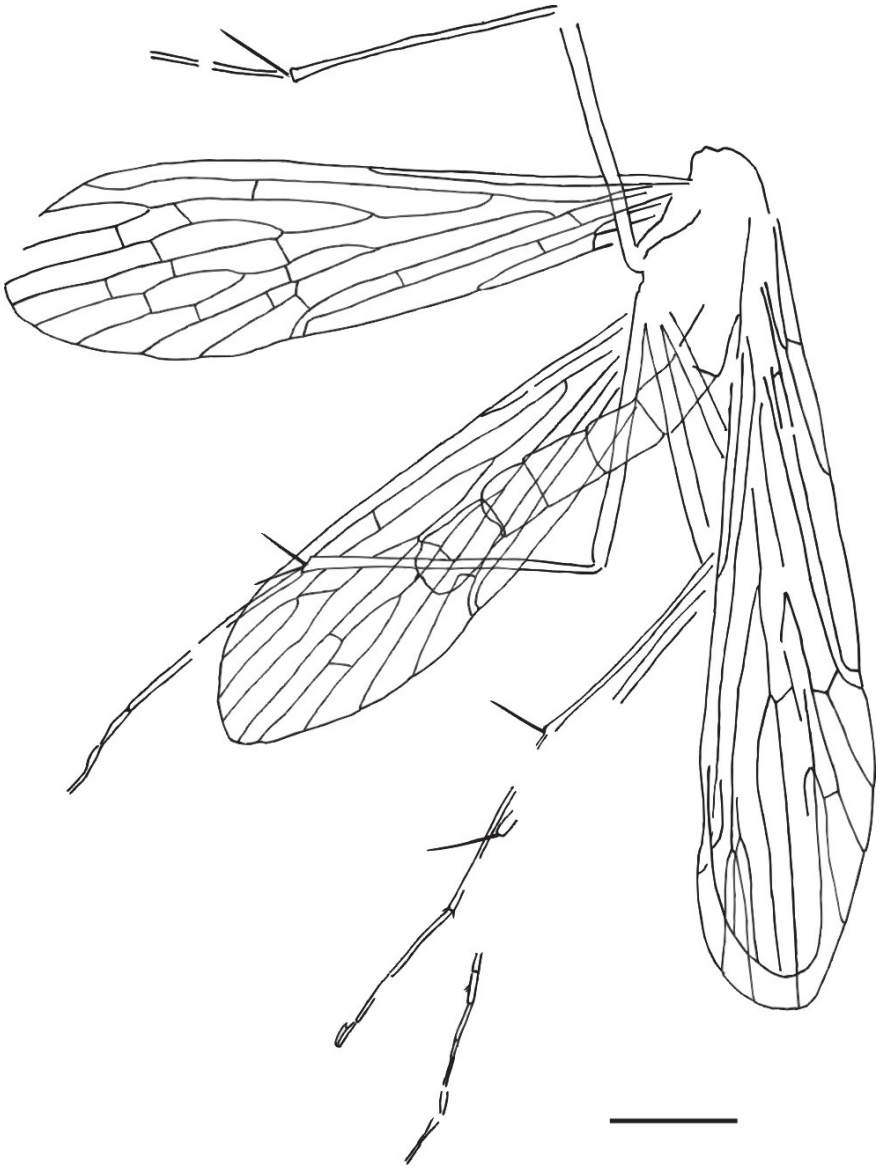

Fig. 2. *M. daohugouensis* holotype, camera lucida drawing. Scale bar = 2 mm.

Mongolbittacus shares with *Antiquanabittacus* and *Orobittacus obscurus* a strongly, posteriorly curved AA3+4 which is linked to AP1+2 by a short crossvein. However, the group formed by *Jichoristella*, *Antiquanabittacus* and *Anabittacus* seems to be well supported by two strong synapomorphies, i.e. basal shifting of the RP1+2+RP3+4+MA bifurcation, and MP3+MP4+CuA1+2 short or non-existent (Petrulevičius & Jarzembowski 2004). Therefore it is assumed that the above character is convergently similar in *Mongolbittacus*, *Antiquanabittacus* and *Orobittacus* and thus is an apomorphy of the new genus.

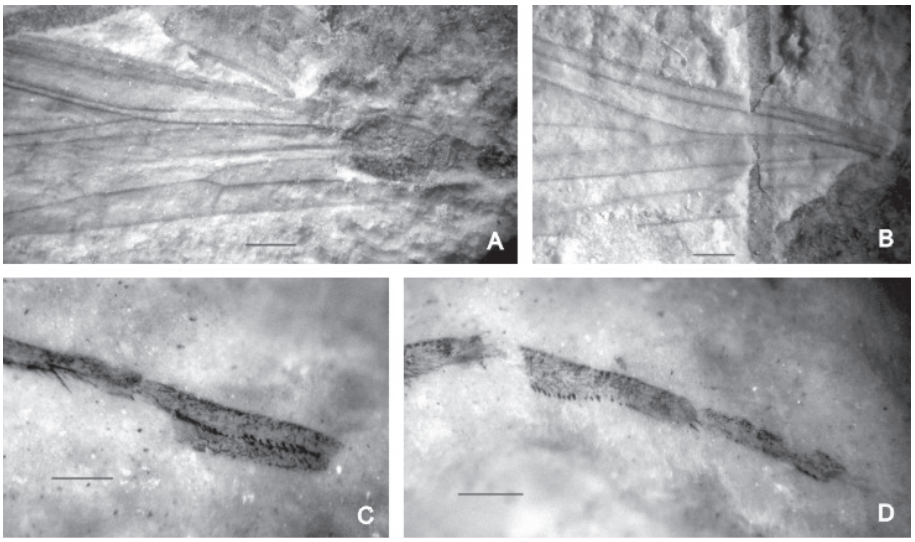

Fig. 3. *M. daohugouensis* holotype: (A) anal field of right fore wing; (B) anal field of left fore wing; (C) fore or middle last two tarsomeres; (D) hind last two tarsomeres. Scale bars = 0.2 mm.

Mongolbittacus daohugouensis sp. n.

Figs 1–4

Etymology: After type locality.

Description:

Body. Abdomen 6.5 mm long, with 7 visible segments, last segment rounded with cerci; hind and mid (?) femur about 4.1 mm long, hind tibia 4.5 mm long, mid (?) tibia 4.3 mm long, hind tarsus about 5.3 mm long, mid tarsus 6.5 mm long; two long tibial spurs on all 4 legs; tarsomere 3 of midtarsus (?) with several long hairs along ventral plane (Fig. 3C); tarsomere 4 of hind tarsus enlarged and with several strong, small ventral spines (Fig. 3D); tarsomere 5 of hind tarsus with less strong, small ventral spines; pretarsal claws not preserved.

Wings. Fore wing (basal part missing): preserved length 11.1 mm; maximum width 3.2 mm; basal part of wing narrow; ScP reaching wing margin just basal to RP fork; ScP without crossveins to RA; R continuous with RA; RA simple and slightly spoon-like, reaching antero-apical wing margin; crossvein between RA and RP1+2; sigmoidal crossvein between RP1+2 and RP3+4; crossvein between RP2 and RP3+4; crossvein between RP3+4 and MA; RP arising from R at an acute angle; RP1+2 arising at almost a right angle from RP, sub-symmetrical with RP3+4+MA; RP1 and RP2 bifurcating symmetrically; RP1+2 forking just basal to curved part of RA; MA nearly straight though fractured by anterior part of the *Kreuz*; RP3+4+MA + RP3+4 sigmoidal; RP3+4 arising from RP3+4+MA at an acute angle, bent posteriorly after crossvein to RP1+2, and running more or less parallel to MA; separation of RP3+4 basal to bifurcation of MP1+2; *Kreuz* not aligned; posterior part of *Kreuz* reaching MP3 just distal from its base; two crossveins between MA and MP1; one crossvein between MP1 and MP2; one crossvein between MP2 and MP3; MP4 fused with CuA1+2 and closely aligned

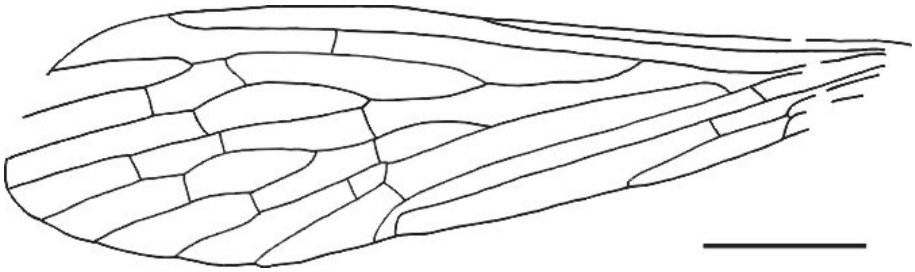

Fig. 4. *M. daohugouensis* holotype, camera lucida drawing of right fore wing. Scale bar = 2 mm.

with MP3; one crossvein between MP3 and MP4+CuA1+2; CuA arising from Cu at an oblique angle and fused with MP for a short distance; CuA3+4 and CuP running parallel to each other; final part of CuP strongly curved and reaching wing margin at approximately right angles; AA3+4 reaching wing margin slightly distal to bifurcation of R; one crossvein between CuP and AA3+4; AA3+4 strongly curved posteriorly and linked to AP1+2 by short crossvein; in left wing, curvature of AA3+4 is more pronounced and crossvein longer than in right wing, where AA3+4 is less curved (Figs 3A, 3B); AP1+2 running well separated from wing margin and reaching wing margin just basal to CuA, producing a wide posterior anal field; AP1+2 reaching wing margin with a strong curvature after crossvein to AA3+4, the curvature fractured in the left wing and rounded in the right (Figs 3A, 3B).

Hind wing (basal part missing): preserved length 9.5 mm; maximum width 2.7 mm; ScP reaching wing margin basal to forking of RP; ScP without crossveins to RA, shorter than in forewing; R continuous with RA; RA simple and slightly spoon-like (?), reaching antero-apical wing margin; crossvein between RA and RP1+2; oblique crossvein between RP3+4 and base of bifurcation of RP1 and RP2; RP arising from R at approximately right angles; RP1+2 arising from RP at an acute angle, sub-symmetrical with RP3+4 + MA; RP1 and RP2 bifurcating sub-symmetrically; MA nearly straight, fractured by anterior part of the *Kreuz*; RP3+4+MA + RP3+4 sigmoidal; RP3+4 arising from RP3+4+MA at an acute angle, bent posteriorly after crossvein to RP1+2, and running more or less parallel to MA; separation of RP3+4 basal to bifurcation of MP1+2; *Kreuz* not aligned; posterior part of *Kreuz* reaching MP3 just distal from its base (?); a single crossvein between MA and MP1 and between MP1 and MP2; MP4 fused with CuA1+2 and closely aligned with MP3; CuA3+4 and CuP running parallel to each other; final part of CuP strongly curved, reaching wing margin at a right angle.

Holotype: NIGPAS 133709, almost complete and articulated female specimen, without head; thorax not well preserved in lateral view, mid and hind legs legs preserved. CHINA: *Inner Mongolia*: Ningcheng County, Daohugou; Middle Jurassic, Jiulongshan Formation.

Remarks: Bittacidae are usually preserved disarticulated and are thus represented by isolated wings in the fossil record. The entomofauna from the Middle Jurassic of Daohugou is mainly represented by complete specimens. This introduces the possibility of observing intraspecimen variation in the wing venation. This variation was observed in *M. daohugouensis* in the venation of the anal field (Figs 3A, 3B). Variation of the wing venation in different specimens of the same recent species has been studied by different authors and summarised by Willmann (1989), who also provided new data. This variation is not documented in fossil specimens of the family, and the existence of

such variation at about 170 Ma is of great interest. We have to take into account the review comment of Dr J.G.H. Londt, stating that the specimen appears to be quite small for a bittacid and that small individuals may possess 'simplified' morphology—maybe even reduced venation. As this particular specimen is unique, being the only specimen of this species available for study, we are unable to estimate the variation in size between individuals of this species. Thus it is a possibility that the intraspecimen variation of wing venation in *M. daohugouensis* gen. et sp. n. is due to its small size. Future discoveries and subsequent studies of new specimens may help to resolve this matter.

ACKNOWLEDGMENTS

We extend our gratitude to M.M. Solórzano Kraemer (Institut für Paläontologie, Universität Bonn, Germany) for assistance with German translation and M.C. Digiani (Museo de La Plata, Argentina) for valuable help and discussion. We also thank J.G.H. Londt (Natal Museum, South Africa) and an anonymous reviewer for improvement of the manuscript.

We thank for the funds and support provided for this research: DR, grants Nos 30370184 and 30430100 from the National Natural Science Foundation of China, Scientific Research Key Program (KZ200410028013) and PHR Project of Beijing Municipal Commission of Education; DYH, grant No. 40672013 from the National Natural Science Foundation of China and the Major Basic Research Project (2006-CB806400) from MST of China; JFP, grant PIP 6393 from CONICET (National Research Council, Argentina), DAAD (German Academic Exchange Service) and MNHN (National Museum of Natural History, France), also grants directed by P. Wilf and provided by USA institutions: National Science Foundation (grant DEB-0345750) and National Geographic Society (grant 7337-02).

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