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Three New Species of Mesosciophilid Gnats from the Middle-Late Jurassic of China (Insecta: Diptera: Nematocera: Mesosciophilidae)

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Abstract: Three extinct new species from the Callovian or Oxfordian (uppermost Middle Jurassic or lowermost Upper Jurassic) Daohugou beds in Inner Mongolia, China is described as *Mesosciophila abstracta* sp. n., *Mesosciophilodes synchrona* sp. n. and *Paramesosciophilodes eximia* sp. n. (Family Mesosciophilidae). All the records of mesosciophilid gnats are briefly reviewed.

Key words: Insecta, diptera, Nematocera, Mesosciophilidae, new species, Jurassic, China

INTRODUCTION

Our knowledge of mesosciophilid gnats (the family Mesosciophilidae) is based mainly on impressions of wings from the Jurassic and Lower Cretaceous. Entire remains of this family are rare. Only four species, *Mesosciophila venosa* (Rohdendorf, 1946), *M. eucalla* (Zhang, 2007), *Mesosciophilopsis curta* (Blagoderov, 1994) and *Paramesosciophilodes ningchengensis* (Zhang, 2007) have been described based on nearly complete bodies with wings. To date, this family comprises ten species of five genera: *Mesosciophila venosa*, *M. eucalla*, *Mesosciophilina bolshakovi* (Kovalev, 1985), *M. irinae* (Kovalev, 1985), *Mesosciophilodes angustipennis* (Rohdendorf, 1946), *M. similis* (Rohdendorf, 1964), *Mesosciophilopsis curta* (Blagoderov, 1994), *M. expleta* (Blagoderov, 1994), *M. minor* (Blagoderov, 1994) and *Paramesosciophilodes ningchengensis*. In addition, *Eoboletina gracilis* (Rohdendorf, 1946) and *Sinosciophila meileyingziensis* (Hong, 1992) may be representatives of the Mesosciophilidae (Blagoderov, 1994; Zhang, 2007). *Pseudalysiinia fragmenta* Jell and (Duncan, 1986), can be transferred to the Mesosciophilidae but belongs to a new unnamed genus rather than to the extant *Pseudalysiinia* (Tonnoir, 1929), within the Mycetophilidae (Blagoderov, 1994). The genus *Sciophilites* (Kovalev, 1990), belongs to either the Mesosciophilidae or the Mycetophilidae (Blagoderov, 1994). Herein, three extinct new species *Mesosciophila abstracta* sp. n., *Mesosciophilodes synchrona* sp. n. and *Paramesosciophilodes eximia* sp. n. referable, respectively to *Mesosciophila* (Rohdendorf, 1946), *Mesosciophilodes* (Rohdendorf, 1946) and

Paramesosciophilodes (Zhang, 2007), within the Mesosciophilidae is described from the Daohugou Formation in Chifeng, Inner Mongolia based on nearly complete male or female gnats.

The geological age for the fly-bearing sedimentary rocks in the vicinity of Daohugou village has been the focus of much debate. It has been dated as early Middle Jurassic or Middle Jurassic. However, based on the biostratigraphic correlation and isotope dating, it should be latest Middle Jurassic-earliest Late Jurassic (Zhang, 2004, 2005, 2006; Zhang and Kluge, 2007; Liu *et al.*, 2006).

Wing venation in the descriptions follows that of Wootton and Ernos (1989) and has also been adopted by Shcherbakov *et al.* (1995), Mostovski (1997) and Blagoderov *et al.* (2002). The vein traditionally named 1A is, in fact, CuP (Fig. 5).

MATERIALS AND METHODS

Specimens NIGPCAS were collected in 2002 and deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China. DHG200714, DHG200715 and DHG200716, a male and two female mesosciophilid gnats in shale, are preserved. The insect-bearing sedimentary rocks of the Daohugou beds are located in the vicinity of Daohugou village in Ningcheng County, Chifeng City, Inner Mongolia, China.

Specimen descriptions, photographs and drawings were obtained without the application of glycerol to the surface of the specimens. The line drawings were executed with a camera lucida and the digital photographs were taken using a stereomicroscope.

RESULTS AND DISCUSSION

Paramesosciophilodes eximia sp. n. (Fig. 1-5): Holotype, NIGPCAS, DHG200714, a nearly complete impression of male, dorsoventral aspect, from the latest Middle Jurassic-earliest Late Jurassic Daohugou Formation in the vicinity Daohugou village, Ningcheng County, Chifeng City, Inner Mongolia, China; deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences.

Description: Head, thorax, abdomen and legs darkish brown, wings yellowish brown. Head large, subcircular and clearly narrower than thorax. Eyes large, suboval. Mesonotum large, oval. Scutellum large. Wing 2.1-2.5 times longer than wide; venationally, Sc1 0.46 times as long as wing length, its end distad to midlength of cell r; Sc2 well developed; section of R (from Sc2 to Rs origin) distinctly longer than bRs; bRs about one-half (little more in right wing, little less in left wing) of length of r-m; R2+3 oblique and only somewhat curved terminally; cell r 0.17-0.18 times as long as wing length; M1+2 furcated almost at level of fork of Rs and at level of Sc1 end; bM1t2 slightly shorter than dM1t2. CuA smoothly arched, its end distad to fork of Rs. Legs thin and long, but femora of hindleg short and massive, tibiae cylindrical, with basitarsi nearly one-half of length of femora, second tarsi nearly one-half of length of basitarsi, remainder poorly preserved; tibial spurs invisible. Abdomen relatively thin and long, subcylindrical, with six abdominal segments, first segment elongate and third segment wider than remainder segments. Male terminalia very large, subcircular with gonocoxites massive, gonostyli large, falcate, strongly curved inward.



Fig. 1: *Paramesosciophilodes eximia* sp. n. Holotype, NIGPCAS, DHG200714. Photograph. Body with wings in dorsoventral view, scale bar represents 1 mm



Fig. 2: *Paramesosciophilodes eximia* sp. n. Holotype, NIGPCAS, DHG200714. Photograph. Right wing, scale bar represents 1 mm



Fig. 3: *Paramesosciophilodes eximia* sp. n. Holotype, NIGPCAS, DHG200714. Photograph. Male terminalia, scale bar represents 1 mm



Fig. 4: *Paramesosciophilodes eximia* sp. n. Line drawing. Body with wings in dorsoventral view, scale bar represents 1 mm

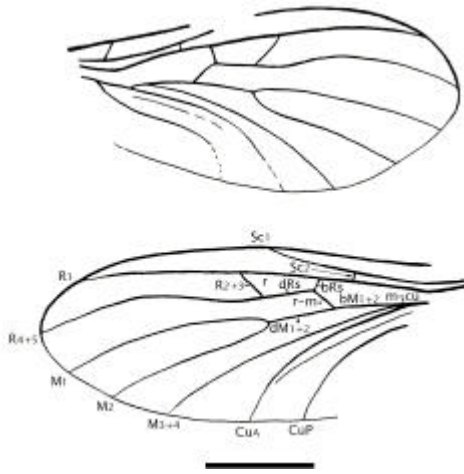


Fig. 5: *Paramesosciophilodes eximia* sp. n. Line drawings. Wings, scale bar represents 1 mm

Measurements: Length of body 6.1, width 1.2 mm; length of head 0.5, thorax 1.3 mm, abdomen 4.3 mm; length of wing 3.6-4.0 mm, width 1.6-1.7 mm; length of femur of hindleg 1.2 mm, tibia 2.3 mm, tarsus (as preserved) 2.1 mm.

Remarks: This new species can be assigned to the genus *Paramesosciophilodes* (Zhang, 2007) on the basis of Sc1 elongate, which is slightly shorter than one-half of wing length; Sc2 situated distinctly basad to Rs origin, arising near midway between h to Sc1 end; bRs markedly shorter than r-m; R1 slightly curved; both R1 and R4+5 divergent terminally; R4+5 arched near its midlength; R2+3 oblique; cell r 0.17-0.18 times as long as wing length and stem of M not developed. The new species is closely similar in wing venation to the type species *Paramesosciophilodes ningchengensis* (Zhang, 2007) but differs in the Sc1 end, which is distad clearly to the midlength of cell r; the M1+2 furcated almost at level of fork of Rs and at level of Sc1 end and the CuA smoothly arched, its end distad distinctly to Rs fork.

***Mesosciophila abstracta* sp. n. (Fig. 6-9):** Holotype, NIGPCAS, DHG200715, a nearly complete impression of female, lateral aspect, from the latest Middle Jurassic-earliest Late Jurassic Daohugou Formation in the vicinity Daohugou village, Ningcheng County, Chifeng city, Inner Mongolia, China; deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences.

Description: Female. Body yellowish brown. Head small and oviform. Eyes small, suboval. Antennae nearly 3.5 times as long as head, with oblong flagellomeres, that are



Fig. 6: *Mesosciophila abstracta* sp. n. Holotype, NIGPCAS, DHG200715. Photograph. Body with wings in lateral view, scale bar represents 1 mm



Fig. 7: *Mesosciophila abstracta* sp. n. Holotype, NIGPCAS, DHG200715. Photograph. Right wing, scale bar represents 1 mm

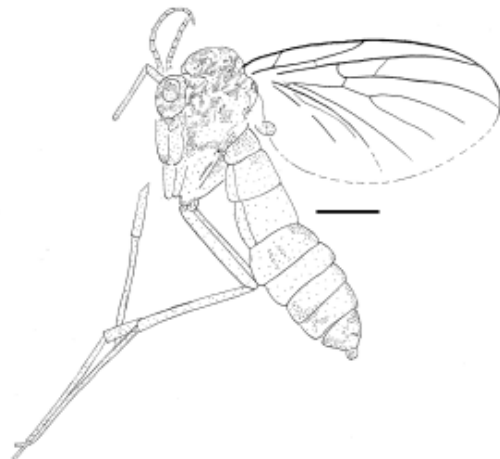


Fig. 8: *Mesosciophila abstracta* sp. n. Line drawing. Body with wing in lateral view, scale bar represents 1 mm

gradually reduced in length terminally, last one tapering apically. Thorax broadoval. Mesonotum strongly convex. Scutellum sharp, clearly projecting. Wing short and wide, about 1.8 times longer than wide; venationally, Sc1 long, nearly one-half (ca. 0.48 times) of wing length, ending distad to midlength of cell r and nearly at level of M1+2 fork. Sc2 developed, but rather faint and slender; section of R (from Sc2 to Rs origin) nearly as long as bRs; bRs distinctly curved, almost vertical to R stem and clearly longer (nearly twice) than r-m; R2t3 oblique, rather faint and slender (hardly visible); R4+5 smoothly arched; cell r about 0.19 times as long as wing length; M1t2 furcated nearly at level of Rs fork; bM1t2 1.6 times longer than dM1t2; M3t4 running close to CuA basally, but neither coalescent; m-cu well developed and somewhat oblique. Legs relatively thin and long, coxae clavate and femora of hindleg cylindrical and slightly shorter than tarsi, basitarsi seemingly rather long. Abdomen with first three segments subcylindrical, remainder elongate-oval. Female terminalia obtuse-triangular, with short and rounded cerci.

Measurements: Length of head 0.5 mm, antenna (as preserved) 1.7 mm, thorax 1.5 mm, abdomen 4.0 mm, length of wing 4.1 mm, width 2.3 mm; length of femur of hindleg 1.7 mm, tibia ca. 2.1 mm, tarsus (as preserved) 2.8 mm.

Remarks: The wing venation closely resembles that of *M. eucalla* (Zhang, 2007), but differs in the following characters: the longer Sc1 which is nearly one-half of wing length and ends distad to midlength of cell r; the rather faint and slender R2+3; the longer bM1+2 which is clearly longer than dM1+2 and the distad M1+2 fork which is nearly at level of Rs fork.

Meanwhile, this new species is easily separated from *M. venosa* (Rohdendorf, 1946) by the short and wide wing, the longer Sc1, the strongly curved bRs which is nearly vertical to Rs stem, the rather faint and slender R2+3 which is clearly longer than bRs and the longer bM1+2 which is distinctly longer than dM1+2.

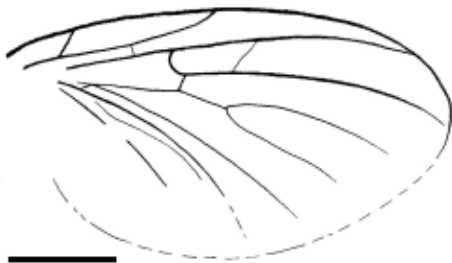


Fig. 9: *Mesosciophila abstracta* sp. n. Line drawing. Right wing, scale bar represents 1 mm

***Mesosciophilodes synchrona* sp. n. (Fig. 10-14):**

Holotype, NIGPCAS, DHG200716, a nearly complete impression of female, lateral aspect, from the latest Middle Jurassic-earliest Late Jurassic Daohugou Formation in the vicinity Daohugou village, Ningcheng County, Chifeng City, Inner Mongolia, China; deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences.

Description: Female. Body yellowish brown. Head rather small and subcircular. Eyes small, suboval. Maxillary palps five-segmented, 1.5 times longer than head length, with first three segments short and massive, fourth segment coniform, last one fliform, much slender and long. Antennae probably 16-segmented, 4.1 times as long as



Fig. 10: *Mesosciophilodes synchrona* sp. n. Holotype, NIGPCAS, DHG200716. Photograph. Body with wings in latest view, scale bar represents 1 mm



Fig. 11: *Mesosciophilodes synchrona* sp. n. Holotype, NIGPCAS, DHG200716. Photograph. Head with antennae and maxillary palps, scale bar represents 1 mm

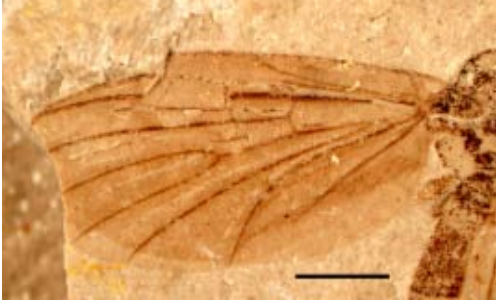


Fig. 12: *Mesososciophilodes synchrona* sp. n. Holotype, NIGPCAS, DHG200716. Photograph. Wings, scale bar represents 1 mm

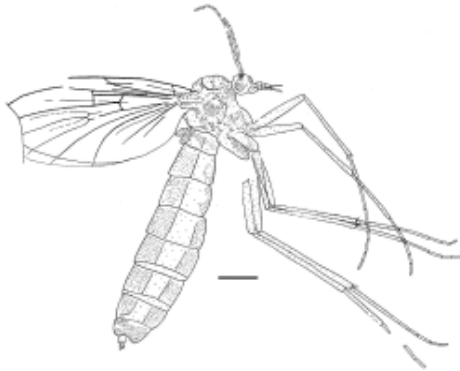


Fig. 13: *Mesososciophilodes synchrona* sp. n. Line drawing. Body with wings in lateral view, scale bar represents 1 mm

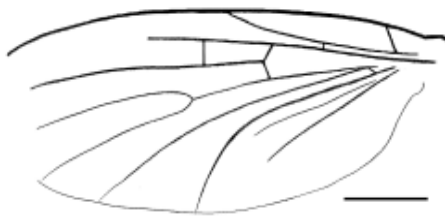


Fig. 14: *Mesososciophilodes synchrona* sp. n. Line drawings. Restored wing based on type specimen, scale bar represents 1 mm

head, with scapes and pedicels bed-preserved, flagellomeres oblong, gradually reduced in length terminally, last one tapering apically. Thorax short and broadoval. Mesonotum clearly convex. Scutellum projecting. Wing relatively narrow and long, about 2.3 times longer than wide; venationally, Sc1 long, ending distad to midlength of cell r. Sc2 developed, but somewhat faint and slender; section of R (from Sc2 to Rs origin) much longer than bRs; bRs nearly as long as r-m; R2t3

straight, nearly vertical to both of R and Rs stems and slightly longer than bRs; R4+5 almost straight (only a little curved downward); cell r about 0.15 times as long as wing length; M1t2 furcated distinctly distad to Rs fork; bM1t2 1.2 times longer than dM1t2; M3t4 running close to CuA basally, but neither coalescent; m-cu well developed and oblique. Legs relatively thin and long, coxae clavate, femora cylindrical, tibiae obviously longer and thinner than femora, but shorter and thicker than tarsi, with tibial spurs well developed, basitarsi elongate and slightly shorter than (or nearly as long as) remainder combined, others gradually shortened terminally. Abdomen subcylindrical, with fourth and fifth thickest. Female cerci rather thin and small.

Measurements: Length of head 0.6 mm, antenna 2.6 mm, thorax 1.6 mm, abdomen 6.0 mm, length (as preserved) of wing 4.8 mm (total length ca. 5.0 mm), width 2.2 mm; length of femur of foreleg 1.5 mm, tibia 1.9 mm, tarsus 3.3 mm (1.4:1.0:0.4:0.25:0.25); femur of hindleg 1.8 mm, tibia 2.7, tarsus 3.0 mm (1.5:0.6:0.4:0.25:0.25).

Remarks: The wing venation of *Mesososciophilodes synchrona* sp. n. closely resembles the known species *M. angustipennis* (Rohdendorf, 1946), but the Sc1 is quite long which ends distad to midlength of cell r; the M1+2 is furcated clearly distad to Rs fork; and the bM1+2 is distinctly longer than dM1+2.

On the other hand, this new species can be distinguished from *M. similis* (Rohdendorf, 1964) by the longer Sc1, the straight R2+3 (not curved in its midlength) and the shorter bRs which is nearly as long as r-m.

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