



## New Middle Jurassic tangle-veined flies from Inner Mongolia, China

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Many Jurassic fossil nemestrinid flies have been found in the Palaeartic region. China is an important locality for fossil nemestrinid flies. Up to now, 2 genera with 3 species have been discovered in China. In the present paper, a third genus and species, *Ahirmoneura neimenguensis* Zhang, Yang, and Ren, gen. et sp. nov., from the Middle Jurassic Daohugou Formation of China is described. A key to genera of fossil nemestrinid flies from China is given.

### Introduction

The family Nemestrinidae (tangle-veined flies) is a cosmopolitan group of brachyceran Diptera consisting of about 300 described species in over 20 genera. They are found in all zoogeographic regions, most abundant and diverse in the Palaeartic, Australian, and Afrotropical regions, sparse in the Nearctic region. All known nemestrinid larvae are parasites of grasshoppers

and scarabaeid beetle larvae. Bernardi (1973) have summarized the genera of Nemestrinidae around the world, including the morphology and distribution of fifteen extant and five fossil genera belonging to six subfamilies. Before this paper, 12 genera and 28 species of fossil Nemestrinidae have been described (Bequaert 1936; Bernardi 1973; Evenhuis 1994; Ren 1998; Mostovski 1998; Ansoerge and Mostovski 2000; Mostovski and Martínez-Delclòs 2000). They have been found from the Jurassic to Tertiary of Germany, Kazakhstan, China, Spain, Russia, and USA. Besides, the genera *Rhagionemestrius* Ussatchev, 1968 and *Sinonemestrius* Hong and Wang, 1990 were removed from the family Nemestrinidae by Nagatomi and Yang (1998) as two independent families, Rhagionemestriidae and Sino-nemestriidae.

Ren (1998) found 2 genera and 3 species of fossil Nemestrinidae for the first time from Western Liaoning of China. These are *Florinemestrius pulcherrimus* Ren, 1998, *Protonemestrius juras-*

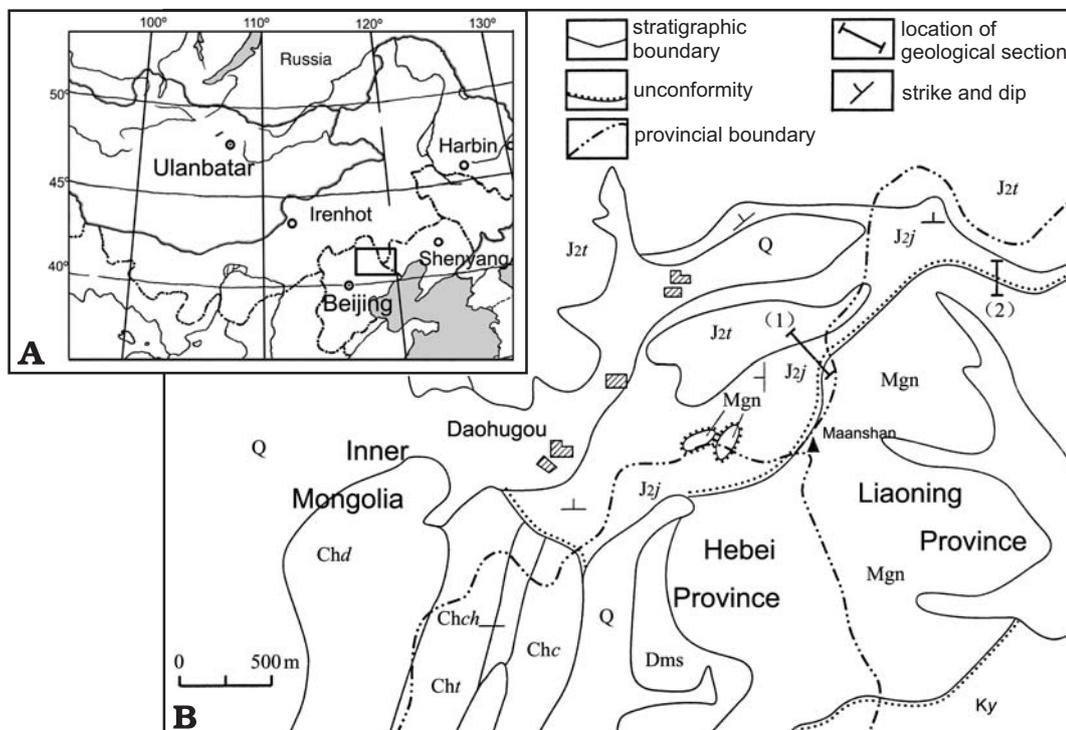


Fig. 1. Location of the type locality of *Ahirmoneura neimenguensis* Zhang, Yang, and Ren, gen. et sp. nov. Daohugou Village, Shantou Township, Ningcheng County, Inner Mongolia, China. **A.** Outlined location. **B.** Detailed location. Abbreviations: Chc, Changchougou Formation; Chch, Chuanlinggou Formation; Chd, Dahongyu Formation; Cht, Tuanshanzi Formation; J<sub>2j</sub>, Jiulongshan Formation; J<sub>2t</sub>, Tiaojiang Formation; Ky, Yixian Formation; Q, Quaternary; Dms, Dalaiyingzi erosion surface; Mgn, Maanshan gneiss.

*sicus* Ren, 1998, *Protonemestrius beipiaoensis* Ren, 1998. These two genera were discovered from the Late Jurassic Yixian Formation of Beipiao City, Liaoning Province. In the present paper, we describe the oldest nemestrinid from China from the Middle Jurassic (Aalenian-Bajocian) deposits of Jiulongshan Formation (Daohugou Village, Shantou Township, Ningcheng County, Inner Mongolia Province). During the past several years, the Daohugou locality (Fig. 1) became famous of excellently preserved animal and plant fossils known as Daohugou biota. The palaeoenvironmental reconstructions of the Daohugou site, suggest humid and warm-temperate climate for this volcanic region with mountain streams (Ren and Krzeminski 2002; Ren et al. 2002; Liu et al. 2004).

*Institutional abbreviation.*—CNU, Capital Normal University, Beijing, China.

*Other abbreviations.*—bm, basal medial; br, basal radial; C, costa; CuA<sub>1</sub>, CuA<sub>2</sub>, anterior branches of cubitus; d, discal; M<sub>1</sub>, M<sub>2</sub>, M<sub>3</sub>, posterior branches of media; m<sub>1</sub>, m<sub>2</sub>, m<sub>3</sub>, medial; R<sub>1</sub>, anterior branch of radius; R<sub>2</sub>, R<sub>4</sub>, R<sub>5</sub>, posterior branches of radius; r<sub>1</sub>, r<sub>2</sub>, r<sub>4</sub>, r<sub>5</sub>, radial; r-m, radial-medial; Rs, radial sector; Sc, subcosta; sc, subcostal.

## Systematic palaeontology

Basic terminology follows McAlpine (1981) and Teskey (1981).

### Order Diptera Linné, 1758

#### Family Nemestrinidae Macquart, 1834

#### Genus *Ahirmoneura* Zhang, Yang, and Ren, nov.

*Type species:* *Ahirmoneura neimengguensis* Zhang, Yang, and Ren, sp. nov.

*Derivation of the name:* The generic name refers to the difference between the new genus and *Hirmoneura*.

*Diagnosis.*—Body large. Eyes large, dichoptic, ommatidia clearly visible. Wing elongate and rather narrow: Base of vein C swollen and sclerotized with dense setulae. Vein Sc short, ending slightly beyond middle of wing, far from level of fork of vein R<sub>4+5</sub>. In apical part of wing, veins running parallel to anterior margin, ending before wing-tip. Vein R<sub>3</sub> absent; vein R<sub>4</sub> cambered basally. Crossvein r-m located at extreme base of cell d. Vein M<sub>2</sub> arising from apex of cell d; veins M<sub>3</sub> and CuA<sub>1</sub> fused before wing margin with a petiole. Vein CuA<sub>1</sub> arising from apex of cell d. Abdomen incomplete, 4 segments preserved. Segment I widest.

*Remarks.*—Judging from the wing venation, *Ahirmoneura* gen. nov. is similar to *Hirmoneura* Meigen, 1820 by having crossvein r-m present, vein M<sub>2</sub> reaching the anterior margin of the wing, veins M<sub>3</sub> and CuA<sub>1</sub> fused before wing margin with a petiole, alula broad. But, the new genus differs from *Hirmoneura* in vein Sc ending slightly beyond the middle of the wing, crossvein r-m at the extreme base of cell d, vein Rs distinctly longer than the distance between vein R<sub>2</sub> and crossvein r-m, vein M<sub>2</sub> arising from the apex of cell d, the mouth of cell r<sub>1</sub> over twice as long as that of cell r<sub>2</sub>, cell r<sub>4</sub> longer than cell m<sub>1</sub>, cell br much shorter than cell bm. In *Hirmoneura*, vein Sc is

ending far beyond the middle of the wing, crossvein r-m is located at the apical part of cell d, vein Rs is distinctly shorter than the distance between vein R<sub>2</sub> and crossvein r-m, vein M<sub>2</sub> is arising from cell m<sub>3</sub>, the mouth of cell r<sub>1</sub> is less than twice as long as that of cell r<sub>2</sub>, cell r<sub>4</sub> is shorter than cell m<sub>1</sub>, cell br is much longer than cell bm.

Key to genera of fossil (Jurassic) nemestrinid flies from China:

1. Crossvein r-m at extreme base of cell d; vein M<sub>2</sub> arising from cell d ..... *Ahirmoneura*  
— Crossvein r-m at apical part of cell d; vein M<sub>2</sub> arising from cell m<sub>3</sub> ..... 2
2. Crossvein between veins M<sub>1</sub> and M<sub>2</sub> present; veins M<sub>2</sub> and CuA<sub>1</sub> + M<sub>3</sub> converged at a point at base ..... *Florinemestrius*  
— Crossvein between veins M<sub>1</sub> and M<sub>2</sub> absent; veins M<sub>2</sub> and CuA<sub>1</sub> + M<sub>3</sub> diverged at base ..... *Protonemestrius*

*Distribution.*—The genus is known only from China and is currently represented by one species.

#### *Ahirmoneura neimengguensis* Zhang, Yang, and Ren, sp. nov.

Fig. 2.

*Derivation of the name:* After the type region: Inner Mongolia (Chinese pronunciation is “nei meng gu”).

*Holotype:* CNU-B-NN2006003, an almost complete adult body with wings in dorsal view.

*Type locality:* Daohugou Village, Shantou Township, Ningcheng County, Inner Mongolia, China.

*Type horizon:* Aalenian-Bajocian Jiulongshan Formation, Middle Jurassic.

*Material.*—Only holotype specimen.

*Dimensions.*—Body length over 22.5 mm, wing length 15.5 mm, wing width 5.0 mm.

*Diagnosis.*—The same as for the genus.

*Description.*—A large, dark fly. Head hemispherical in dorsal view, without hairs. Eyes large; dichoptic, ommatidia visible clearly. Antenna and proboscis not preserved.

Only anterior part of thorax preserved. Legs partly visible with dense pubescence. Wing elongate, rather narrow, pubescent; supernumerary crossvein absent. Base of vein C distinctly swollen, sclerotized with dense setulae. Vein Sc short, ending slightly beyond middle of wing, far from level of fork of vein R<sub>4+5</sub>. In apical part of wing, veins running parallel to anterior margin, ending before wing-tip. So-called diagonal vein (consisting of elements of Rs, common stem of veins R<sub>4</sub> and R<sub>5</sub>, crossvein r-m, M<sub>1</sub>, M<sub>2</sub>, M<sub>3</sub>, and CuA<sub>1</sub>) absent. Vein R with four branches, vein R<sub>3</sub> absent; base of vein R<sub>4</sub> cambered. Crossvein r-m located at extreme base of cell d. Veins M<sub>1</sub> and M<sub>2</sub> diagonal and parallel; vein M<sub>2</sub> arising from apex of cell d, ending slightly before wing tip; veins M<sub>3</sub> and CuA<sub>1</sub> fused before wing margin with a petiole. Crossvein m-cu absent. Vein CuA<sub>1</sub> arising from apex of cell d. Vein CuA<sub>2</sub> shorter than 1/2 of cell bm. Apex of vein A not preserved. Mouth of cell sc longer than that of cell r<sub>1</sub>.

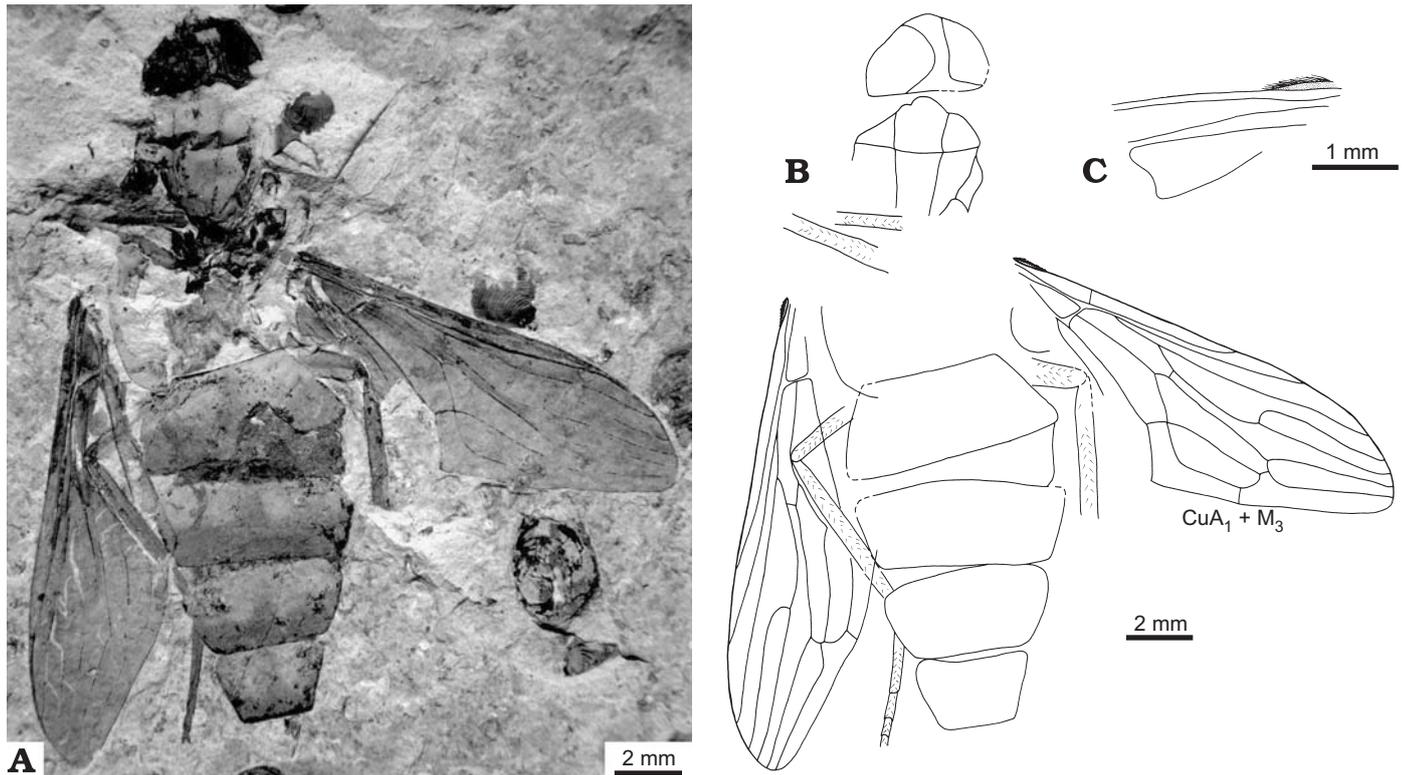


Fig. 2. Nemestrinid fly *Ahirmoneura neimengguensis* Zhang, Yang, and Ren, gen. et sp. nov., holotype CNU-B-NN2006003, from the Daohugou Village, Inner Mongolia, China; Aalenian-Bajocian Jiulongshan Formation, Middle Jurassic. **A.** Body with wings photograph in dorsal view. **B.** Camera lucida drawing, based on the original photograph, in dorsal view. **C.** Camera lucida drawing, base of vein C details.

Mouth of cell  $r_1$  longer than wing margin between veins  $R_2$  and  $R_5$ . Mouth of cells  $r_4$ ,  $r_5$ ,  $m_1$  subequal in length. Cell  $r_4$  longer than cell  $m_1$ . Cell br short and small, apical portion of cell br narrow but unpointed. Cell d longer than cell  $m_3$ . Five posterior cells present, cell  $m_1$  shorter than cell  $m_2$ , cell  $m_3$  closed far before wing margin with a petiole. Anal lobe narrow. Alula broad.

Abdomen robust, covered with setulae. Abdomen incomplete, 4 segments preserved, apex not preserved. Segment I widest, abdomen segments narrowing toward tip. Gender unknown.

## Discussion

The presence of so-called diagonal veins is the most conspicuous diagnostic character in most nemestrinid flies, including all known extinct genera. *Ahirmoneura* gen. nov. is unique among Nemestrinidae in lacking so-called diagonal veins, crossvein r-m located at the extreme base of cell d, vein  $M_2$  arising from cell d, cell  $m_3$  ending before cell d. These unusual characters, which are different from the extant genera and other extinct genera of Nemestrinidae, might be the plesiomorphies. Some similar states also have been observed in *Sinonemestrius* Hong and Wang, 1990. It provides evidence on how the composite “diagonal vein” was assembled over evolutionary time. Especially, the positional transformation of crossvein r-m and cell  $m_3$  plays a vital part in the progress of the venational evolution of family Nemestrinidae.

**Acknowledgments.**—We are greatly indebted to David K. Yeates (CSIRO Entomology, Canberra, Australia) and Mikhail B. Mostovski (The Natal Museum, Pietermaritzburg, South Africa) for insightful comments on the manuscript. This research was supported by the National Natural Science Foundation of China (No. 30430100, 30225009, 30025006), PHR Project of Beijing Municipal Commission of Education.

## References

- Ansorge, J. and Mostovski, M.B. 2000. Redescription of *Prohirmoneura jurassica* Handlirsch 1906 (Diptera: Nemestrinidae) from the Lower Tithonian lithographic limestone of Eichstätt (Bavaria). *Neues Jahrbuch für Geologie und Paläontologie. Monatshefte* 2000 (4): 235–243.
- Bequaert, J.C. 1936. The Nemestrinidae of the Miocene of Florissant, Colorado, and their relations to the recent fauna. *Journal of Paleontology* 10: 395–409.
- Bernardi, N. 1973. The genera of the family Nemestrinidae (Diptera: Brachycera). *Arquivos de Zoologia* 24: 1–318.
- Evenhuis, N.L. 1994. Family Nemestrinidae. In: N.L. Evenhuis (ed.), *Catalogue of the Fossil Flies of the World (Insecta: Diptera)*, 313–315. Backhuys Publishers, Leiden.
- Liu, Y., Liu, Y., Li, P., Zhang, H., Zhang, L., Li, Y., and Xia, H. 2004. Daohugou biota-bearing lithostratigraphic succession on the southeastern margin of the Ningcheng basin, Inner Mongolia, and its geochronology. *Geological Bulletin of China* 23: 1180–1185.
- McAlpine, J.F. 1981. Morphology and terminology—adults. In: J.F. McAlpine, B.V. Peterson, G.E. Shewell, H.J. Teskey, J.R. Vockeroth, and D.M. Wood (eds.), *Manual of Nearctic Diptera*, Vol. 1. *Research Branch Agriculture Canada, Monograph* 27: 9–63.

- Mostovski, M.B. 1998. A revision of the nemestrinid flies (Diptera, Nemestrinidae) described by Rohdendorf, and a description of new taxa of the Nemestrinidae from the Upper Jurassic of Kazakhstan. *Paleontological Journal* 32: 369–375.
- Mostovski, M.B. and Martínez-Delclòs, X. 2000. New Nemestrinoidea (Diptera: Brachycera) from the Upper Jurassic–Lower Cretaceous of Eurasia, taxonomy and palaeobiology. *Entomological Problems* 31: 137–148.
- Nagatomi, A. and Yang, D. 1998. A review of extinct Mesozoic genera and families of Brachycera (Insecta, Diptera, Orthorrhapha). *Entomologist's Monthly Magazine* 134: 95–192.
- Ren, D. 1998. Late Jurassic Brachycera from northeastern China. *Acta Zootaxonomica Sinica* 23: 65–83.
- Ren, D., Gao, K., Guo, Z., Ji, S., Tan, J., and Song, Z. 2002. Stratigraphic division of the Jurassic in the Daohugou area, Ningcheng, Inner Mongolia. *Geological Bulletin of China* 21: 584–591.
- Ren, D. and Krzeminski, W. 2002. Eoptychopteridae (Diptera) from the Middle Jurassic of China. *Annales Zoologici* 52: 207–210.
- Teskey, H.J. 1981. Nemestrinidae. In: J.F. McAlpine, B.V. Peterson, G.E. Shewell, H.J. Teskey, J.R. Vockeroth, and D.M. Wood (eds.), *Manual of Nearctic Diptera*, Vol. 1. *Research Branch Agriculture Canada, Monograph* 27: 585–588.

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