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# A new mesopanorpodid scorpionfly (Insecta: Mecoptera) from the Mesozoic of Jilin Province, northeastern China

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Mesopanorpodidae Tillyard, 1918 is a small extinct family of Mecoptera described from France, Russia, China, Australia, and South Africa ranging from the Late Permian to the Late Triassic. The systematic placement of Mesopanorpodidae is debated; some suggested it as a separate family (Riek, 1953, 1976; Carpenter, 1992; Ren *et al*., 1995; Van Dijk & Geertsema, 1999; Hong *et al*., 2002; Hong & Guo, 2003; Sun *et al*., 2007), whereas others considered it a member of Permochoristidae Tillyard, 1918 (Martynova, 1962; Novokshonov, 2001; Novokshonov *et al*., 2004; Bashkuev, 2011). As all mesopanorpodids distinctly differ from Permochoristidae by their constant four-branched Rs and M in both forewing and hind wing, here we regard it as a valid family. Herein, we describe the first species of *Prochoristella* Riek, 1953 (Mesopanorpodidae) from the Xiaofengmidingzi Formation of Jilin Province, northeastern China.

## Geological setting

The Xiaofengmidingzi Formation, distributed in the central area of Jilin Province, northeastern China, is a set of volcano-sedimentary strata, rich in plant fossils. The lower section is represented by acid pyroclastic rocks, and upper section represented by conglomerates, sandstones, siltstones, interbedded with coal beds, and a small amount of tuff (Mi *et al*., 1993, Jilin Bureau of Geology and Mineral Resources, 1997). Hong (1993) described three specimens of cockroaches (Blattodea) from the South Mine of Bamianshi Coal Mine in Shuangyang District, including two named species (*Rhipidoblattina shuangyangensis* Hong, 1993 and *Triassoblatta shaoguojieensis* Hong, 1993) and one undefined species (*Triassoblatta* sp.). The age of the Xiaofengmidingzi Formation has been controversial. Mi *et al*. (1993) considered that the upper Xiaofengmidingzi Formation is the Upper Triassic based on plant fossils, but did not assign a precise age for the lower part. During this period, it was prevalent to consider the age of strata as the Late Triassic (Jilin Bureau of Geology and Mineral Resources, 1997). Some authors had conducted isotopic dating on this formation, obtaining the ages from the top formation of 151.2 Ma and 153.2 Ma, and the middle formation of 167.8 Ma according to the whole rock isotopic dating in different localities (Wu & Song, 1997), and determined it as late Middle Jurassic, correlated with the Tiaojishan Formation (= Lanqi Formation in the original paper) in western Liaoning Province. However, a recent integrative stratigraphic study revealed that the Tiaojishan Formation is Late Jurassic in age (Huang, 2019). Due to deficiencies in methods and inaccuracy of isotopic dating in the 1990s, the first data are probably not reliable. Recently, updated isotopic dating at the type locality of the Xiaofengmidingzi Formation and other sites show that the zircon U-Pb age of the rhyolite in type locality is 192 ± 2 Ma (Early Jurassic), while the zircon U-Pb age of the andesite in other sites is 172 ± 1 Ma (Middle Jurassic). Therefore, it has been suggested that the former age represents the real age of this formation, and the latter should be possibly considered as the Nanloushan Formation (Zhang *et al*., 2016).

Recently, we have collected hundreds of fossil insects from a coal gangue of the Bamianshi Coal Mine (Fig. 1), including isolated beetle elytra (Coleoptera), a few hemipterans, and one mecopteran. The fossiliferous black shale and siltstone yield numerous plant remains as well.

## Material and methods

The new species is erected based on a specimen preserved in the organics-rich coal gangue, co-occurring with a wealth of plant fossils (such as Cycadopsida, Ginkgopsida, Filicopsida,

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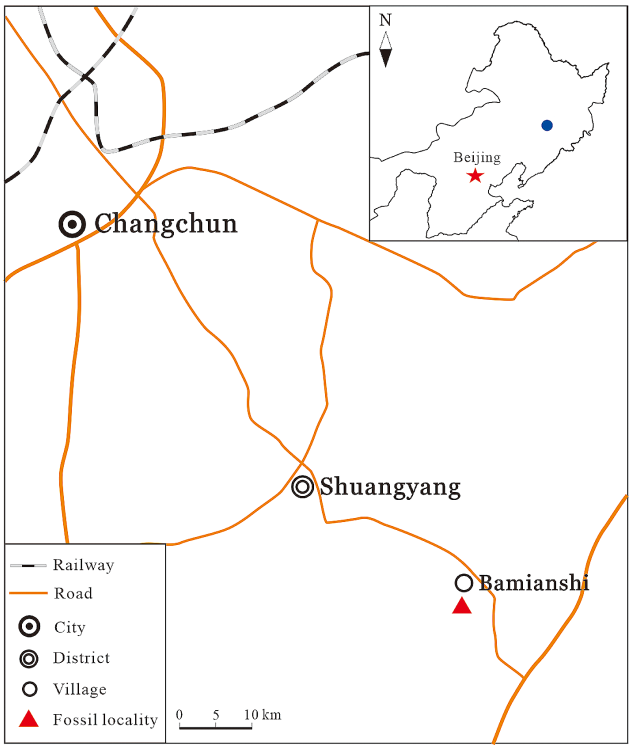


**FIGURE 1.** Fossil locality at Bamianshi Coal Mine, Shuangyang District, Changchun City, Jilin Province, northeastern China.

and Coniferopsida). The photomicrograph was taken using a digital camera attached to a Zeiss Discovery V20 microscope. The line drawing was drawn using CorelDraw 2020 graphic software. The specimen is housed in the Nanjing Institute of Geology and Palaeontology, CAS, Nanjing, China.

The venational terminology is based on the nomenclature of Grimaldi *et al*. (2005).

## Systematic palaeontology

**Order Mecoptera Packard, 1886**
**Family Mesopanorpodidae Tillyard, 1918**
**Genus *Prochoristella* Riek, 1953**

**Type species.** *Prochoristella megaloprepia* Riek, 1953.

**Included species.** *Prochoristella megaloprepia* Riek, 1953, *P. exilis* Riek, 1953, *P. anagaura* Riek, 1953, *P. pusilla* Riek, 1953, *P. concinna* Riek, 1953, *P. belli* (Tillyard, 1926), *P. whitehousei* Riek, 1955, *P. hartmani* Riek, 1976, *P. balgowanensis* Van Dijk & Geertsema, 1999, *P. bulwerensis* Van Dijk & Geertsema, 1999, *P. longa* Novokshonov, 1997, *P. ignara* Novokshonov, 1997, *P. vicina* Novokshonov, 2001, and *P. pilosa* Papier, Nel & Grauvogel-Stamm, 1996.

***Prochoristella shuangyangensis* sp. nov.**
(Fig. 2)

**Materials.** Holotype, with part and counterpart, NIGP173909a, b. The part is a nearly complete hind wing, while the counterpart preserved only a small part near the wing base.

**Etymology.** Derived from Shuangyang District, where the specimen was collected.

**Diagnosis.** Hind wing, relatively large, long-oval shape with four coloured strips. $Rs_{1+2}$ and $Rs_{3+4}$ forking early and almost at same level, $M_{1+2}$ stem at least four times as long as $M_{3+4}$ stem.

**Type locality and horizon.** South Mine of Bamianshi Coal Mine, Shuangyang District, Changchun City, Jilin Province, northeastern China; Lower Jurassic (?) Xiaofengmidingzi Formation.

**Description.** Hind wing long-oval, length 10.4 mm (preserved), width 4.0 mm, greatest width at two-thirds of wing, evenly rounded; four strips perpendicular to longitudinal veins, veins generally invisible inside the strips; costal space not expanded, Sc relatively short, terminated about the middle of wing, with an oblique crossvein joined to $R_1$ near its apex; $R_1$ curved apically, with two twigs, a possible crossvein joined $Rs_1$ and the distal part of $R_1$; $Rs_{1+2}$ and $Rs_{3+4}$ paralleled to C, forking early and almost at same level; stem of Rs slightly longer than that of $Rs_{1+2}$; M with four branches, $M_1$ tilted downwards apically; $M_{1+2}$ stem at least four times as long as $M_{3+4}$ stem; CuA straight and simple, fused with M stem for a long distance from wing base, CuP straight and simple; two anal veins detected.

**Remarks.** The new species, erected based on a hind wing, is assigned to *Prochoristella* Riek, 1953 by the combination of the following characters: long-oval wing, Sc simple and relatively short, $R_1$ forked only near apex, while supposedly simple in the original diagnosis of Riek (1953), four-branched Rs and M, and $Rs_{1+2}$ and $Rs_{3+4}$ forked almost at same level. The new species is quite different from other congeneric species. It differs from *P. concinna* Riek, 1953 (hind wing) from the Upper Permian of New South Wales (Belmont fossil beds) of Australia by its much larger size (10.4 mm preserved *vs.* 5.0 mm), the presence of distinct strips, $Rs_{1+2}$ and $Rs_{3+4}$ forking early and almost at same level, larger ratio (length of $M_{1+2}$ stem/length of $M_{3+4}$ stem more than four *vs.* about two), CuP not fused with $A_1$; it differs from *P. vicina* Novokshonov, 2001 (forewing) from the Middle or Upper Triassic (Madygen Formation) of Kyrgyzstan by its much larger size (10.4 mm preserved *vs.* 6.9 mm), the presence of distinct strips, Sc relatively short and simple (the relatively long and two-branched Sc of *P. vicina* are forewing characters), $Rs_{1+2}$ and $Rs_{3+4}$ forking much earlier, and larger ratio (length of $M_{1+2}$ stem/length of $M_{3+4}$ stem) (more than four *vs.* less than two). *Prochoristella longa* has wings 9.2 to 11.0 mm long, thus of nearly the same size as *Prochoristella shuangyangensis* **sp. nov.**, but with $Rs_{3+4}$ forking earlier than $Rs_{1+2}$. *Prochoristella megaloprepia* is based on a forewing,

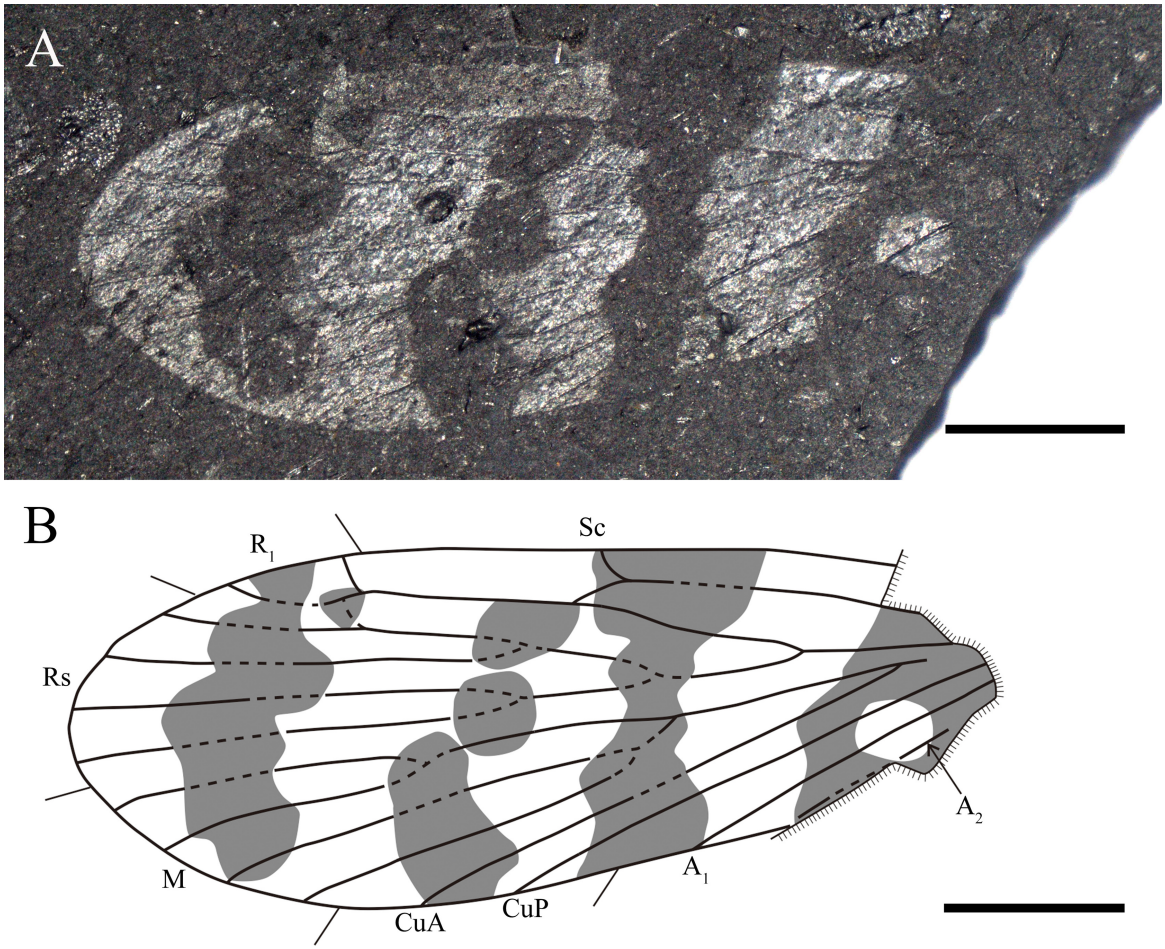


**FIGURE 2.** Hind wing of *Prochoristella shuangyangensis* **sp. nov.**, holotype, part, NIGP173909a, from the Xiaofengmidingzi Formation in Jilin Province. **A**, Photomicrograph. **B**, Line drawing. Scale bars represent 2 mm.

6.5 mm to 7.0 mm long, much smaller than *Prochoristella shuangyangensis* **sp. nov.**, and with $Rs_{3+4}$ forking earlier than $Rs_{1+2}$.

## Discussion

*Prochoristella* have been described from France, Kyrgyzstan, Australia, South Africa, and now China ranging from the Late Permian to the Late Triassic (Tillyard, 1926; Riek, 1953, 1955, 1976; Papier *et al*., 1996; Van Dijk & Geertsema, 1999; Novokshonov, 1997, 2001). The new scorpionfly species from Jilin Province is different from those from the Middle–Late Jurassic Daohugou biota (Inner Mongolia), which is rich in the exquisitely preserved fossil insects. Mesopanorpodidae have not been known from the Daohugou biota, except for some species that have been transferred later to other families such as Mesopsychidae and Nannochoristidae (Cao *et al*., 2015). The new species distinctly differs from the Mecoptera (Orthophlebiidae) from the Early Jurassic and Late Triassic of Junggar Basin, Xinjiang, northwestern China (Zhang, 1996). All 'mesopanorpodids' from the Middle Triassic Tongchuan Formation of Shaanxi Province, northwestern China have been transferred out of Mesopanorpodidae (Bashkuev, 2011). *Mesopanorpodes shaanxiensis* Hong, Guo & Wang, 2002, described based on a forewing from the Tongchuan Formation, is very likely to be a member of Mesopanorpodidae, but its incomplete preservation renders its affinity uncertain.

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## References


Bashkuev, A.S. (2011) The earliest Mesopsychidae and revision of the family Mesopanorpodidae (Mecoptera). *Zookeys*, 130, 263–279.
https://doi.org/10.3897/zookeys.130.1611

Cao, Y.Z., Shih, C.K., Bashkuev, A. & Ren, D. (2015) Revision and two new species of *Itaphlebia* (Nannochoristidae: Mecoptera) from the Middle Jurassic of Inner Mongolia, China. *Alcheringa*, 40 (1), 24–33.
https://doi.org/10.1080/03115518.2015.1079692

Carpenter, F.M. (1992) Order Mecoptera Packard, 1886. *In*: Roger L.K., (Ed.). *Treatise on Invertebrate Paleontology Pt R: Arthropoda 4 Vol 4: Superclass Hexapoda*. Geological Society of America, Boulder, Colorado and the University of Kansas, Lawrence, Kansas, pp. 380–395.

Grimaldi, D., Rasnitsyn, A., Zhang, J.F. & Fraser, N. (2005) Revision of the bizarre Mesozoic scorpionflies in the Pseudopolycentropodidae (Mecopteroidea). *Insect Systematics & Evolution*, 36 (4), 443–458.
https://doi.org/10.1163/187631205794761021

Hong, Y.C. & Guo, X.R. (2003) Two new Middle Triassic genera and species of [Mesopanorodidae] from Shaanxi (Insecta, Mecoptera). *Acta Zootaxonomica Sinica*, 28 (4), 716–720.

Hong, Y.C., Guo, X.R. & Wang, W.L. (2002) Middle Triassic new fossils of Mesopanorpodidae (Insecta: Mecoptera) from Tongchuan, Shaanxi Province, China. *Acta Zootaxonomica Sinica*, 27 (2), 278–283.

Huang, D.Y. (2019) Jurassic integrative stratigraphy and timescale of China. *Science China-Earth Sciences*, 62 (1), 223–255. [In Chinese with English abstract].
https://doi.org/10.1007/s11430-017-9268-7

Jilin Provincial Bureau of Geology and Mineral Resources. (1997) *Lithologic Stratigraphy of Hebei Province*. China University of Geosciences Press, Wuhan, 324 pp. [In Chinese].

Li, L.M., Ren, D. & Wang, Z.H. (2007) Prophalangopsids from Late Mesozoic of China (Orthoptera, Prophalangopsidae, Aboilinae). *Acta Zootaxonomica Sinica*, 32 (2), 412–422.

Martynova, O.M. (1962) Order Mecoptera: Scorpionflies. *In*: Rohdendorf B.B., (Ed.), *Fundamentals of Paleontology Vol. 9, Arthropoda, Tracheata, Chelicerata*. Moscow, pp. 283–294. [In Russian; translated into English: (1991) Amerind Publishing, New Delhi, pp. 405–424].

Mi, J.R., Zhang, C.B. & Sun, C.L. (1993) *Late Triassic Stratigraphy, Paleontology, and Paleogeography of the Northern Part of the Circum-Pacific Belt, China*. Science Press, Beijing, 219 pp.

Novokshonov, V.G. (1997) New Triassic scorpionflies (Insecta, Mecoptera). *Paleontological Journal*, 31 (6), 628–635.

Novokshonov, V.G. (2001) New Triassic scorpionflies (Insecta, Mecoptera) from Kyrgyzstan. *Paleontologicheskii Zhurnal*, 25 (3), 281–288.

Novokshonov, V.G., Sukacheva, I.D. & Aristov, D.S. (2004) An Early Triassic scorpionfly (Panorpida=Mecoptera) of the Vologda Region. *Paleontological Journal*, 38 (Suppl 2), S214–S215.

Papier, F., Nel, A. & Grauvogel-Stamm, L. (1996) Deux nouveaux insectes Mecopteroidea (Insecta: Pseudopolycentropidae et Mesopanorpidae) du Bundstanstein supérieur (Trias) des Vosges (France). *Paleontologia Lombarda*, 5, 37–46.

Ren, D., Lu, L.W., Guo, Z.G. & Ji, S.A. (1995) *Faunae and Stratigraphy of Jurassic-Cretaceous in Beijing and the Adjacent Areas*. Geological Publishing House, Beijing, 222 pp.

Ren, D. & Yin, J.C. (2003) New 'osmylid-like' fossil Neuroptera from the Middle Jurassic of Inner Mongolia, China. *Journal of the New York Entomological Society*, 111 (1), 1–11.
https://doi.org/10.1664/0028-7199(2003)111[0001:NOFNFT]2.0.CO;2

Riek, E.F. (1953) Fossil mecopteroid insects from the Upper Permian of New South Wales. *Records of the Australian Museum*, 23 (2), 55–87.
https://doi.org/10.3853/j.0067-1975.23.1953.621

Riek, E.F. (1955) Fossil insects from the Triassic beds at Mt. Crosby, Queensland. *Australian Journal of Zoology*, *Melbourne*, 3 (4), 654–691.
https://doi.org/10.1071/ZO9550654

Riek, E.F. (1976) New Upper Permian insects from Natal, South Africa. *Annals of the Natal Museum*, 22 (3), 755–789.

Sun, J.H., Ren, D. & Shih, C.K. (2007) Middle Jurassic Mesopanorpodidae from Daohugou, Inner Mongolia, China (Insecta, Mecoptera). *Acta Zootaxonomica Sinica*, 32 (4), 865–874.

Tillyard, R.J. (1926) Upper Permian insects of New South Wales. II. The orders Mecoptera, Paramecoptera and Neuroptera. *Proceedings of the Linnean Society of New South Wales*, 51, 265–282.

Van Dijk, D.E. & Geertsema, H. (1999) Permian insects from the Beaufort Group of Natal, South Africa. *Annals of the Natal Museum*, 40 (1), 137–171.

Wu, Y.H. & Song, Z.Q. (1997) Discussion on age of Xiaofengmidingzi Formation in Shuangyang Basin. *Coal Technology of Northeast China*, (1), 53–56 [In Chinese with English abstract].

Zhang, H.C. (1996) Mesozoic insects of Orthophlebiidae (Insecta, Mecoptera) from Junggar Basin, Xinjiang, China. *Acta Palaeontologica Sinica*, 35 (4), 442–454.

Zhang, H.H., Xu, W.L., Wang, F. & Cao, H.H. (2016) Formation timing of the volcanic rocks from the Xiaofengmidingzi Formation in Central Jilin Province and its geological implications: evidence from zircon U-Pb dating and Hf isotope compositions. *Journal of Jilin University Earth Science Edition*, 46 (5), 1418–1429 [In Chinese with English abstract].
https://doi.org/10.13278/j.cnki.jjuese.201605112