

New Jurassic Pseudopolycentropodids from China (Insecta: Mecoptera)

REN Dong^{1,*}, SHIH Chungkun¹ and Conrad C. LABANDEIRA²

¹ College of Life Science, Capital Normal University, Beijing 100048, China

² Department of Paleobiology, Smithsonian Institution, National Museum of Natural History, Washington, DC 20560, USA

Abstract: In this paper two new species of fossil *Pseudopolycentropus* Handlirsch, 1906 are described: *Pseudopolycentropus janeannae* sp. nov. and *P. novokshonovi*, sp. nov. All of them were recovered from the Middle Jurassic non-marine sedimentary strata of northeastern China. The new material from China reveals that the early diversification of pseudopolycentropodids was well underway by the Middle Jurassic.

Key words: Pseudopolycentropodidae, Mecoptera, fossil, new taxa, Jurassic, China

1 Introduction

The Pseudopolycentropodidae is an extinct and small family, considered as phylogenetically basal to recent Mecoptera (Bode, 1953; Handlirsch, 1925; Carpenter, 1992; Willmann, 1989; Novokshonov, 2002). Novokshonov (1997) gave a general morphology of *P. latipennis* Martynov, 1927 and stated that all structural details of *P. latipennis* seem to be typical of the whole family, except for forewing shape (not showing the broadened state yet in an undescribed Triassic genus from the Madygen, Kyrgyzstan).

Grimaldi et al (2005) have made a comprehensive revision on this bizarre scorpionflies and gave a complete list of previously described species of *Pseudopolycentropus* and their stratigraphic distributions. Presently, the Mesozoic Pseudopolycentropodidae consists of eleven described species belonging to three genera from the mid-Triassic to the mid-Cretaceous (Ansorge, 1996, 2003; Novokshonov, 1997; Papier, Nel and Grauvogel-Stamm, 1996; Whalley, 1985; Grimaldi et al, 2005). Five of these eleven described species were based on fossils of fore wing only. One was based on fore and hind wings. Of the remaining five species described from wings and bodies, only three have preserved mouthparts. They are *Pseudopolycentropus latipennis* Martynov, 1927 (Late Jurassic of Karatau, Kazakhstan); *Pseudopolycentropus daohugouensis*, Zhang 2005 (Middle Jurassic of Daohugou, Inner Mongolia, China) and *Parapolycentropus burmiticus* Grimaldi et Rasnitsyn 2005

(Middle Cretaceous of Kachin, Myanmar). These scorpionflies are very interesting because they had special elongated (siphonating or piercing-sucking) proboscis which revealed that this group may feed on liquid food.

Recently we recovered many well-preserved fossil pseudopolycentropodids from the Middle Jurassic Jiulongshan Formation in Daohugou Village, Ningcheng County, Inner Mongolia, China (Tan, Ren and Shih, 2006; Tan, Huang and Ren, 2007). Two new species of the genus *Pseudopolycentropus* Handlirsch, 1906 are described herein. All of them show an elongated proboscis.

2 Material and Methods

This study is based on ten (four pairs of parts/ counterparts and two parts) specimens housed in the fossil insect collection of the Key Lab of Insect Evolution & Environmental Changes, College of Life Science, Capital Normal University, Beijing, China (CNUB; Dong Ren, Curator). Line drawings were prepared with the aid of a camera lucida attached to a Leica MZ12.5 stereomicroscope. The terminology used here follows that of Grimaldi et al. (2005).

3 Systematic Paleontology

Family Pseudopolycentropodidae Handlirsch, 1925

Genus *Pseudopolycentropus* Handlirsch, 1906

Pseudopolycentropus janeannae sp. nov. (Figs. 1-2, Plate I-III, Plate IV-1, 2)

* Corresponding author. E-mail: rendong@mail.cnu.edu.cn

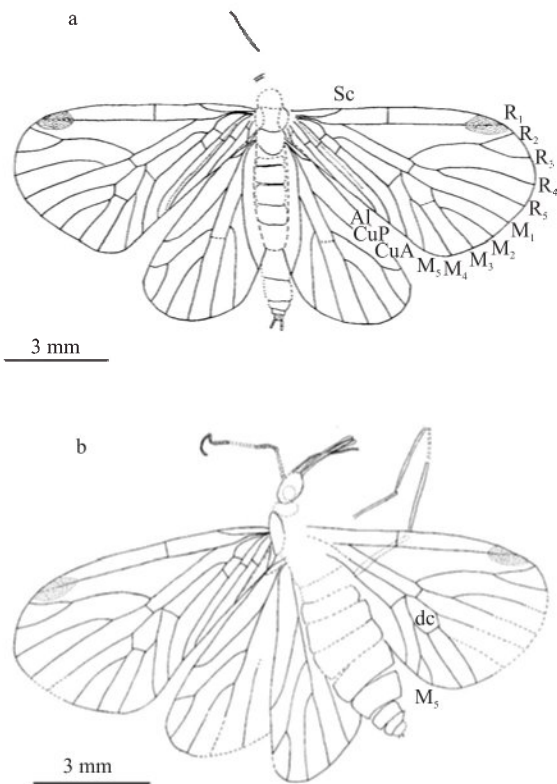


Fig. 1. Female of *Pseudopolycentropus janeannae* sp. nov. a. Holotype, No. CNU-M-NN2005001-1; b. paratype, No. CNU-M-NN2005030-1

Etymology: The species name is dedicated to Ms. Jane Ann Shih, daughter of Dr. Shih, for demonstrating initiatives, caring and leadership in her study and work, and for providing inspiration and support to paleontology.

Holotype: Two almost complete specimens with well-preserved body and wings, female, part and counterpart, No. CNU-M-NN2005001-1, No. CNU-M-NN2005001-2. Fore wing length 8 mm, width 4 mm; body length (excluding antennae and proboscis) 7 mm.

Paratypes: Two almost complete specimens with body and wings, female, part and counterpart, No. CNU-M-NN2005030-1, No. CNU-M-NN2005030-2. Fore wing length 7.5 mm, width 3.8 mm; proboscis length at least 1.7 mm; body length (excluding antennae and proboscis) 7 mm.

An almost complete well-preserved body with wings, female, No. CNU-M-NN2005003. Fore wing length 7.5 mm, width 3.5 mm; body length (excluding antennae) 7 mm; antenna length (preserved part) at least 3.5 mm; proboscis length (preserved part) at least 1.7 mm.

Two almost complete specimens with well-preserved body and wings, male, part and counterpart, No. CNU-M-NN2005004-1, No. CNU-M-NN2005004-2. Fore wing length 7 mm, width 3 mm; proboscis length (preserved part) at least 1.5 mm; body length (excluding antennae and

proboscis) 7 mm; antenna length (preserved part) at least 4 mm.

No. CNU-M-NN2005031-1, No. CNU-M-NN2005031-2, part and counterpart, two almost complete well-preserved wings, sex unknown, fore wing length 8 mm, width 4 mm.

Locality and horizon: Daohugou Village, Shantou Township, Ningcheng County, Inner Mongolia, China; Jiulongshan Formation, Middle Jurassic (Aalenian-Bajocian) (Ren, 1994; Ren et al., 1995; Ren and Lu, 1996; Ren et al., 2002; Ren and Yin, 2003; Gao and Ren, 2006).

Diagnosis: In the general venation scheme the *Pseudopolycentropus janeannae* somewhat resembles *P. latipennis* Martynov, 1927, but differs from the latter by broad forewing (length/width ratio from 2:1 to 2.3:1); apex of Sc reaching to level of Rs origin; crossvein c-r perpendicular to adjoining longitudinal veins; crossvein m-cua closer to basal dc cell; crossvein a₁-a₂ basal to cup-a₁; in hind wing Sc distinctly short.

P. janeannae is distinguished from *P. daohugouensis* by the following venational features: pterostigma well developed; M₂₊₃ stem longer than that of *P. daohugouensis*; crossvein m-cua closer to basal dc cell; 5 stable crossveins distinctly present in both Cu and A area, versus one such crossveins in *P. daohugouensis*.

Description: Female: The specimen show the complete insect (see Fig. 1, Fig. 2a; Plates I-2, Plate III, 1). Both pairs of the fore and hind wings in holotype are almost symmetrically arranged.

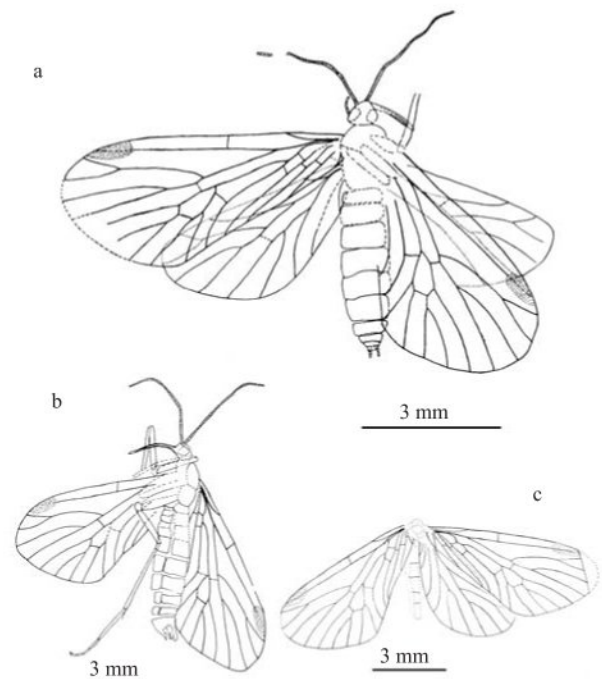


Fig. 2. *Pseudopolycentropus janeannae* sp. nov. a. Paratype, No. CNU-M-NN2005003, female; b. paratype, No. CNU-M-NN2005004-1, male; c. paratype, No. CNU-M-NN2005031-1

Head (based mostly on paratype No. CNU-M-NN2005030-1, No. CNU-M-NN2005030-2): with a long and slightly curved proboscis. Eyes large. Antennae multiarticulate, distinctly longer than proboscis, with numerous segments. Proboscis composed of 3 discernible stylets.

Thorax: Pronotum small; Meso- and metanota more or less similar to each other; scutum and scutellum not discernible on both.

Legs untraceable.

Forewing broad (length/width ratio 2:1), apical margin rounded, with narrow base. Membrane covered in macrotrichia. Sc short, apex reaching to level of Rs origin, without anterior branches. Humeral vein absent. Crossvein c-r vertical to both R_1 and C, just before wing midlength. R stem shortly arched near base, then running to the pterostigma directly. Pterostigma distinct. Rs stem straight. R_2+R_3 stem smoothly arched, with 2 shorter branches. Crossvein r-m oblique inward, not perpendicular to R and M veins, connected to basal half of discal cell (dc cell). R_4+R_5 forking earlier than R_2+R_3 , with 2 long branches. M forking a little earlier than Rs. Thyridium untraceable. M with 5 branches. M_{4+5} forking a little earlier than anterior one (M_{1+3}). M_{2+3} forking very early among described species here. Crossvein m-cua near basal dc cell. M+CuA stem arched obviously. In CuA base, 2 oblique crossveins cua-cup present, almost equidistant from M-CuA fork. CuA bent at crossvein m-cua. CuP almost straight, only curved backwards near apex. A longitudinal fold and one crossvein cup-a, located distal of basal crossvein cua-cup distinct between CuP and A_1 . Anal veins A_1 and A_2 well-developed, A_3 extremely reduced, among them two crossveins present. Crossvein a_1-a_2 located more basally than cup- a_1 . Posterior margin almost straight.

Hind wing smaller than forewing distinctly, of similar shape. Sc distinctly short. R_1 smoothly arched, entering margin far from wing tip. Pterostigma untraceable. Rs with four short branches. M forked very early, with two branches. One crossvein present between Rs and M. CuA smoothly arched. Anal veins invisible.

Wings with venation in details as depicted in Fig. 1.

Abdomen elongated, tapering apically, with 10 visible segments. Basitergum (T1) fused to metathorax, slightly shorted but not constricted at attachment to thorax. Segments 6-8 distinctly longer. Segments 9-11 more slender than 2-6, without an enlarged genital bulb indicating female character (Plate II-1). Cerci at least 2-segmented, arising from T11. Basal segments of cerci are not fused with each other.

The details of the abdomen are depicted in Plate II-1.

Male (based on paratype No. CNU-M-NN2005004-1,

No. CNU-M-NN2005004-2; see Fig. 2b and Plate IV-1): The specimen shows the whole insect in lateral view. A pair of forewings are preserved. Based on the same venation scheme between the holotype and paratype we assume that they are of the same species, though they are different in sex.

Head in profile oval. Proboscis curved distinctly, containing a pair of stylets. Antennae almost completely preserved, many segmented, filiform, at least reaching forewing midlength. Pronotum not discernible.

Meso- and metanota more or less similar to each other; scutum and scutellum untraceable on both. The mid and hindcoxae narrow, elongated. The hind leg entirely covered with annulate pubescence. Tibiae somewhat longer and slender, with at least 1 apical spur. Tarsi 5-segmented, basitarsus longest. Pretarsus with 2 claws.

Forewing very broad (length/width ratio 2.3:1), with wing venation same as female. Hind wing unknown.

Abdomen elongated, tapering apically, with 9 visible segments. The first one is small and is closely associated with the metathorax. Segments 2-6 normal. Segments 7-8 more slender and narrower than 2-6. Segments 8-11 forming an enlarged genital bulb indicating male character (Figs. 2b and Plate IV-1). Cerci unknown.

Comments. Specimens No. CNU-M-NN2005001-1 and No. CNU-M-NN2005001-2 were chosen as the holotype since they have more stable features preserved from both almost symmetrically pairs of the fore- and hind wings. A longitudinal fold distinct between CuP and A_1 in the holotype (Figs. 1a, Plate I) and in the paratype No. CNU-M-NN2005031-1 and No. CNU-M-NN2005031-2 (Fig. 2c, Plate III-2, 3). It is unusual for *Pseudopolycentropus*.

In the paratype No. CNU-M-NN2005030-1, No. CNU-M-NN2005030-2, the forking mode of vein M is somewhat asymmetrical. In the right forewing (Fig. 2-b and Plate II-2) M_5 bifurcating again, but single in left forewing. We consider the difference between left and right wings of the same individual was a common individual variability in pseudopolycentropodids.

The new species is distinct from all known Jurassic species of the genus by curved proboscis. Most distinctly curved one is shown in the paratype male No. CNU-M-NN2005004-1, No. CNU-M-NN2005004-2; see Plate IV-2. The other two paratype females (No. CNU-M-NN2005030-1, No. CNU-M-NN2005030-2 and No. CNU-M-NN2005003) also show slightly curved proboscis.

***Pseudopolycentropus novokshonovi* sp. nov. (Fig. 3; Plate IV-3)**

Etymology: The species is named in honour of the Russian palaeoentomologist, V. G. Novokshonov.

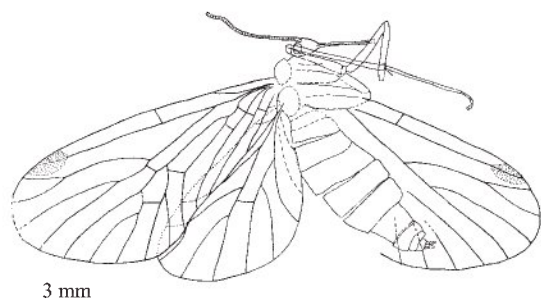


Fig. 3. Female of *Pseudopolycentropus novokshonovi* sp. nov.
Holotype, No. CNU-M-NN2005002.

Holotype: An almost complete well-preserved body with wings, female, No. CNU-M-NN2005002, housed in College of Life Science, Capital Normal University, Beijing; Fore wing length 8 mm, width 3.9 mm; body length (excluding antennae and proboscis) 7 mm; antenna length (preserved part) at least 3 mm.

Locality and horizon: Daohugou Village, Shantou Township, Ningcheng County, Inner Mongolia, China; Jiulongshan Formation, Middle Jurassic (Aalenian-Bajocian).

Diagnosis. The new species is distinct from all known Jurassic species of the genus by crossvein c-r oblique inwards; crossvein cup-a₁ connected with basal crossvein cua-cup, virtually in line with each other; posterior wing margin concave distinctly.

Description: The specimen shows the whole insect in lateral aspect (see Fig. 3). Both left fore and hind wings are almost well preserved.

Head in lateral view small and oval. Antennae incomplete, preserved part short and many segmented, filiform. Straight proboscis well developed, almost as long as mid femur, could contain a pair of stylets. Pronotum and fore legs not discernible.

Meso- and metanota in lateral aspect more or less similar to each other; coxae narrow, elongated. Mid legs entirely covered with annulate pubescence, tibiae with at least 1 apical spur. Tarsi of mid leg 5-segmented, basitarsus longest. Pretarsus with 2 claws. Hind legs unknown.

Forewing very broad (length/width ratio 2.2:1), apical margin rounded, with narrow base. Sc short, almost reaching to level of Rs origin, without anterior branches. Humeral untraceable. Crossvein c-r oblique inwards, just before wing midlength. R smoothly arched near base, then running to the pterostigma directly. Pterostigma distinct. Rs stem straight. R₂+R₃ stem smoothly arched, with 2 branches. Crossvein r-m oblique inward distinctly,

connected to basal half of dc cell. R₄+R₅ forking earlier than R₂+R₃, with 2 long branches. M forking a little earlier than Rs, with 5 branches. Thyridium untraceable. Crossvein m-cua near basal dc cell. M+CuA stem arched obviously. In CuA base 2 oblique crossveins cua-cup present, not equidistant from M-CuA fork. CuA bent at crossvein m-cua. CuP almost straight, only curved backwards near apex. A longitudinal fold untraceable but one crossvein cup-a₁ distinct between CuP and A₁, which connected with basal crossvein cua-cup, virtually in line with each other. Anal veins A₁ and A₂ well developed, A₃ extremely reduced, among them two crossveins present. Posterior wing margin concave distinctly.

Hind wing smaller than forewing distinctly, of similar shape. Sc distinctly short. R₁ smoothly arched, entering margin far from wing tip. Pterostigma untraceable. Rs with four short branches. M forked very early, with two branches. One crossvein present between Rs and M. CuA smoothly arched. A₁ and A₂ present.

The details of the wing venation depicted in Fig. 3.

Abdomen elongated, tapering apically, with 10 visible segments. Basitergum (T1) fused to metathorax. Segments 4-7 distinctly broad. Segments 8-11 more slender than 4-7, without an enlarged genital bulb indicating female character (Fig. 3). Cerci at least 2 visible segments, arising from segment 11. Basal segments of cerci are not fused with each other.

Male unknown.

Acknowledgements

The research was supported by the National Natural Science Foundation of China (30430100, 40872022), the Beijing Natural Science Foundation (5082002) and Key and PHR Project of Beijing Municipal Commission of Education.

Manuscript received March 19, 2008

accepted June 20, 2008

edited by Fei Hongcai

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Explanation of Plate

Plate I Female of *Pseudopolycentropus janeannae* sp. nov.

1. Holotype, No. CNU-M-NN2005001-1; 2. holotype, No. CNU-M-NN2005001-2

Plate II Female of *Pseudopolycentropus janeannae* sp. nov.

1. Terminal with cerci in holotype No. CNU-M-NN2005001-1; 2. paratype, No. CNU-M-NN2005030-1.

Plate III *Pseudopolycentropus janeannae* sp. nov.

1. Paratype, No. CNU-M-NN2005003, female; 2. Paratype, No. CNU-M-NN2005031-1, sex unknown; 3. Paratype, No. CNU-M-NN2005031-2, sex unknown;

Plate IV *Pseudopolycentropus janeannae* sp. nov. and *Pseudopolycentropus novokshonovi* sp. nov.

1. Paratype of *Pseudopolycentropus janeannae* sp. nov., No. CNU-M-NN2005004-1, male; 2. *Pseudopolycentropus janeannae* sp. nov., head with curved proboscis in paratype No. CNU-M-NN2005004-1; 3. Holotype of *Pseudopolycentropus novokshonovi* sp. nov., No. CNU-M-NN2005002, female.

Plate I Female of *Pseudopolycentropus janeannae* sp. nov.

1. Holotype, No. CNU-M-NN2005001-1; 2. holotype, No. CNU-M-NN2005001-2.

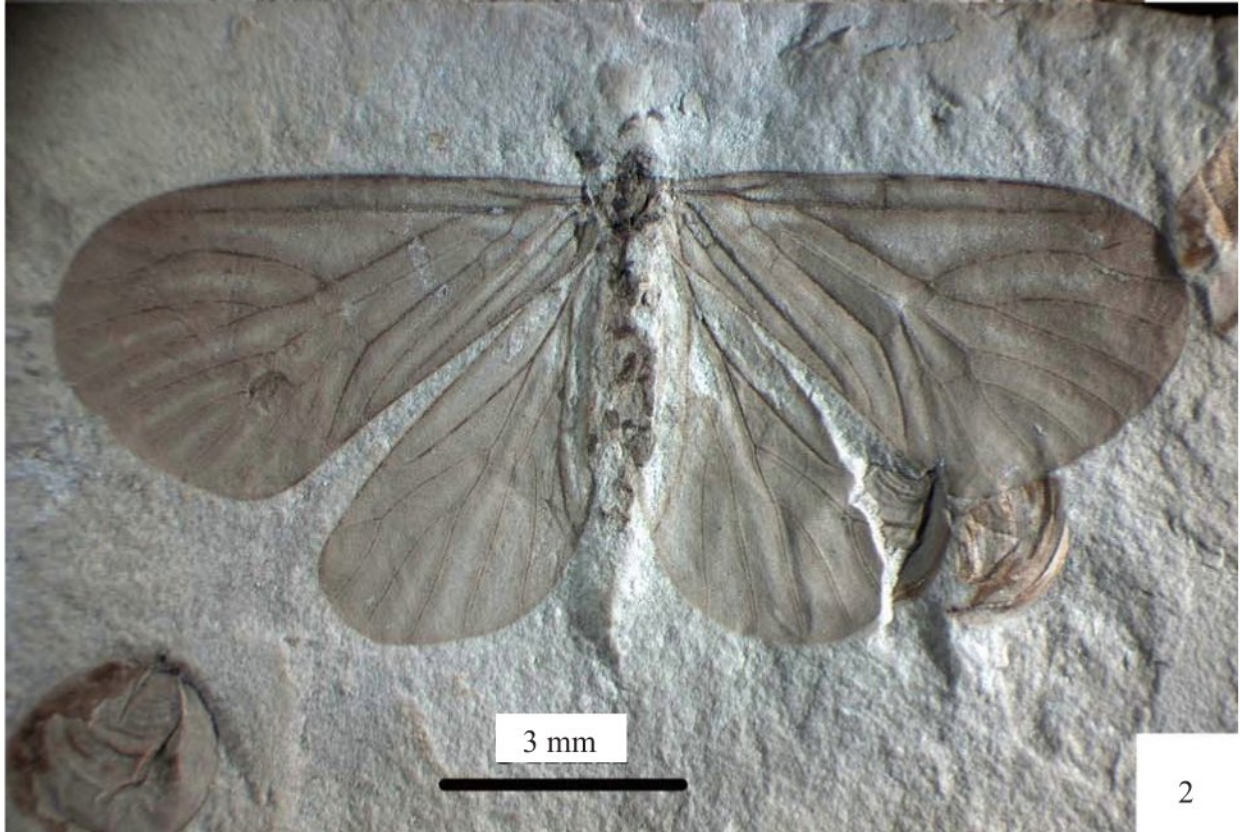
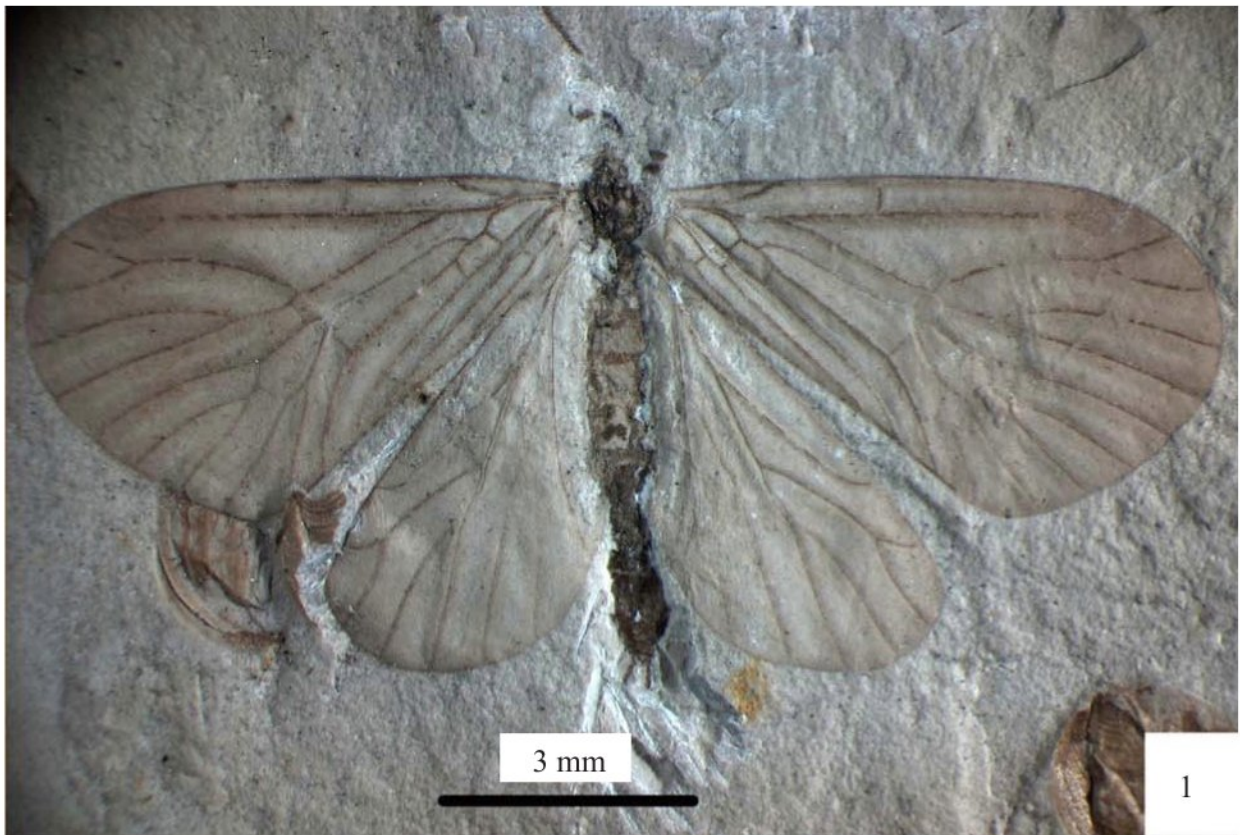


Plate II Female of *Pseudopolycentropus janeannae* sp. nov.

1. Terminal with cerci in holotype No. CNU-M-NN2005001-1; 2. paratype, No. CNU-M-NN2005030-1.

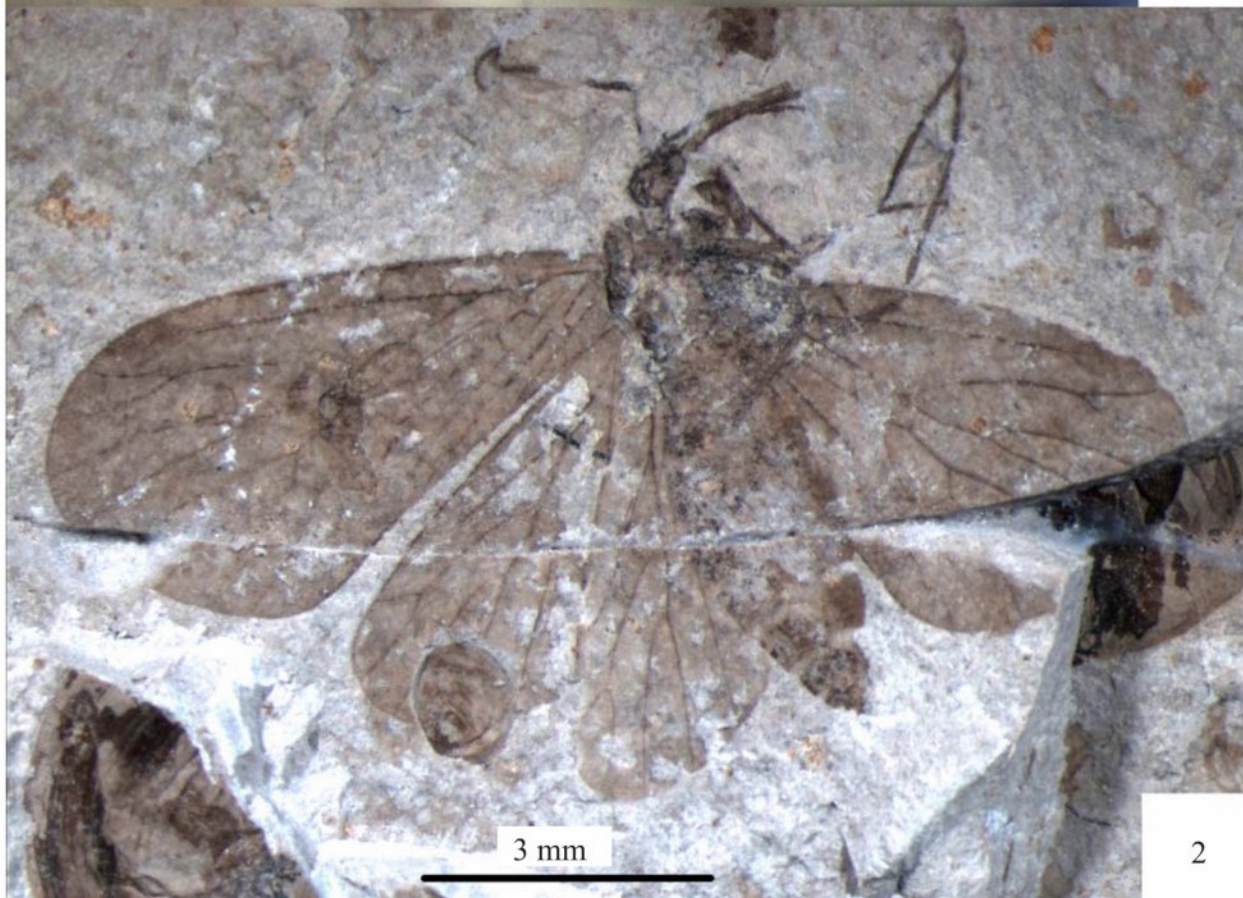
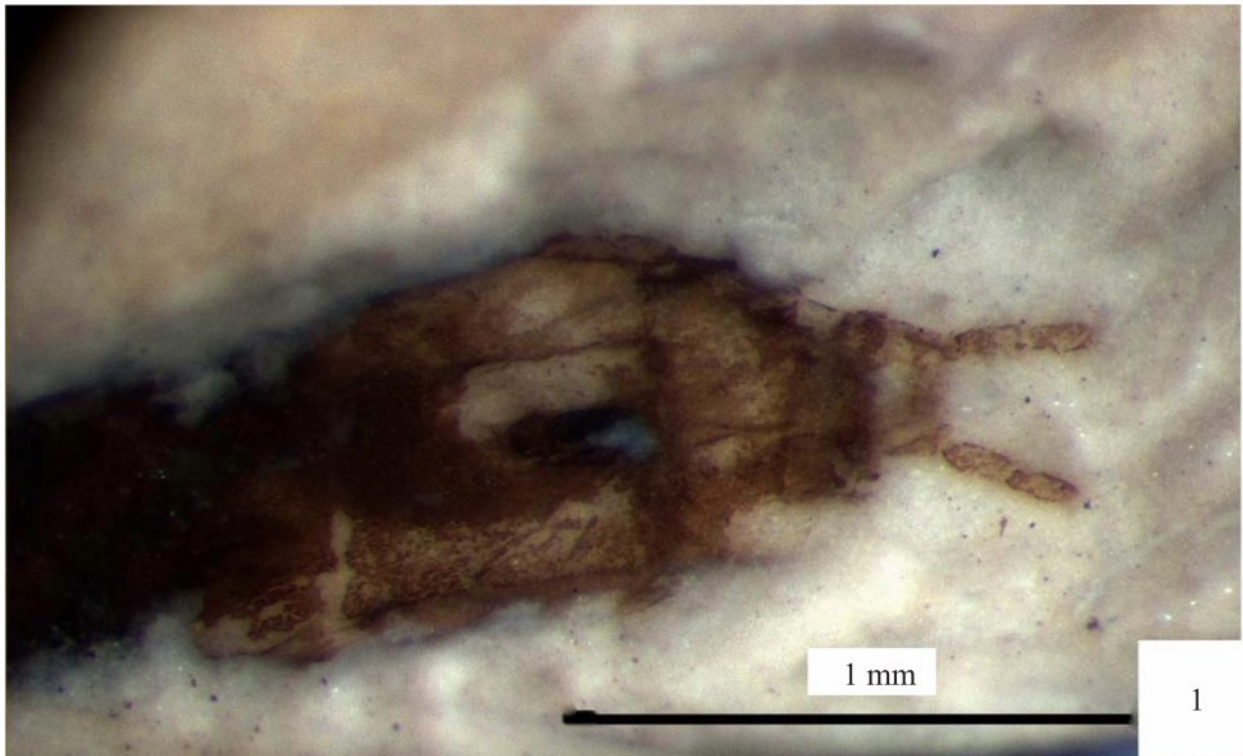


Plate III *Pseudopolycentropus janeannae* sp. nov.

1. Paratype, No. CNU-M-NN2005003, female; 2. Paratype, No. CNU-M-NN2005031-1, sex unknown; 3. Paratype, No. CNU-M-NN2005031-2, sex unknown.

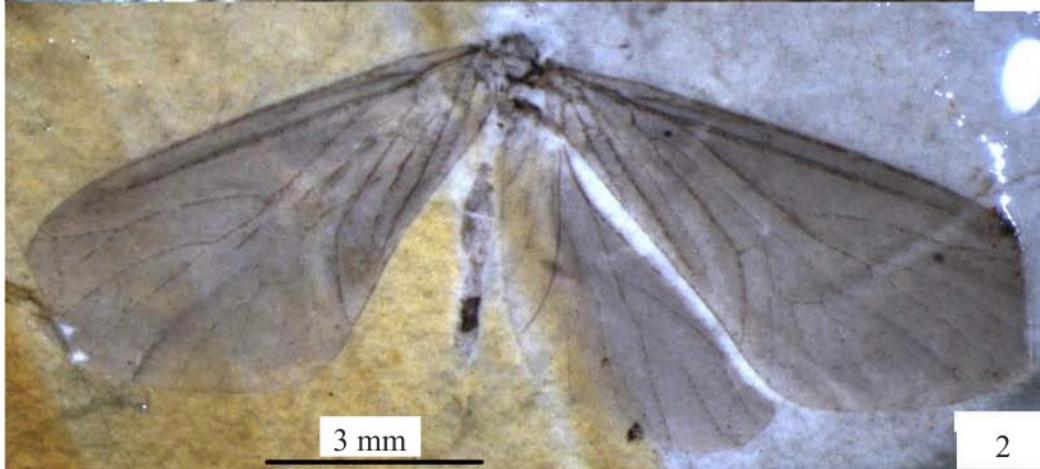
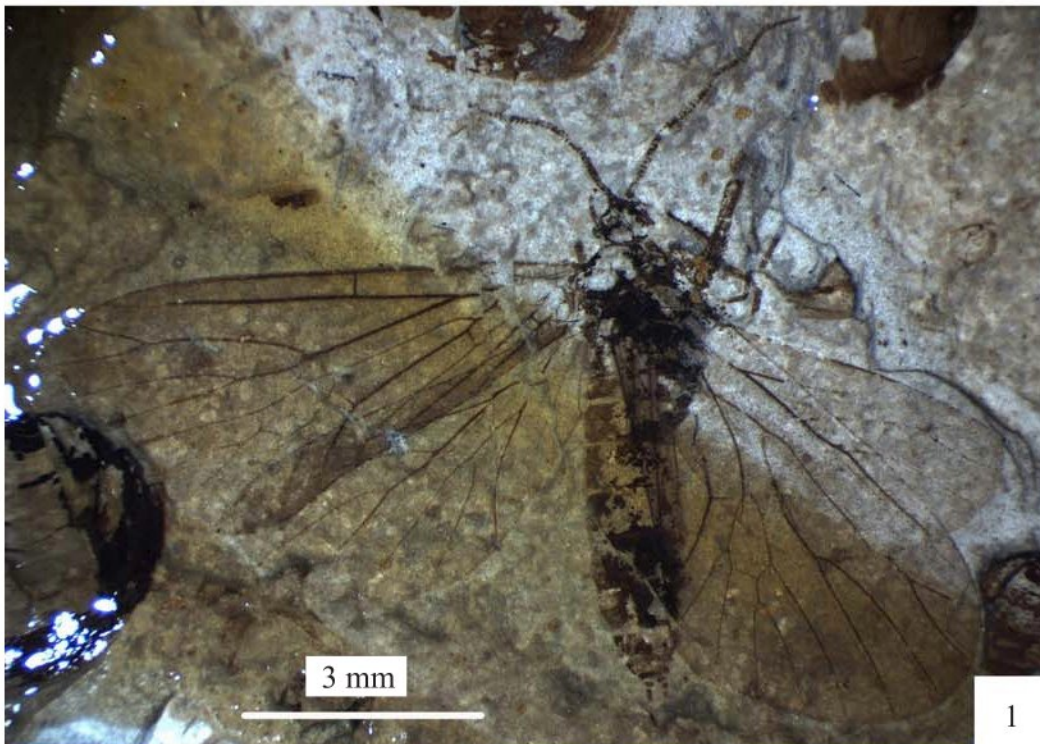


Plate IV *Pseudopolycentropus janeannae* sp. nov. and *Pseudopolycentropus novokshonovi* sp. nov.

1. Paratype of *Pseudopolycentropus janeannae* sp. nov., No. CNU-M-NN2005004-1, male; 2. *Pseudopolycentropus janeannae* sp. nov., head with curved proboscis in paratype No. CNU-M-NN2005004-1; 3. Holotype of *Pseudopolycentropus novokshonovi* sp. nov., No. CNU-M-NN2005002, female.

