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A remarkable new genus of Protosmylinae (Neuroptera: Osmylidae) from late Eocene Florissant, Colorado

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Abstract

Pseudosmylidia relicta **gen. et sp. nov.** (Neuroptera: Osmylidae) is described from the late Eocene of Florissant (U.S.A., Colorado). It is assigned to the subfamily Protosmylinae based on the presence of two venational features characteristic of the subfamily: most crossveins in the radial to intramedial spaces of the forewing are arranged in four gradate series, and CuP is short and simple or forked only once in the hind wing. This genus is remarkable by CuP in the forewing bearing few pectinate branches. This is the only genus of extant and Cenozoic fossil Osmylidae in which this plesiomorphic condition is retained.

Key words: Osmylidae, Protosmylinae, Florissant, Eocene

Introduction

The Osmylidae is a rather small family today, with little more than 200 species widely distributed in tropical to warm-temperate areas of the world except North America (Oswald 2015). The family has a rich fossil record of 54 species in 37 genera from the Early Jurassic to the Eocene (pers. data). It has eight currently recognized subfamilies: the Jurassic to Recent Protosmylinae, Gumillinae and Kempyninae, the Eocene to Recent Osmylinae, and the exclusively extant Spilosmylinae, Stenosmylinae, Porismimae and Eidoporismimae (Grimaldi & Engel 2005; Oswald 2015; pers. data). The Jurassic Mesosmylininae are poorly understood; this subfamily apparently includes two genera, *Mesosmylina* Bode, 1953 and *Sogjuta* Martynova, 1958 (Makarkin *et al*. 2014).

The subfamily Protosmylinae comprises 20 extant species in four genera. The genera *Heterosmylus* Krüger, 1913, *Gryposmylus* Krüger, 1913 and *Lysmus* Navás, 1911 are distributed in southeastern and eastern Asia, and the monotypic genus *Paryphosmylus* Krüger, 1913 is known from Ecuador (Wang 2010; Martins *et al*. 2016; Winterton & Wang 2016). Fossil representatives of the subfamily include five genera and eight species, i.e., the Middle Jurassic *Juraheterosmylus* Wang *et al*., 2010; the Late Jurassic *Jurosmylus* Makarkin et Archibald, 2005; the Early Cretaceous *Protosmylina* Jepson *et al*., 2009; and the late Eocene *Osmylidia* Cockerell, 1908 and *Protosmylus* Krüger, 1913 (Pictet-Baraban & Hagen 1856; Krüger 1923; Carpenter 1943; Panfilov 1980; Wichard *et al.* 2009; Khramov 2014).

To date, two osmylid species have been described from the late Eocene locality of Florissant (Colorado, U.S.A.), i.e., *Lithosmylus columbianus* (Cockerell, 1908) (probably Osmylinae) known from two specimens, and *Osmylidia requieta* (Scudder, 1890) (Protosmylinae) from seven specimens (Scudder 1890; Cockerell 1908, 1913, 1914; Bather 1909; Carpenter 1943; pers. obs.). In this paper, another new genus and species is described from this locality. This species is remarkable for possession of CuP having few branches in the forewing, a plesiomorphic condition hitherto unknown in extant and Cenozoic fossil osmylids.

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Material and methods

This study is based on one specimen collected at the late Eocene Florissant locality in Colorado (U.S.A.), probably by T.D.A. Cockerell in the early Twentieth Century. Photographs were taken by David Zelagin using a Canon 5D Mark II camera and a Canon 65 MP-E macro lens. Helicon Focus v 5.3 was used to stack the images to enhance focus. The line drawing was prepared by the author using Adobe Photoshop CS3.

Venational terminology in general follows Kukalová-Peck & Lawrence (2004) as interpreted by Yang *et al*. (2012, 2014); that of venational detail (e.g., spaces, veinlets) follows Oswald (1993).

Abbreviations: AA1–AA3, first to third branches of anterior anal vein; CuA, anterior cubitus; CuP, posterior cubitus; MA and MP, anterior and posterior branches of media; RA, anterior radius; RP, posterior sector; RP1, proximal-most branches of RP; ScP, subcosta posterior.

Institutional abbreviations: UCM, Museum of Natural History of the University of Colorado, Boulder, U.S.A.

Systematic paleontology

Order Neuroptera Linnaeus, 1758

Family Osmylidae Leach, 1815

Subfamily Protosmylinae Krüger, 1913

Genus *Pseudosmylidia* gen. nov.

Type species. *Pseudosmylidia relicta* sp. nov.

Diagnosis. May be easily distinguished from other genera of Protosmylinae by the following combination of forewing character states: few-pectinate CuP (only two branches); some subcostal veinlets shallowly forked.

Etymology. From the Greek *pseudos*, false, and *Osmylidia*, a genus-group name of Osmylidae.

Pseudosmylidia relicta sp. nov.

Figs 1, 2

Description. Head visible in lateral view, with vertex slightly raised, eyes relatively small; antennae probably incompletely preserved, with scapus not enlarged. Prothorax relatively short. Other parts of body, legs poorly preserved (details not visible).

Forewing oval, 12.1 mm long, 4.7 mm wide. Costal space broad, broadest approximately at proximal 1/5; rather abruptly narrowed basad, radually narrowed distad. Subcostal veinlets moderately widely spaced; simple proximally, shallowly forked distally (some veinlets poorly preserved). ScP, RA fused far from wing apex. ScP+RA entering margin before from wing apex. Veinlets of ScP+RA poorly preserved; at least forked once. Subcostal space poorly preserved, narrow. RA space moderately broad, with five detected crossveins (more crossveins possible). RP with nine branches. RP1 originated rather close to origin of RP. All branches of RP shallowly forked (far distad outer gradate series of crossveins), mostly dichotomous. M forked at level of origin of RP2. MA, MP dichotomously forked slightly distad outer gradate series of crossveins. Cu rather long, dividing into CuA, CuP relatively far from wing base. Anterior trace of CuA shallowly trident-like forked, with four shallowly-forked pectinate branches (termination of two proximal-most branches poorly visible). CuP few pectinate, with two shallowly forked branches (terminations poorly preserved). AA1 pectinate, with four oblique branched; all probably shallowly forked. AA2 poorly preserved, probably few branched. AA3 not detected. All preserved crossveins in radial to mediocubital spaces arranged in four gradate series. Three crossveins detected between CuA, CuP. Trichosors prominent along outer wing margin; basally indistinct or absent. Nygmata not detected. Color pattern probably absent.

Hind wing very poorly preserved, ca. 10.5–11 mm long, 4.0 mm wide. RP with nine branches. Radial crossveins mostly arranged in three gradate series. CuP short, simple or forked once (poorly preserved). AA1 probably pectinate (Fig. 2C).

Type material. Holotype UCM 85899 (only part), likely collected by T.D.A. Cockerell, and deposited in UCM. A nearly complete, rather poorly preserved specimen with all four wings overlapping. Written on the rock is "W14", indicating one of Cockerell's collecting localities at Florissant (T. Karim, pers. com.).

Type locality and horizon. U.S.A.: Colorado: Florissant (UCM locality No. 83014); late Eocene.

Etymology. From the Latin *relictus*, *-a*, *-um* - abandoned, referring to relict nature of this species.

Remarks. Only one forewing is rather distinctly preserved and allows a detailed drawing. The other forewing and the hind wings are poorly preserved. Many details of the hind wings are difficult to separate.

FIGURE 1. The holotype UCM 85899 of *Pseudosmylidia relicta* **gen. et sp. nov.** Scale bar = 2 mm.

Discussion

The protosmyline affinity of *Pseudosmylidia* **gen. nov.** is supported by the presence of two features of its venation which are characteristic of all genera of the subfamily: most crossveins in the radial to intramedial spaces of the forewing are arranged in four gradate series, and CuP is short and simple or once forked in the hind wing. Although the hind wings of the holotype are, in general, poorly preserved, a portion with CuP and AA1 is relatively clearly visible; it is unknown, however, of which wing: right, left or both (Fig. 2C). The configuration of the preserved CuP and AA1 is very similar to those of most extant protosmylines.

The former character state is found only in Protosmylinae. In most other osmylids, crossveins in the radial to intramedial spaces do not form gradate series, none (i.e., in Gumillinae, Porismimae) or one or two distal series (in Osmylinae, Kempyninae, Stenosmylinae and Eidoporismimae). Crossveins of these spaces in Spilosmylinae are arranged in more than five irregular gradate series.

The simple or once-forked CuP in the hind wing is also characteristic of the subfamilies Spilosmylinae and Gumillinae, but these differ from Protosmylinae by their crossvein arrangement (see above). Also, the forewing CuP of all Spilosmylinae is strongly pectinate. Further, spilosmylines are characterized by an important synapomorphy, i.e., the possession of a spur-like process on the basal part of the hind wing MP directed proximally (see Tjeder 1957: Fig. 171). This process is unknown in any fossil, and so there is no confident support for a fossil record of the Spilosmylinae. The forewing venation of all Gumillinae differs from that of all Protosmylinae also by the far distal origin of RP1.

The forewing venation of the Jurassic Mesosmylininae is similar to that of both Protosmylinae and Spilosmylinae in their arrangement of the radial crossveins. The forewing venation of the genus *Sogjuta* is especially similar to that of Protosmylinae (see Khramov 2011: Fig. 3, 4c). However, the hind wings of Mesosmylininae are still unknown and, therefore, the relationships among these three subfamilies remain unclear.

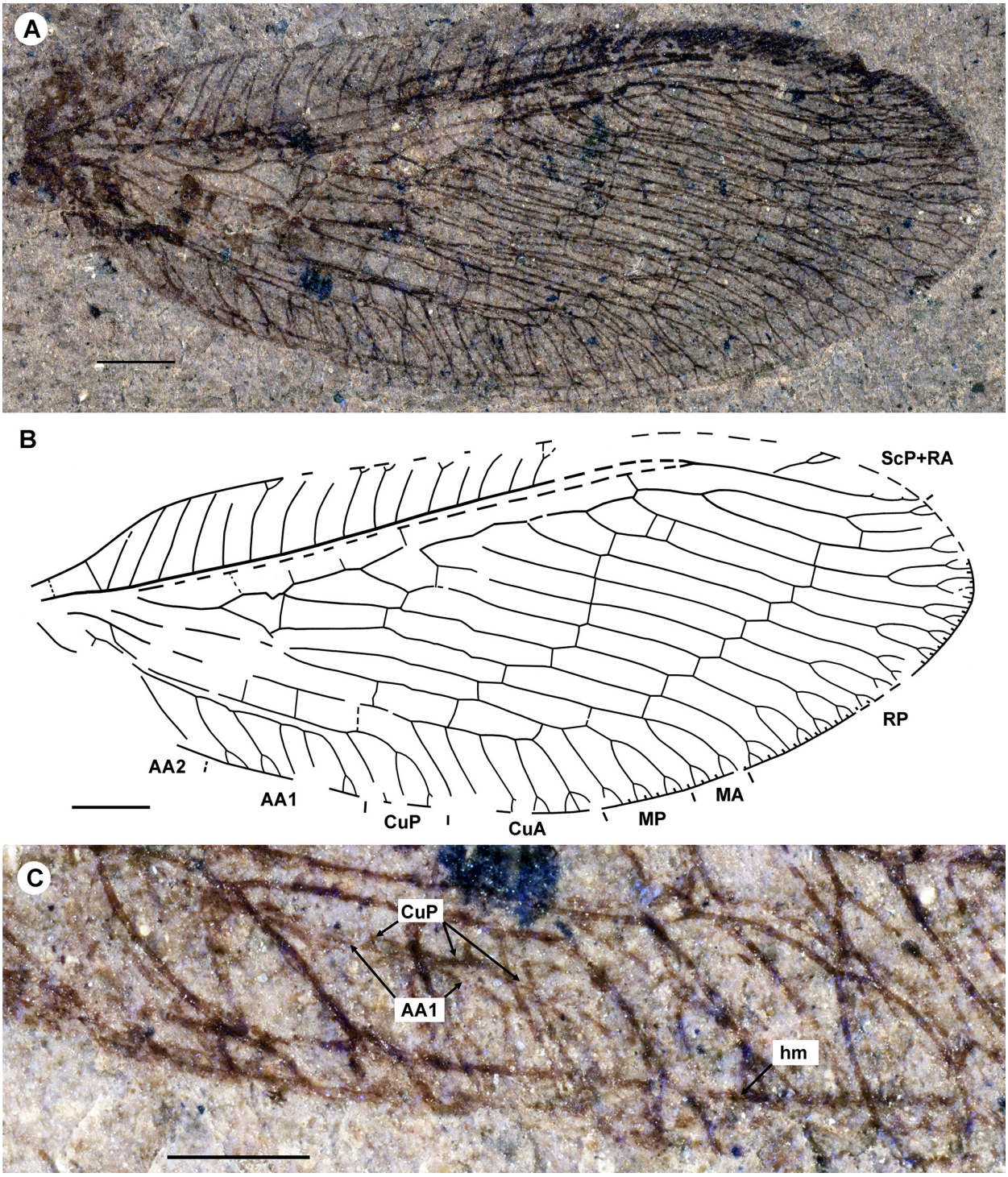

FIGURE 2. The holotype UCM 85899 of *Pseudosmylidia relicta* **gen. et sp. nov.** A, photograph of wings taken with a polarized filter. B, forewing venation. C, portion of wings showing the hind wing CuP and AA1 (hm, hind margin of hind wing). All converted to standard view, with apex to the right. Scale bars = 1 mm (A, B), 0.5 mm (C).

The new genus is most remarkable by CuP in the forewing bearing only two branches. This configuration is present in the Late Jurassic genus *Jurosmylus* (Protosmylinae), the Middle Jurassic *Archaeosmylidia* Makarkin e*t al*., 2014, whose subfamily affinity is not clear, and the Early/Middle Jurassic *Mesosmylina mongolica* Ponomarenko, 1984 (Mesosmylininae) (see Ponomarenko 1984: Fig. 1; Khramov 2014: Fig. 1; Makarkin e*t al*. 2014: Fig. 1). A similar CuP with few branches (here, three) is present in the Middle Jurassic *Juraheterosmylus* and the Early Jurassic *Mesosmylina exornata* Bode, 1953 (see Ansorge 1996: Fig. 77; Wang *et al*. 2010: Figs 1F, 2A,

4A; pers. obs.). Two branches of CuP are present also in some Jurassic Gumillinae, e.g., *Epiosmylus panfilovi* Ren et Yin 2002 and *Allotriosmylus uniramosus* Yang *et al*., 2010 (see Ren & Yin 2002: Fig. 3; Yang *et al*. 2010: Fig. 2A). However in these, both branches are widely spaced, unlike the condition found in the genera mentioned above. CuP is strongly pectinate (i.e., with four or more branches) in all other species of Protosmylinae, including two other Eocene genera (*Osmylidia* and *Protosmylus*), and in other Osmylidae.

Therefore, a CuP with few pectinate branches was hitherto found only in Jurassic osmylids. This character state is certainly plesiomorphic, as it is characteristic of all other families of the osmyloid clade (see Makarkin *et al*. 2013), i.e., the Permian/Triassic Archeosmylidae and the Jurassic Saucrosmylidae, Panfiloviidae and Grammolingiidae, and the majority of other Neuroptera, including all Permian taxa. A strongly pectinate CuP is found only (besides most Osmylidae) in most Psychopsidae, and some Kalligrammatidae and Dilaridae.

Pseudosmylidia **gen. nov.** is the only genus of extant and fossil Cenozoic Osmylidae in which this plesiomorphic condition of the forewing CuP is retained.

All veinlets of ScP in most species of Protosmylinae are simple, some are forked only in the extant *Gryposmylus* and *Heterosmylus flividus* Yang, 1992, and the Middle Jurassic *Juraheterosmylus antiquatus* Wang *et al*., 2010 (see Carpenter 1943: Fig. 1; Wang, 2010: Fig. 19c; Wang *et al*., 2010: Figs 1–4; Winterton & Wang 2016: Figs 3B, 4). However, these forks are relatively deep in these taxa, whereas in *Pseudosmylidia relicta* **sp. nov.**, they are shallow to very shallow.

The new genus is not especially different from other genera of the Protosmylinae by other character states.

Pseudosmylidia **gen. nov.** may be considered a relict taxon, as such a primitive forewing CuP occurs only in Jurassic Osmylidae. At Florissant, there is another Mesozoic relict within the Neuropterida, i.e., the Raphidiopteran family Baissopteridae, which is only known in the Cenozoic from this locality (Makarkin & Archibald 2014).

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