

## Two Rare Eremoneuran Flies (Diptera: Empididae and Opetiidae) from the Purbeck Limestone Group

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**Abstract**—Two new monobasic genera of eremoneuran flies are described from the Purbeck Limestone Group (Early Cretaceous, Berriasian) of southern England. The position of the new genera and stratigraphical distribution of Empididae are discussed. Specimens from the Lower Cretaceous of Transbaikalia previously referred to Opetiidae are transferred to Empididae.

### INTRODUCTION

The Lower and Middle Purbeck beds in Durlston Bay, Dorset, UK, have yielded thousands of insect remains. However, only a few brachycerous flies have been found (Jarzembowski, 1984; Jarzembowski and Coram, 1997; Mostovski, 1999a). Most of them come from Bed 175 (Clements, 1993), including various Empididae, Rhagionidae, and others. The only specimen previously identified as belonging to the flat-footed flies (Mostovski, 1999a) is now shown to be an opetiid. The specimen is described below as a representative of a new monobasic genus. It is noteworthy as the most ancient definite record of these flies. Other flies from the Lower Cretaceous locality of Baissa, Transbaikalia, which were previously reported as opetiids (Mostovski, 1995a) have turned out to be empidids. These specimens are housed in the collection of Paleontological Institute (nos. 3064/9687, 9688, 9689). The familial placement of one fragmentary individual (no. 3064/9684) cannot be clarified at present due to its poor condition. Several species described from the Lower Cretaceous Laiyang Formation of China (Zhang, 1987) were also assigned to Opetiidae (Mostovski, 1995a): judging from the published work, they actually resemble empidids or rhagionids (Grimaldi and Cumming, 1999); however, the type material needs to be re-examined.

The flies of the family Empididae *sensu lato* but excluding the mainly Jurassic Protempidinae entered the fossil record in the earliest Cretaceous. They are found in some diversity in the basalmost Cretaceous deposits in Mongolia, viz. at the Tsagaan-Tsav, Ulaan-Tolgoy, Hotont, Har-Hutul (Hutel-Hara *auct.*) localities. Their distribution and abundance seem to be strongly depended on the paleoenvironmental conditions of each region. The extant representatives of the family are restricted mainly to wet and temperate areas,

although they may also be found in very dry places (e.g., Chvála, 1991). The same appears to have been true for empidids in the past. Thus, this family forms more than 43% of the brachyceran assemblage in the fauna of the locality of Baissa in Transbaikalia. The age of the Baissa deposits is debatable, but is most probably Neocomian (Zherikhin *et al.*, 1999), possibly even Berriasian (Rasnitsyn *et al.*, 1998), and the climate was warm to temperate and wet to semi-arid (Lyamina, 1980; Zharkov *et al.*, 1998). The relative decline of Empididae in the fauna of Bon-Tsagaan in Mongolia (12%) reflects the warming during the Barremian–Albian (Chumakov *et al.*, 1995). In the fauna of Obeshchayushchii in the northern Russian Far East as well as in the Upper Cretaceous fossil resins of Siberia, the percentage of empidids rises to 45%. A humid climate with seasonal changes and temperature oscillations from warm temperate to cold temperate have been postulated for North and East Siberia in the Mid-Cretaceous (Chumakov *et al.*, 1995; Herman, 1994; Herman and Spicer, 1997).

In this connection the vertical distribution of Empididae in the Lower Cretaceous deposits of England is of particular interest. There is only one empidid recorded in the Lulworth Formation alongside at least nine non-empidid brachycerous flies. There are six empidids and 17 representatives of other brachyceran families found in the succeeding Durlston Formation. The early Upper Wealden deposits at Clockhouse Brickworks have yielded 15 empidids and seven other brachycerans. And, finally, a single empidid and three non-empidid flies have come from the late Upper Wealden deposits at Smokejacks Brickworks. Such a pattern of stratigraphical distribution agrees well with climatic reconstructions proposed for this region (Allen, 1998) and reflects transition from hot and dry conditions in early Purbeck times to a warm and humid climate in late Pur-

beck and much of Wealden times but with a drought phase towards the end of the latter.

Flies of the empidid subfamily Atelestinae have not been recorded as fossils for a long time (Evenhuis, 1994). Only recently, a new monotypic genus of atelestine was described from Lower Cretaceous Lebanese amber (Grimaldi and Cumming, 1999). The authors considered it as the most plesiomorphic of all the members of this subfamily. Indeed, *Atelestites senectus* has quite primitive wing venation, including a long anal cell, broad discoidal cell, and a transverse intermedial vein connecting  $M_2$  and  $M_{3+4}$ . The bizarre new genus described below clearly has more derived characters compared to than the genus *Atelestites* from Lebanese amber.

Taxa included in Opetiidae and Atelestinae are of great interest with respect to the evolution of Eremoneura and the origin of Cyclorrhapha (Cumming *et al.*, 1995; Griffiths, 1996; Wiegmann *et al.*, 1993), and their systematic position is controversial (e. g., Chvála, 1983; Disney, 1987; Kessel and Maggioncalda, 1968). The new finds cannot shed light on the phylogeny of Eremoneura as some useful characters are still unknown, but it is noteworthy that they coincide with or even precede records of Platypezidae, Ironomyiidae, Sciadoceridae, and Lonchopteridae in the Early Cretaceous (Grimaldi and Cumming, 1999; Mostovski, 1995a, b, 1999b).

#### SYSTEMATIC PALEONTOLOGY

##### Family Empididae Latreille, 1809

##### Subfamily Atelestinae Hennig, 1970

##### Genus *Dianafranksia* Coram, Jarzembowski et Mostovski, gen. nov.

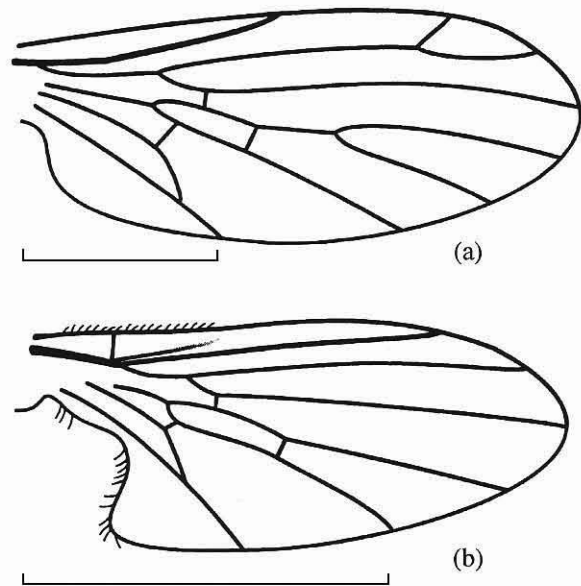
**Etymology.** After Diana Franks, geologist, of Headcorn, Kent, UK.

**Type species.** *D. fisheri* sp. nov.

**Diagnosis.** Transverse intermedial vein *im* present.  $R_{2+3}$  forked. Discoidal cell small.  $M_{1+2}$  forked.  $M_{3+4}$  beyond *im* 1.7 times as long as hind margin of discoidal cell. Anal cell long, narrow, and rather acute.

**Comparison.** The new genus differs from all other genera included in the subfamily in  $R_{2+3}$  forked. Additionally, it differs from European *Atelestus* Walker in the discoidal cell being closed and  $M_{1+2}$  forked; from Holarctic *Meghyperus* Loew in the distal portion of  $M_{3+4}$  longer and the anal cell narrower; from Chilean *Acarteroptera* Collin in  $M_{1+2}$  forked and the anal cell acute; and from extinct *Atelestites* in the stalked  $M_{1+2}$  and the discoidal cell being smaller and narrower. Judging from the general appearance of the wing, the new genus seems to be closest to *Meghyperus*.

**Remarks.** The most remarkable feature in the wing of *Dianafranksia* gen. nov. is the forked anterior branch of RS. Wing venation is rather stable in empidids, although additional veins may occur in the radial



**Fig. 1.** Wings of new eremoneuran flies from the Lower Cretaceous of England: (a) *Dianafranksia fisheri* gen. et sp. nov., Lulworth Formation; (b) *Opetiala shatalkini* gen. et sp. nov., Durlston Formation. Scale bars 1 mm.

sector occasionally, e. g., the short vein between simple  $R_{2+3}$  and  $R_4$  in Clinocerinae and Hemerodromiinae (Chvála, 1983). Such aberrations, however, are still unknown within Atelestinae. Consequently, it is unclear whether the hind branch of the fork in *Dianafranksia* gen. nov. is a true  $R_3$  or an anteriorly shifted  $R_4$ .

Sc is not visible in the holotype, probably due to its close proximity to  $R_1$  or to preservational failure.

##### *Dianafranksia fisheri* Coram, Jarzembowski et Mostovski, sp. nov.

**Etymology.** After the collector Rev. O. Fisher, a nineteenth century geologist.

**Holotype.** Sedgwick Museum, Cambridge, UK, Rev. O. Fisher coll. T54, wing impression; Dorset, Durlston Bay; Lower Purbeck, Lulworth Formation.

**Description** (Fig. 1a). The anterior basal cell is longer than the posterior one. The transverse *rm* is half *mcu*.  $M_{1+2}$  stem beyond *im* is 1.3 times the length of  $M_{1+2}$  stem before *im*. The distal portion of CuA is nearly twice the length of *mcu*.

**Measurements** (mm): wing length, 3.1, wing width, 1.2.

**Material.** The holotype.

##### Family Opetiidae Kessel et Maggioncalda, 1968

##### Genus *Opetiala* Coram, Jarzembowski et Mostovski, gen. nov.

**Etymology.** From the genus *Opetia* and Latin *ala* (wing).

Type species. *O. shatalkini* sp. nov.

**Diagnosis.** Sc short, with its tip faint. Basal portion of  $R_{4+5}$  half the length of RS base. Transverse intermedial vein *im* present. Base of  $M_{3+4}$  present.  $M_{1+2}$  without fork. Anal cell acute, with long petiole.

**Comparison.** The new genus differs markedly from the only extant genus *Opetia* Meigen, comprising three Palearctic species (Saigusa, 1963), in  $R_{4+5}$  stem being shorter,  $M_{1+2}$  simple, and the discoidal cell being closed.

**Remarks.** *Opetiala* gen. nov. might resemble some flat-footed flies in having the discoidal cell and  $M_{1+2}$  unforked. On the other hand, neither recent nor fossil platypezids have such a small and short discoidal cell and  $M_{3+4}$  long. Moreover, the subcostal vein is well developed and not faint at its tip in all platypezids and in *Opetia*. *Opetiala* gen. nov. differs from platypezid genera *Melanderomyia* Kessel and *Microsania* Zetterstedt having intermedial vein lost in Sc disappearing near its tip and  $R_1$  longer. The new genus is similar to *Acarteroptera*, empidid genus restricted to South America, in size and shape of discoidal cell and in Sc disappearing at the tip, but differs significantly from the genus in that in *Acarteroptera* Sc is much shorter, the radial veins are straighter, the anal cell is more acute, and the distal portion of CuA is longer. The latter feature distinguishes the new genus from other empidids. On balance, we are inclined to put *Opetiala* gen. nov. in Opetiidae rather than in Platypezidae or Empididae.

*Opetiala shatalkini* Coram, Jarzembowski et Mostovski, sp. nov.

**Etymology.** After the Russian dipterist A.I. Shatalkin.

**Holotype.** Maidstone Museum & Bentlif Art Gallery, Kent, registration no. MNEMG 2000.28, wing impression; UK, Dorset, Durlston Bay; Middle Purbeck, Durston Formation, bed 175 (Clements, 1993).

**Description** (Fig. 1b). A small fly. The wing membrane is clear, microtrichose, without any dark patches. The veins of RS and medial veins are slightly divergent. The anal lobe is well developed. The axillar ridge and anal lobe have longish hairs on their hind margin. The alula is poorly developed.

**Measurements** (mm): wing length, approx. 1.6, wing width, 0.7.

**Remark.** Flies of the family Opetiidae show sexual dimorphism in the shape of their wing blades. Males have the anal lobe more developed in their wings. If the same holds true for fossil representatives of this family, then the above specimen is male.

**Material.** The holotype.

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