

Worcestobiidae – a new Triassic family of Mecoptera, based on species removed from the family Orthophlebiidae

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ABSTRACT: A new family, Worcestobiidae fam. nov., is established for two Triassic fossil species of Mecoptera removed from the family Orthophlebiidae: *Orthophlebia gigantea* Tillyard, 1933 and *O. haradai* Ueda, 1991. A new genus, *Worcestobia* gen. nov., is erected and both species are transferred to this genus. The new taxa were established as a result of ongoing taxonomic work on Orthophlebiidae, one of the most problematic families within fossil Mecoptera, considered to be a paraphyletic group of species.

KEY WORDS: fossil insects, new family, new genus, revision, scorpionflies, taxonomy.



Investigation of the fossil mecopteran (scorpionfly) family Orthophlebiidae Handlirsch, 1906 started more than 170 years ago, when Mantell (1844) described *Panorpa liassica* Mantell, 1844 from the Upper Triassic (Rhaetian) strata of Wainlode Cliff in the United Kingdom. The following year, Westwood (1845) described a new genus *Orthophlebia*, with one species *O. communis* Westwood, 1845, which he included in the family Panorpidae. In 1906, Handlirsch established the new family Orthophlebiidae, to which he transferred *Orthophlebia* with *O. communis* as the type species. Almost ninety years later, Tillyard (1933) synonymised *O. communis* with *O. liassica* (= *P. liassica*). Since the first description of the genus *Orthophlebia*, more than 130 species have been described and assigned to the Orthophlebiidae (Giebel 1856; Brauer *et al.* 1889; Bode 1905, 1953; Handlirsch 1906–08, 1939; Martynov 1927, 1937; Tillyard 1933; Martynova 1948, 1956; Riek 1950, 1955; Kolosnitsyna 1964, 1982; Willmann 1977, 1978, 1984; Lin 1980, 1986; Hong 1983, 1985, 2009; Sukatsheva 1985, 1990; Whalley 1985; Jell & Duncan 1986; Ueda 1991; Ren 1995, 1997; Zhang 1996; Hong & Xiao 1997; Novokshonov 1997a, b, 1998; Willmann & Novokshonov 1998a, b; Hong *et al.* 2002; Novokshonov & Sukatsheva 2003; Hong & Zhang 2004, 2007; Grimaldi & Engel 2005; Hong & Guo 2010; Petrulevičius & Ren 2012; Qiao *et al.* 2012; Archibald *et al.* 2013; Krzemiński *et al.* 2015; Jarzembowski & Soszyńska-Maj 2017, this volume).

A lack of precise diagnosis of the Orthophlebiidae has resulted in the use of this family as a “wastebasket” for many taxa of ultimately unclear taxonomic position. Willmann (1989) additionally considered Orthophlebiidae to be a paraphyletic group: “Orthophlebiidae”. Ongoing work on the taxonomic range and definition of Orthophlebiidae has resulted in the decision to remove some taxa from this family, including ‘*Orthophlebia martynovae*’ Sukatsheva, 1985, now transferred to the family Austropanorpidae (Krzemiński *et al.* 2017, this volume). Here we establish a new family, Worcestobiidae fam. nov., for two Late Triassic species originally included in Orthophlebiidae: *Orthophlebia haradai* Ueda, 1991 from Japan and *O. gigantea* Tillyard, 1933 from England.

We present here a diagnosis of the newly established family and genus. The two species transferred to this new genus are redescribed and refigured. A well preserved forewing of the type species of the Orthophlebiidae is also refigured for comparative purposes (Fig. 1).

1. Materials and methods

With the aim of revising the family Orthophlebiidae, most available holotypes, paratypes and lectotypes were examined. These comprise the material described by Handlirsch (1906, 1939) in the University of Greifswald, Germany and the National History Museum, London (NHMUK); Tillyard’s (1933) material in the NHMUK; and Bode’s (1953) material in the University of Greifswald, Georg August University of Göttingen, Roemer- und Pelizaeus-Museum Hildesheim and Institut für Geologie und Paläontologie, TU Clausther-Zellerfeld in Germany. The types of Martynov (1927, 1937), Martynova (1948, 1956), Kolosnitsyna (1964, 1982), Sukatsheva (1985) and Willmann & Novokshonov (1998a, b) were examined in the Paleontological Institute, Russian Academy of Sciences in Moscow and the Jura Museum, Eichstätt in Germany. Additionally, new material was studied from the Middle-Upper Jurassic of Daohugou Village in the collection of the College of Life Sciences in Beijing, China and from the Lower Jurassic of England collected by one of the authors (RAC).

The holotype of *Orthophlebia gigantea* Tillyard, 1933 and a wing of *Orthophlebia liassica* (Mantell, 1844), both housed in the Natural History Museum, London were restudied with the use of a stereomicroscope, under reflected light. Drawings were made from the photographs and digitally processed in Corel X5. The study of the holotype of *Orthophlebia haradai* (Ueda, 1991), housed in the Kitakyushu Museum of Natural History, Japan (KMNH), was based on good quality photographs accompanying the original description in Ueda (1991).

The terminology of wing venation follows Willmann (1989), with some modifications which are presented in Figure 1.

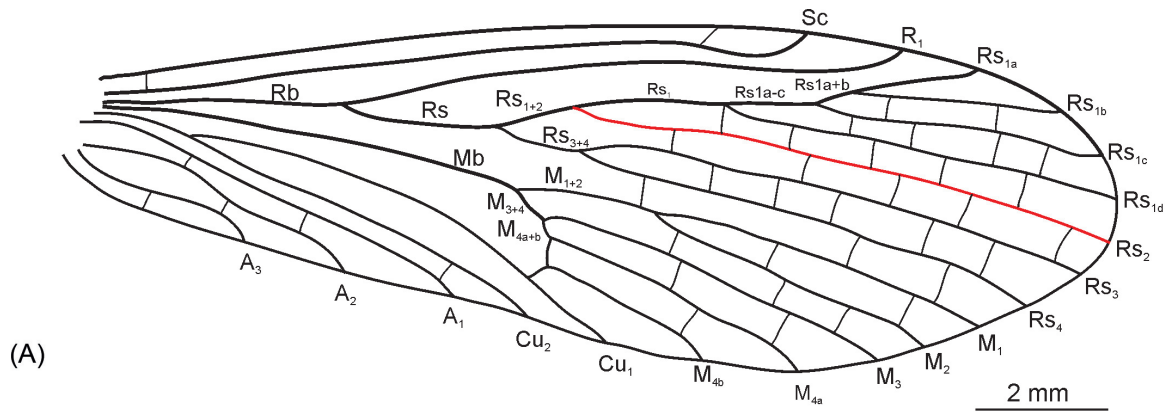


Figure 1 Forewing of *Orthophlebia liassica* (Mantell, 1844), NHMUK I. 11684, Upper Triassic (Rhaetian), Forthampton, Gloucestershire, UK: (A) interpretive drawing; (B) photograph.

2. Systematic palaeontology

Order Mecoptera Packard, 1886
Family Worcestobiidae fam. nov.

Type genus. *Worcestobia* gen. nov. Family monotypic with one genus.

Diagnosis. Distinguished from all other scorpionfly families by the combination of the following characters: vein Sc long, reaching the pterostigma without additional branches; costal field narrow; seven or eight veins reaching the outer margin in radial sector (Rs); R_1 with one branch surrounding the pterostigmal area; Rs_1 pectinate, forks into 3–4 simple veins reaching the outer margin; Rs_2 forks into two single and straight veins Rs_{2a} and Rs_{2b} reaching the outer margin; Rs_3 and Rs_4 simple and straight; five longitudinal veins in medial sector in fore wing and four in hindwing; two cubital veins fused in basal part in fore wing, Mb fused with Cu_1 in hindwing; three anal veins.

Remarks. The most important character, separating this new family from the Orthophlebiidae (and from all other families within the superfamily Panorpoidea), is the forking of Rs_2 into two long veins Rs_{2a} and Rs_{2b} reaching the outer wing margin (see discussion).

Genus *Worcestobia* gen. nov.

Type species. *Worcestobia gigantea* (Tillyard, 1933) = *Orthophlebia gigantea* Tillyard, 1933.

Diagnosis. As for the family by monotypy.

Etymology. From Worcestershire, county in the West Midlands of England, where the type species was found.

Worcestobia gigantea (Tillyard, 1933) comb. nov.
(Fig. 2)

= *Orthophlebia gigantea* Tillyard, 1933: 9, 42–43, fig. 15.

Material. Holotype NHMUK I. 11102, hindwing; Brodie collection from Strensham, Worcestershire; Lilstock Formation (Rhaetian).

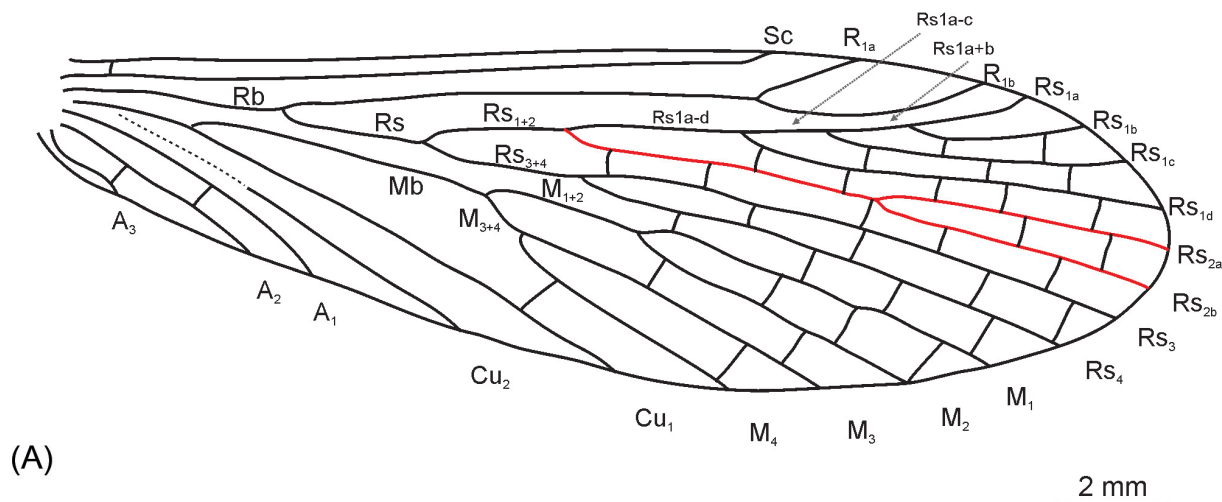
Diagnosis. Rs_1 forks into four veins reaching the outer margin; Rs_{1+2} almost equal in length to Rs; Rs_{2a} almost equal in length to Rs_{2a+b} .

Description. Only the hind wing is known, 17.5 mm length, 5.5 mm wide; vein Sc ends almost opposite R_1 forking; vein R_1 forks towards its end; radial sector (Rs) with eight veins reaching the outer margin; Rs almost equal in length to Rs_{1+2} , Rs_{1+2} slightly shorter than Rs_{3+4} ; Rs_1 pectinate, forking into four veins reaching the outer margin; Rs_2 forks just beyond half its length into two veins Rs_{2a} and Rs_{2b} ; Rs_{3+4} forks into two single veins, Rs_3 three and a half times longer than Rs_{3+4} ; four veins in medial sector reaching the outer margin; M_{1+2} three times longer than M_{3+4} ; M_1 almost two and a half times longer than M_{1+2} , M_3 seven times longer than M_{3+4} ; two cubital veins Cu and three anal veins.

Worcestobia haradai (Ueda, 1991) comb. nov.
(Fig. 3)

= *Orthophlebia haradai* Ueda, 1991, p. 100, fig. 2.

Material. Holotype KMNH IP 000,002, forewing; Okuhata, Mine City, Japan; Upper Triassic (Carnian).



(A)



(B)

Figure 2 Hindwing of *Worcestobia gigantea* (Tillyard, 1933) comb. nov., holotype NHMUK I. 11102, Upper Triassic (Rhaetian), Strensham, Worcestershire, UK: (A) interpretive drawing; (B) photograph.

Diagnosis. Rs_1 forks into three veins reaching the outer margin; Rs_{1+2} slightly shorter than Rs ; Rs_{2a} almost twice as long as Rs_{2a+b} .

Description. Only the forewing is known, 14 mm length, 5 mm width; vein Sc ends beyond the forking of R_1 ; radial sector (Rs) with seven veins reaching the outer margin; Rs_{1+2} slightly shorter than Rs ; Rs_1 forks into three single veins reaching the outer margin; Rs_2 forks into two veins (Rs_{2a} and Rs_{2b}); Rs_{2a+b} slightly longer than Rs_{2a} ; Rs_{1+2} almost equal in length to Rs and *ca.* shorter than Rs_{3+4} ; Rs_3 is three and a half times longer than Rs_{3+4} ; five veins in medial sector reaching the outer margin, M_{1+2} more than three times longer than M_{3+4} ; M_1 slightly longer than M_{1+2} , M_3 seven times longer than M_{3+4} , M_4 very short and forks into two veins (M_{4a} and M_{4b}); two cubital veins and three anal veins.

3. Discussion

Through lack of precise diagnosis of the family Orthophlebiidae, some included species are evidently representatives of other families of Mecoptera. Two Late Triassic species, originally described as members of the Orthophlebiidae, are redescribed

here and placed in the genus *Worcestobia* gen. nov.: *Worcestobia gigantea* (Tillyard, 1933) comb. nov. from the Rhaetian of England; and *Worcestobia haradai* (Ueda, 1991) comb. nov. from the Carnian of Japan. These are now transferred to the newly established family Worcestobiidae fam. nov. A basic character and apomorphy of the new Triassic family, Worcestobiidae fam. nov., which distinguishes it from the Orthophlebiidae, is the forking of Rs_2 into two long veins Rs_{2a} and Rs_{2b} , reaching the outer wing margin. Such forking of vein Rs_2 does not occur in any other family included in the superfamily Panorpoidea, which includes Orthophlebiidae, since all other species within that family have vein Rs_2 single and straight (Fig. 1). A similarly forked vein Rs_2 occurs in some species of Permochoristidae, such as *Sylvopanorpa carpenteri* Martynov (1940) and Kaltanidae; e.g., *Pinnachorista sarbalensis* Martynova (1958). However, Worcestobiidae differs from Permian Kaltanidae in the former having no branches in the costal field, no cross-veins between Sc and R and fewer branches in the medial sector; and from Permochoristidae in the pectinate Rs_1 and fewer veins in the medial sector, along with simple M_1 and M_2 . The forking of Rs_2 into long Rs_{2a} and Rs_{2b} is, therefore, quite rare among Mecoptera and clearly homoplastic in separate families that otherwise show substantial differences in venation.

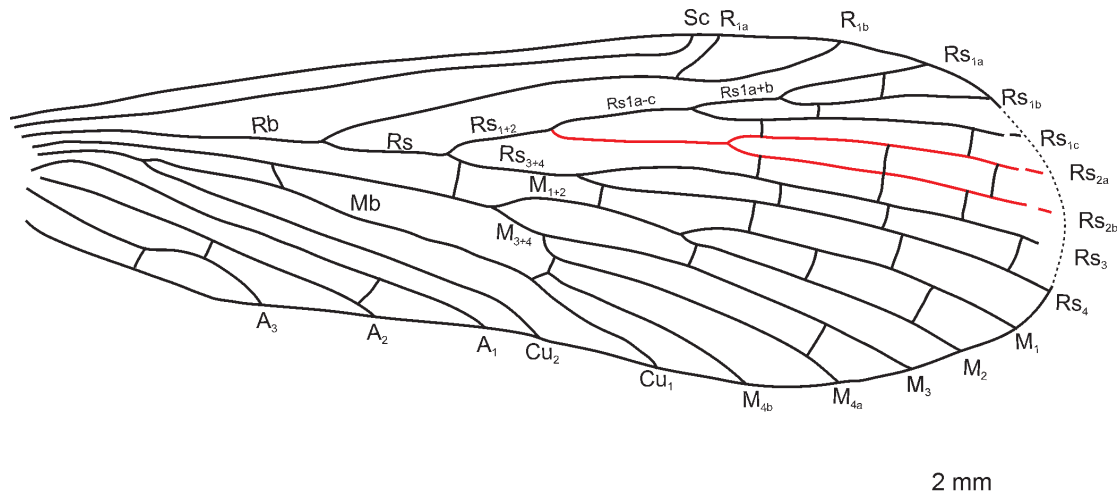


Figure 3 Forewing of *Worcestobia haradai* (Ueda, 1991) comb. nov., holotype KMNH IP 000,002, Upper Triassic (Carnian), Okuhata, Japan (redrawn from Ueda 1991).

We consider that the presence of this distinctive character in two species previously regarded as Orthophlebiidae justifies their inclusion in the separate new panorpoid family Worcestobiidae.

The ongoing revision of the “Orthophlebiidae” group of species (see also Krzemiński *et al.* 2017, this volume) will hopefully contribute to clarification of this important family. The phylogenetic and taxonomic system of this family has not been studied recently in the light of much new material and improved investigative techniques. A precise and updated diagnosis of Orthophlebiidae would be of great value to fossil Mecoptera specialists.

4. Acknowledgements

We are very grateful for the opportunity to work in, and for the hospitality extended to us by, the following institutions: University of Greifswald, Germany (Stefan Meller, Jorg Ansoerge); Natural History Museum, London, UK (Claire Mellish); Georg August University of Göttingen, Germany (Alexandr Gehler); Roemer- und Pelizaeus-Museum Hildesheim (Jürgen Vespermann); Institut für Geologie und Paläontologie, TU Clausthal-Zellerfeld, Germany (Carsten Brauckmann, Elke Groening); the Paleontological Institute, Russian Academy of Sciences, Moscow, Russia (Alexandr Rasnitsyn, Alexei Bashkuev); and the Paleontology and Geology Departments of Capital Normal University, Beijing, China (Dong Ren). The copyright of the photographs of *Worcestobia gigantea* and *Orthophlebia liassica* belongs to the Natural History Museum, London. The research was fully supported by the Polish National Science Centre (grant no. 2013/09/B/NZ8/03270).

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MS received 30 May 2016. Accepted for publication 27 October 2016.