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The first mayfly from the Lower Cretaceous of southern England (Insecta: Ephemerida= Ephemeroptera)

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The first mayfly from the British Cretaceous, *Durlophlebia radleyi* gen. et sp. nov., is described on the basis of a subimaginal hind wing from the Berriasian Purbeck Limestone Group of Dorset, UK. Its presence in hypersaline deposits in the Lulworth Formation indicates that there were also fresher water bodies in the region at that time.

KEY WORDS: fossil insects; Ephemeroptera; Lower Cretaceous; Purbeck; England; gen. nov.; sp. nov.

1. Introduction

Early Cretaceous mayflies are diverse and widely distributed, mainly in fossil lake deposits. Lacustrine mayfly assemblages have been recorded from Europe (see below), Asia (Siberia, Mongolia, China, Korea: Sinitshenkova, 1990), North Africa (Algeria: Sinitshenkova, 1975), South America (Brazil: McCafferty, 1990), and Australia (Victoria: Jell & Duncan, 1986). As a rule, they are dominated by nymphal remains, often in great numbers, whereas the winged stages are uncommon. Their fossils are most abundant in shallow-water sediments of large lakes while the deep-water offshore deposits contain few, if any, remains. This type of assemblage is clearly autochthonous, comprising lentic species with immature stages that developed in the lakes where the insect-bearing sediments were deposited. In contrast, mayflies that inhabited various types of running water in the Early Cretaceous (such as adults recorded from Lebanese amber: McCafferty, 1997) are poorly known.

Few Early Cretaceous mayflies have been recorded from Europe. In Spain the nymphs of *Mesopalingea* Whalley & Jarzembowski (Potamanthidae) are common in the lacustrine limestones of Montsec, and further undescribed nymphs tentatively assigned to the families Euthyplociidae and Leptophlebiidae are mentioned from the Montsec and Las Hoyas fossil sites (Whalley & Jarzembowski, 1985; Peñalver *et al.*, 1999). Abundant nymphs and rare adults of *Hexameropsis* Tshernova & Sinitshenkova (Hexagenitidae) have been recorded from a Ukrainian fossil lake deposit (Tshernova & Sinitshenkova, 1974).

The Purbeck Limestone Group of southern England consists predominantly of lagoonal sediments currently considered to be Berriasian in age (Allen & Wimbledon, 1991). Insect fossils are common and diverse, comprising mainly terrestrial taxa. Aquatic insects are relatively undiverse and probably mainly brackish water inhabitants, being represented by several taxa of heteropteran bugs, immature stages of dipterans, trichopteran cases and rare odonate larvae (Coram & Jarzembowski, in press). Several aquatic beetle taxa are also present but usually in relatively small numbers (except some hydrophilids); no beetle larvae have been recorded (Ponomarenko *et al.*, 2000). A well-preserved wing recently collected from Durlston Bay, Swanage, Dorset (National Grid Reference SZ 035 780) is the first Cretaceous mayfly from the British Isles. Although the taxonomic position of the fossil cannot be determined with certainty, it clearly differs from any previously known Mesozoic mayflies and deserves a description.

Systematic palaeontology

Class: Insecta Linnaeus, 1758
Order: Ephemeroptera Hyatt & Arms, 1890
Ephemeroptera *incertae sedis*

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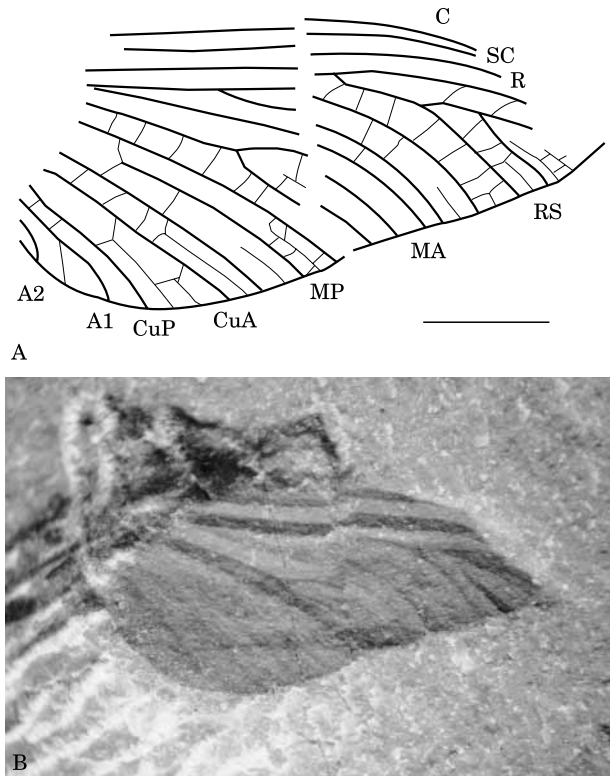

Figure 1. *Durlophlebia radleyi* gen. et sp. nov., holotype MNEMG 2002.3; Durlston Bay, Lower Berriasian; line drawing (A) of photograph (B). Scale bar represents 2.0 mm.

Genus *Durlophlebia* gen. nov.

Derivation of name. Generic name from Durlston Bay and *phlebos*, Greek, a vein.
Type species. D. radleyi sp. nov. described below.

Diagnosis. Subimago. Hind wing broad, slightly more than twice as long as wide. Costalization weak: costal, subcostal and radial fields broad. RS multibranched. MA forks near midlength of wing, considerably distad of first fork of RS; MP evidently forks near wing base. Tornus not clearly developed, cubital area very narrow, with two intercalary veins of different length. Anal veins long, A1 with fork, A2 simple. Intercalary veins near the wing margin long, solitary. Gemination of veins is completely absent.

Durlophlebia radleyi sp. nov.
Figure 1

Derivation of name. The species is named after Dr Jonathan Radley, Purbeck researcher.
Holotype. MNEMG 2002.3, Maidstone Museum and Bentlif Art Gallery; Clements' (1993) Bed DB55a, Soft Cockle beds, Lulworth Formation; Durlston Bay, Swanage, Dorset, UK; Lower Berriasian; collected by R. Coram.

Diagnosis. As for genus.

Description. Positive impression of nearly complete subimaginal hind wing in a good state of preservation; wing base missing. Wing length as preserved 9.0 mm (estimated total length 10 mm), width 4.7 mm. Costal, subcostal and radial fields in the middle third of the wing of equal width. MA forks slightly distad of the second RS fork; MPI intercalary much longer than the fork of MA. All three MP veins and CuA almost straight up to the wing margin while the other longitudinal veins are slightly curved. Cross veins very slender and poorly visible due to thick wing membrane. Intercalary veins near wing margin slender and comparatively long. Anterior intercalary vein in the cubital field half the length of the posterior one.

Remarks. The wing seems to have a rather dark membrane, and the veins are of the same colour and relatively thick. This indicates that it is subimaginal since in this stage the wing hypoderm is thick, rendering the wing opaque and, as a rule, uniformly coloured including both membrane and veins. The wing is interpreted as a hind one because it is relatively short and broad, with a very narrow space between CuA and CuP, wide anal area, and weakly developed tornus (angle at wing margin, usually between CuA and CuP). In modern mayflies in which the hind wings are not strongly reduced and retain a rich venation, the MP branches usually originate at the wing base, and MA forks near the midlength, which is also the case in this fossil.

Discussion

The taxonomic position of *Durlophlebia* cannot be established with certainty. The unique fossil wing has an unusually narrow cubital area and wide costal, subcostal and radial fields. This combination of characters is not known in the hind wings of any other mayflies, living or fossil, and justifies the creation of a new genus. However, some extinct Mesozoic families are known either as isolated forewings (Aenigmephemeridae and Mesephemeridae, both restricted to the Late Jurassic) or only as nymphs (Torephemeridae, Mesonetidae and Epeoromimidae, known from the Jurassic as well as from the Early Cretaceous). The Purbeck wing cannot be attributed to any known genera of those families because of its large size. The wing shape and venation indicate that

the hind wings of *Durlophlebia* are only moderately shortened, most probably being somewhat longer than half the forewing length, giving the mayfly a total wingspan of about 40 mm. The weak reduction of the hind wings is a plesiomorphic condition occurring in some ephemeroid and siphlonuroid families. The extinct family Hexagenitidae, widespread in the Jurassic and Early Cretaceous, has large hind wings with a rich venation, and the members of this family were often of large size. The veins in the hexagenitid hind wings, however, are obviously germinated (arranged in pairs) which is not the case in *Durlophlebia.*

The nymphal biotope of *Durlophlebia* is not known. It is interesting to note that the fossil was collected from an evaporite-bearing horizon evidently deposited in hypersaline conditions and otherwise almost entirely lacking aquatic insect remains. Since no Recent mayflies can tolerate such elevated salinities, the Purbeck wing was almost certainly transported from a less saline life habitat.

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