

Paleoptera

1. Introduction

In the infraclass Paleoptera are the orders Ephemeroptera (mayflies) and Odonata (dragonflies and damselflies), the living species of which represent the few remains of two formerly very extensive groups. Although both are placed in the Paleoptera, authorities disagree on whether the two orders are monophyletic or have separate origins (see Chapter 2, Section 3.2). Even if monophyletic, the Ephemeroptera and Odonata are two very different groups that must have diverged at a very early stage in the evolution of winged insects. They possess the following common features that unite them as Paleoptera: wings that cannot be folded back against the body when not in use, retention of the anterior median wing vein, netlike arrangement of wing veins (many crossveins), aquatic juvenile stage, and considerable change from juvenile to adult form. In members of both orders, wing development is external, though this feature is not, of course, restricted to Paleoptera.

2. Ephemeroptera

SYNONYMS: Plectoptera, Ephemerida

COMMON NAMES: mayflies, shadflies

Adults small- to medium-sized elongate fragile insects; antennae short and setaceous, mouthparts vestigial, compound eyes large, three ocelli present; generally two pairs of membranous wings (though hind pair greatly reduced) held vertically over body when at rest, with many crossveins; abdomen terminated with two very long cerci and frequently a median caudal filament; with subimaginal and imaginal winged stages.

Larvae aquatic; body campodeiform; antennae short, compound eyes well-developed, biting mouthparts; abdomen usually with long cerci and a median caudal filament, and four to seven pairs of segmental tracheal gills.

Approximately 2100 species of this widely distributed order have been described, though this may represent only about one-third of the extant species. Of the described species, about 675 occur in North America, 84 in Australia, and about 50 in Britain.

Structure

Adult. The head is triangular in shape when viewed from above. The compound eyes are large, especially in males where they often meet middorsally and typically are divided horizontally into an upper region with large facets and a lower region with smaller facets (Figure 6.1). This arrangement provides a male with both high acuity and good sensitivity, allowing him to detect and capture an individual female in a swarm at low light intensity. Three ocelli are present, the two laterals often large. The antennae are small, multiannulate, setaceous structures. The mouthparts are vestigial. The thoracic region is dominated by the large mesothoracic segment. Pleural sulci are poorly developed or absent even on the pterothorax. Two pairs of fragile wings are generally present, though the hind pair is always reduced or absent. The wing venation is primitive, the median vein being divided into anterior and posterior branches. The legs are sometimes reduced, associated with the habit of passing the entire adult life on the wing. However, the forelegs of males are usually enlarged and used to grip a female during mating. Primitively there are five tarsal segments, but the basal one or two segments may fuse with the tibia in higher families. The apex of the abdomen has three, usually very long, multiannulate caudal filaments, consisting of the two lateral cerci and a median filament (this is sometimes reduced or absent). In females paired gonopores open behind the seventh abdominal sternum. A typical ovipositor is absent. In males a pair of claspers occurs on the ninth sternum. Between these claspers lies a pair of penes.

The most noteworthy internal feature is the modification of the gut as an aerostatic organ to reduce the specific gravity of the insect. The esophagus is a narrow tube equipped with muscles that regulate the amount of air in the gut. Swallowed air is held in the midgut, which no longer has a digestive function and is lined with pavement rather than columnar epithelium. The hindgut also has a valve to prevent loss of air. The reproductive organs are very primitive; accessory glands are absent, and the gonoducts are paired in both sexes.

Larva. Mayfly larvae exhibit a wide range of body form associated with the diverse habitats in which they are found. The body is of varied shape but is often flattened dorsoventrally. The antennae, compound eyes, and ocelli differ little from those of adults. Larvae possess well-developed biting mouthparts. The structure of the legs varies according to whether a larva is a swimming, burrowing, or clinging form. The abdomen is terminated with a pair of long cerci and usually a median caudal filament. Between four and seven pairs of tracheal gills occur on the abdomen. In open-water forms the gills are usually lamellate; in burrowing species they tend to be plumose. In some species gills may not be directly important in gaseous exchange. They are capable of coordinated flapping movements and may serve simply to create a current of water flowing over the body. In some species accessory gill-like respiratory structures develop on the thorax and head.

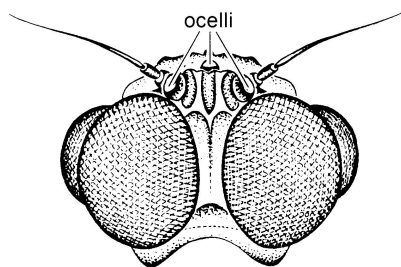


FIGURE 6.1. Dorsal view of head of male *Atalophlebia* (Leptophlebiidae) showing large compound eye divided into upper part with large facets and lower part with small facets. [From W. L. Peters and I. C. Campbell, 1991, Ephemeroptera, in: *The Insects of Australia*, 2nd ed., Vol. I (CSIRO, ed.), Melbourne University Press. By permission of the Division of Entomology, CSIRO.]