

17. Specimens from mainland Australia ... *Riekoperla* (Fig. 74.3)
 -. Specimens from Tasmania ... 18
18. Wing pads with notches in the inner angles where they join the thoracic terga; sometimes with a slight median ridge on abdominal terga (see couplet 9-11 above) ... *Cardioperla* [in part; specimens from high streams.]
 -. Wing pads smoothly united with the thoracic terga so that the junctions at their inner angles are simple curves ... *Riekoperla triloba*
19. With paired dorsal projections on each abdominal tergum ... 20
 -. Abdominal terga without paired protuberances ... 21
20. Specimens from Tasmania; tenth abdominal tergite and shutter-like subanal plates enclose a mass of finger-like gills arising from the bases of the cerci and the inner walls of the plates ... *Crypturoperla*
 -. Specimens from the Australian mainland; tenth abdominal segment with five inconspicuous slender gills formed by extensions of the cerci, the subanal plates and a median filament ... *Acruroperla* (Fig. 74.4)
21. Three terminal beaded abdominal gills (in addition to the similar beaded extensions of the cerci, cf. Fig. 74.4) ... *Austropentura*
 -. Five terminal abdominal gills ... 22
22. Specimens from mainland Australia ... *Austroheptura*
 -. Specimens from Tasmania ... *Tasmanoperla*

* Key compiled by Dr H. B. N. Hynes.

EPHEMEROPTERA

General Biology

The scientific name of this order of aquatic insects is derived from the Greek *ephemeros*, meaning lasting only a day, and *pteron*, meaning wing. This is an apt derivation since the adult flies are very ephemeral; some live for less than a day and all have vestigial mouthparts and do not feed. Despite the short-lived winged stage of their life-cycle, 'mayflies', as they are referred to popularly, are well-known insects of streams and lake shores, particularly to fly-fishermen who use copies of them to entice fish onto kitchen tables.

Uniquely among insects, there are two winged post-nymphal stages; there is a transitory and usually inactive pre-imaginal stage

known to anglers as the 'dun', and a definitive imaginal stage known as the 'spinner'. Both stages are rather similar in structure, but as the vernacular name of the first stage suggests, the dun is duller in appearance than the final adult. Both forms are small- to moderately-sized delicate insects with multi-veined transparent or translucent wings. The forewings are the larger of the two pairs, and both wings are held vertically when at rest. The antennae are small, the eyes large and prominent. The legs are long and slender.

The nymphal stage, which is always aquatic, is the stage that concerns us. It occupies by far the longest part of the life-cycle, the short-lived adults existing primarily for reproductive and dispersal purposes. Nymphal life may extend over many months. The gross structure of nymphs is indicated in Fig. 75 which shows the general appearance of several genera in various families. As the drawings indicate, short antennae, paired abdominal gills and three caudal filaments are characteristic (the gills are enclosed by the thoracic shield in *Prosopistoma*). The length of nymphs depends upon age, but full-grown nymphs are rarely longer than 2.5 cm.

In view of the great interest the order has attracted from freshwater ecologists in Europe and North America, it is surprising that so little is known about the ecology of Australian species. However, some recent work by P. Suter (1979) has provided considerable insight into the ecology of some South Australian representatives.

Nymphs are found in all sorts of running waters, from fast-flowing mountain streams down to sluggish, meandering rivers of the plains. They also occur frequently in lakes and reservoirs, either in unsheltered stony regions or in weedy sheltered bays. They have never been recorded from any Australian lake that was the slightest bit salty, and only a few species breed in localities where water is of seasonal or ephemeral occurrence. Some forms are sedentary and either bury themselves in muddy substrata (e.g. *Jappa*) or hide beneath stones in streams (e.g. *Coloburiscoides*). Others are active, free-swimming forms (e.g. *Tasmanophlebia*, *Ameletoides*, *Mirawara*). The degree of mobility of many nymphs falls somewhere between these two extremes of activity. *Atalophlebioides* nymphs are the most common ones under stones in swift currents, whereas *Atalophlebia* and *Atalonella* occur in quieter waters.

Reproductive phenomena are confined to the aerial, final adult stage. The males characteristically form swarms into which females fly singly. Mating occurs in flight and the eggs are then deposited either singly or, more usually, in ribbons or strings in the water. Deposition of the eggs may occur simply by females 'bombing' the water surface, or the female may actually submerge. Other methods of deposition also occur. There appears to be little delay between oviposition and nymphal hatching.

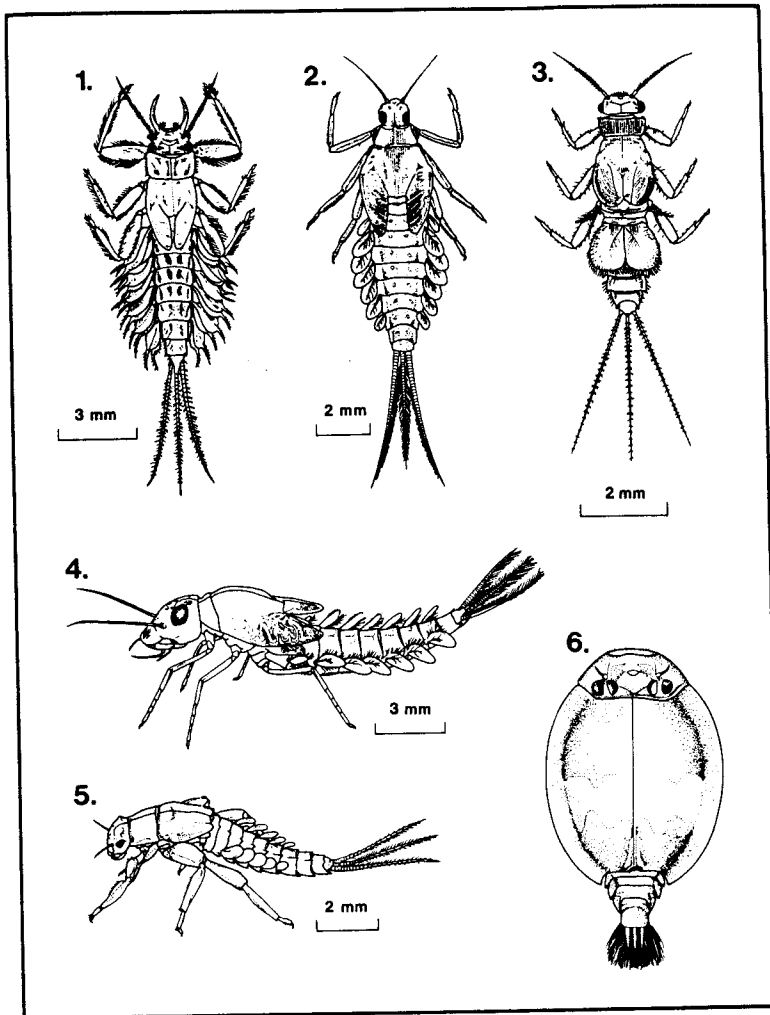


Figure 75: Ephemeroptera. Representatives of each Australian family; each drawing is a dorsal or lateral view of a whole nymph. 1. *Jappa* (Leptophlebiidae); 2. *Centroptilum* (Baetidae); 3. *Tasmanocoenis* (Caenidae); 4. *Mirawara* (Siphonuridae); 5. *Austremarella* (Ephemerellidae); 6. prosopistomatid. 1-5 redrawn after M. Quick; 6 redrawn after S. L. Jensen.

Australian Forms

Five families of the Ephemeroptera have definitely been recorded from Australia. They are the Leptophlebiidae, Baetidae, Caenidae, Siphonuridae and Ephemerellidae. All are cosmopolitan. The domi-

nant family is the first, and it has here invaded habitats similar to those occupied elsewhere by other families, the invasion being accompanied by morphological adaptations usually regarded as characteristic of families other than the Leptophlebiidae. Thus, the burrowing leptophlebiid genus *Jappa* resembles in the form of its gills, forelegs and head-tusks the genus *Ephemera* belonging to the Ephemeridae, a family unknown in Australia. Additionally, the family Prosopistomatidae occurs in Australia; Dr Richard Pearson has collected specimens from streams in northern Queensland though his observations remain unpublished at present. Generic representatives of all six families are illustrated in Fig. 75.

A summary of the present taxonomic status of the order in Australia is given in Table 10. About seventy species in nineteen genera have been described so far. Many more species remain for description according to Riek (1970). Of the genera involved, some are cosmopolitan (e.g. *Cloeon*, *Baetis*, *Pseudocloeon*); others are restricted to Australasia or (largely) to the southern hemisphere (e.g. *Atalophlebia*); yet others are endemic to Australia (e.g. *Bungona*, *Tasmanocoenis*, *Mirawara*). The order occurs throughout Australia.

Table 10: Taxonomic summary of Australian Ephemeroptera

Family	Genus	Number of described species
Prosopistomatidae	(see text)	—
Leptophlebiidae	<i>Atalophlebia</i>	18
	<i>Atalophlebioides</i>	9
	<i>Atalonella</i>	7
	<i>Atalomicria</i>	2
	<i>Jappa</i>	2
	<i>Kirrara</i>	3
	<i>Thraulophlebia</i>	1
	<i>Ulmerophlebia</i>	1
	<i>Tasmanocoenis</i>	3
	Caenidae	<i>Austremarella</i>
<i>Baetis</i>		5
Ephemerellidae	<i>Centroptilum</i>	1
	<i>Cloeon</i>	4
Baetidae	<i>Pseudocloeon</i>	1
	<i>Bungona</i>	1
	<i>Ameletoides</i>	1
	<i>Tasmanophlebia</i>	3
	<i>Coloburiscoides</i>	3
Siphonuridae	<i>Mirawara</i>	3

Species from almost all genera have now been described from both nymphal and adult material so that a more satisfactory generic key to nymphs can be presented than was the case in the first edition of this book. The key below is based almost completely upon one published recently by my colleague Mr P. Suter; it differs only in being slightly expanded to include two leptophlebiid genera (*Atalomicria* and *Kirrara*) which though not formally described are recognizable from Riek's (1970) drawings, and by including a couplet for recognition of prosopistomatid material. Not included in Suter's key nor the one below is any reference to the genera *Thraulophlebia* and *Ulmerophlebia*; nymphs of these genera remain undescribed.

Key to Nymphs of Most Australian Genera of Ephemeroptera*

1. Dorsal part of thorax enlarged to form a shield extending to the sixth abdominal segment; gills enclosed by thoracic shield ... Prosopistomatidae [only the genus *Prosopistoma* has been described for this family.]
- Dorsal part of thorax not enlarged to form a shield; at least some abdominal gills exposed ... 2
2. Head prognathous; thorax and abdomen dorso-ventrally flattened; caudal filaments with whorls or setae at apex of each segment (Fig. 76.1) ... 3
- Head hypognathous; thorax cylindrical (abdomen may be dorso-ventrally flattened); inner margin of lateral caudal filaments and both lateral margins of central filament fringed with long setae (Fig. 76.2) ... 10
3. Prominent double row of spines dorsally on abdomen; five pairs of sub-ovate gills on abdominal segments 2-6 (Ephemerellidae) ... *Austremerella*
- Without double row of dorsal spines on abdomen; gills on abdominal segments 1-5, 1-6 or 1-7 ... 4
4. Seven pairs of paired gills inserted laterally on abdomen, sometimes linear, lanceolate, or broad and multidigitate (Leptophlebiidae) ... 5
- Five or six pairs of gills; first gill is a short single filament (Fig. 76.3), second is enlarged, forming an elytriform gill cover (Fig. 76.4) covering remaining pairs which bear long tracheal filaments (Fig. 76.5) (Caenidae) ... *Tasmanocoenis*
5. Maxillary palps conspicuous, greatly elongated, and extending well beyond front of head (Fig. 76.6) ... *Atalomicria*
- Maxillary palps not as above ... 6

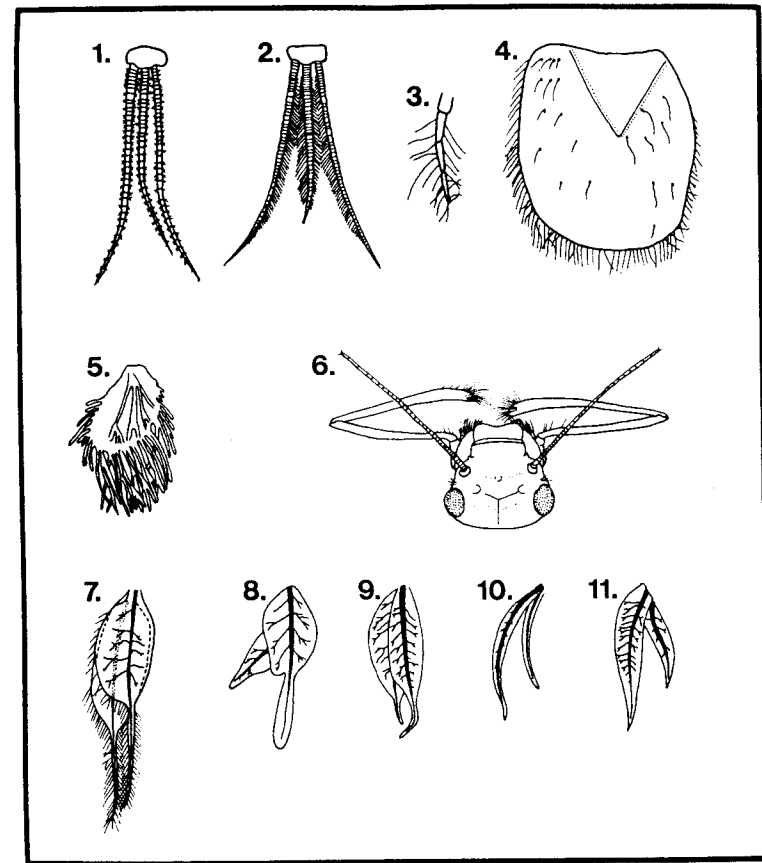


Figure 76: Ephemeroptera. Diagnostic morphological features. 1. caudal filaments of *Atalonella*; 2. caudal filaments of *Baetis*; 3. 4. 5. first, second and third gill, respectively, of *Tasmanocoenis tillyardi*; 6. dorsal view of head of *Atalomicria*; 7. third gills of *Jappa*; 8. 9. 10. gills of *Atalonella*; 11. gill of *Atalophlebioides*. All except 6 redrawn after Suter (1978); 6. redrawn after Riek (1970).

6. Abdominal gills with ventral lobes combining to form a large 'suction' disc ... *Kirrara*
- Abdominal gills not forming a 'suction' disc ... 7
7. Gills broadly ovate with an apical filament on each lamina, long fine setae covering gill surface (Fig. 76.7); legs with long fine setae; two tusk-like projections arising from front of head present or absent ... *Jappa*
- Gill surface without long fine setal covering; legs without long fine setae; head without frontal tusks ... 8

8. Gills linear-lanceolate, sometimes broadly so (Figs. 76.8, 9, 10, 11) ... 9
- Gills broad, apex of each gill lamella subdivided with one, three or multi-tracheal filaments (Figs. 77.1, 2, 3) ... *Atalophlebia*
9. Postero-lateral spines on abdominal segments 4-9; mandibles and maxillae laterally exposed producing broad angular head (viewed dorsally) (Fig. 77.4) with frontal width greater than width at posterior margin; labrum with deep U-shaped median notch (Fig. 77.5) ... *Atalophlebioides*
- Postero-lateral spines on abdominal segments 6-9; mandibles and maxillae held beneath head such that front of head is rounded (Fig. 77.6) with frontal width narrower than width at posterior margin; median notch of labrum not deep (Fig. 77.7) ... *Atalonella*
10. Hind corners of abdominal segments not produced into backward pointing spines; head hypognathous; labrum with square median notch (Baetidae) ... 11
- Hind corners of abdominal segments produced into backward pointing spines; labrum entire or with broad median U-shaped notch; head hypognathous (Siphonuridae) ... 15
11. Gill lamellae double on abdominal segments 1-6; seventh gill single; hind wing pad absent ... *Cloeon*
- Gill lamella single on abdominal segments 1-7 ... 12
12. Labrum square, with deep V-shaped median notch, with pair of teeth at apex of indentation (Fig. 77.8); tarsal claws long and slender, half as long as tarsi ... *Centroptilum*
- Labrum oval, with shallow square median notch (Fig. 77.9); tarsal claws short, less than one quarter tarsal length ... 13
13. Gills pointed with trachea on one half of median line only (Fig. 77.10) ... *Bungona*
- Gills ovoid with trachea branched over entire lamella ... 14
14. Metathoracic wingpads absent in mature nymphs ... *Pseudocloeon*
- Metathoracic wingpads present ... *Baetis*
15. Four pairs of gills, first pair elytriform covering last three pairs ... *Tasmanophlebia*
- Seven pairs of gills ... 16
16. Gills deeply bifid and strongly spinose (Fig. 77.11); thorax strongly humped ... *Coloburiscoides*
- Gills lamellate, not deeply bifid or spinose; thorax weakly humped ... 17
17. Gills lamellate, first two pairs small, with tufts of fibrils situated posteriorly near base; mandibles with long slender incisors;

maxillae with long curved apical spines (carnivorous) ...

Mirawara

- Gills simple lamellate structures; mandibles with single broad incisor; maxillae without curved apical spines ... *Ameletoides*

* Based on Suter (1978; see also text).

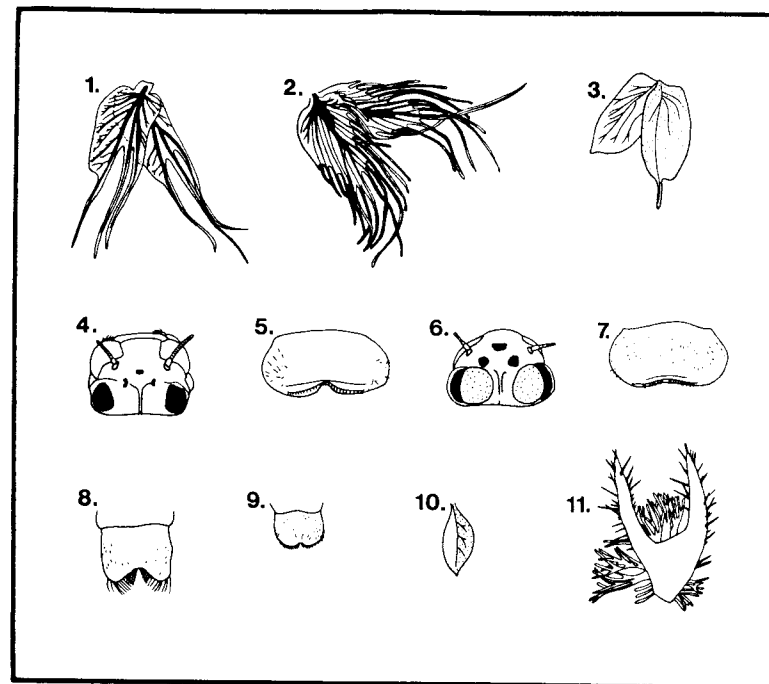


Figure 77: Ephemeroptera. Diagnostic morphological features. 1. third gill of *Atalophlebia australis*; 2. third gill of *A. australasica*; 3. third gill of *A. longicaudata*; 4. dorsal view of head of *Atalophlebioides* (♀); 5. labrum of *Atalophlebioides*; 6. dorsal view of head of *Atalonella* (♂); 7. labrum of *Atalonella*; 8. labrum of *Centroptilum*; 9. labrum of *Baetis*; 10. gill of *Bungona narilla*; 11. gill of *Coloburiscoides*. All except 10. redrawn after Suter (1978); 10. redrawn after Harker (1957).

ODONATA

General Biology

There can be few times when adult Odonata have been mistaken for other insects, for their medium to large size, often bright colours, and quick darting flight are distinctive. The common name given them depends to some extent upon which of the two main suborders