
MAYFLY NYMPHS OF AUSTRALIA

A guide to Genera

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Cover: Leptophlebiidae Genus D
from Badger Creek, Victoria.

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INTRODUCTION

The Ephemeroptera or mayflies of Australia are a relatively small group of insects, with fewer than 100 described species. It is only in recent years that serious taxonomic studies have been undertaken in many parts of the country, and current indications are that the Australian fauna probably consists of over 200 species. This clearly indicates that the Australian mayfly fauna is still poorly known. Many early taxonomic descriptions were based on adults only, and are completely inadequate for species recognition. Few species have been associated with their nymphs and consequently, even where named species exist, there is little confidence in identifying nymphal material. Furthermore, taxonomy at the generic level has also been inadequate, and many described species have been placed into genera that are now recognised as inappropriate. In some families it will be virtually impossible to identify most specimens until nymphs have been associated with adults and the adult taxonomy completely revised.

The present study has been undertaken to provide a generic framework for the Australian mayfly nymphs, and thus facilitate future taxonomic studies at the species level. Keys are provided to all recognised genera, both described and undescribed, and in addition a short diagnosis is presented for each genus. However, additional undescribed genera may occur in Australia, and this should be borne in mind when using the keys.

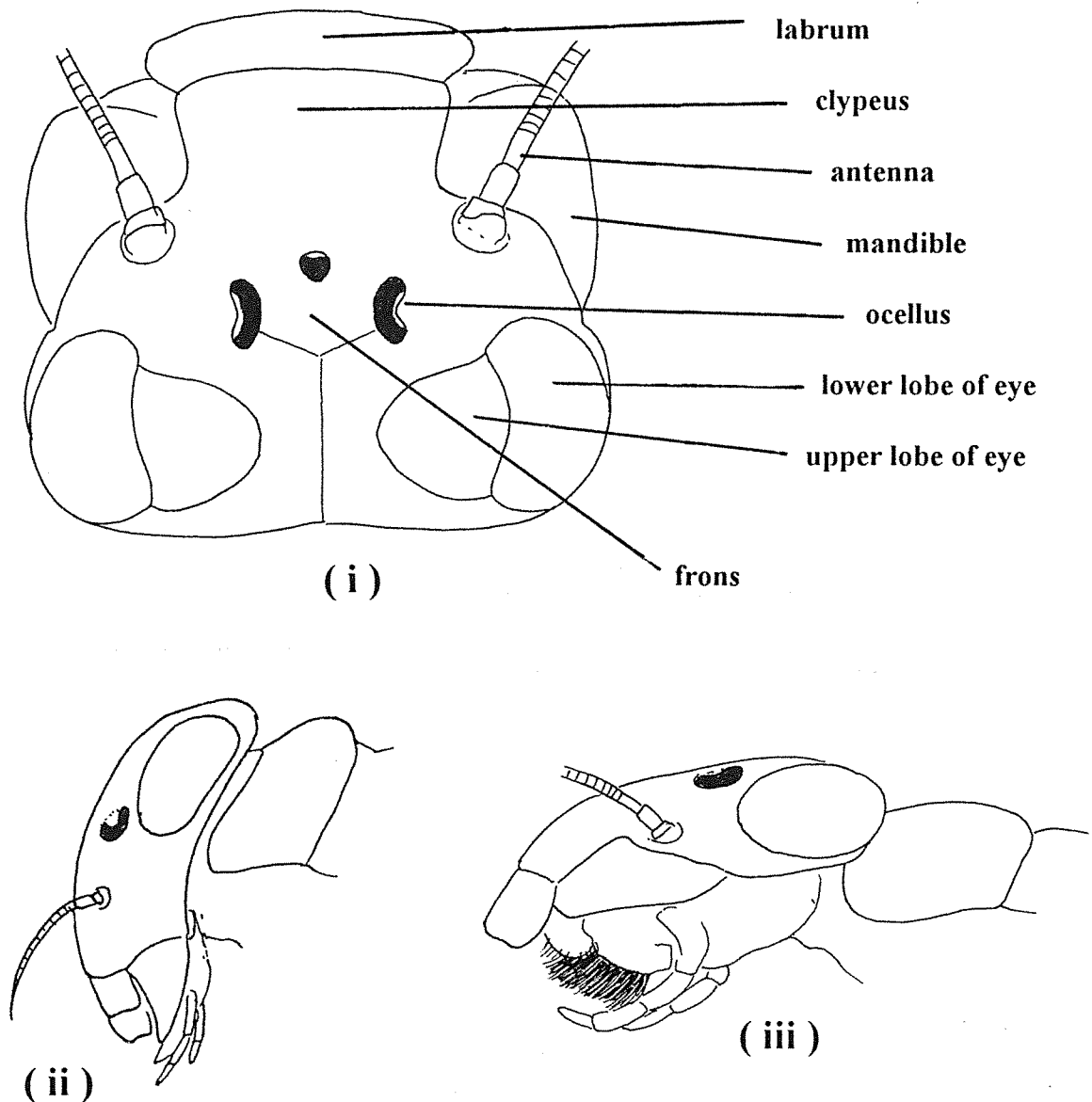
Nine families of Ephemeroptera have been recorded from Australia, of which six are only represented by a single genus. By far the richest family is the Leptophlebiidae, with at least twenty genera, while nine genera of Baetidae and five genera of Caenidae are recognised. Species richness is apparently greatest in south-eastern Australia, although information is limited on the mayfly fauna of coastal Queensland. In northern Australia, twenty-four species have been recorded from the Kakadu region (Suter, 1992), and nine species are known from Cape York in Queensland (Wells & Cartwright, 1993). The species of south-western Australia probably number about a dozen, fourteen species have been recorded from South Australia (Suter, 1986; Alba-Tercedor & Suter, 1990), about seventy species are known from Victoria (Dean, unpublished), and, on the basis of published and unpublished information, the mayflies of Tasmania probably number about thirty species.

Despite the relatively low diversity of mayflies, they are one of the more abundant groups of invertebrates in many Australian rivers and streams, and in terms of biomass often exceed the combined mass of all other macroinvertebrates in samples. Therefore, they are of considerable importance to the ecology and trophic structure of lotic communities. This, combined with the intolerance of most species to poor water quality and habitat degradation, make the mayflies an important indicator group for environmental monitoring programs.

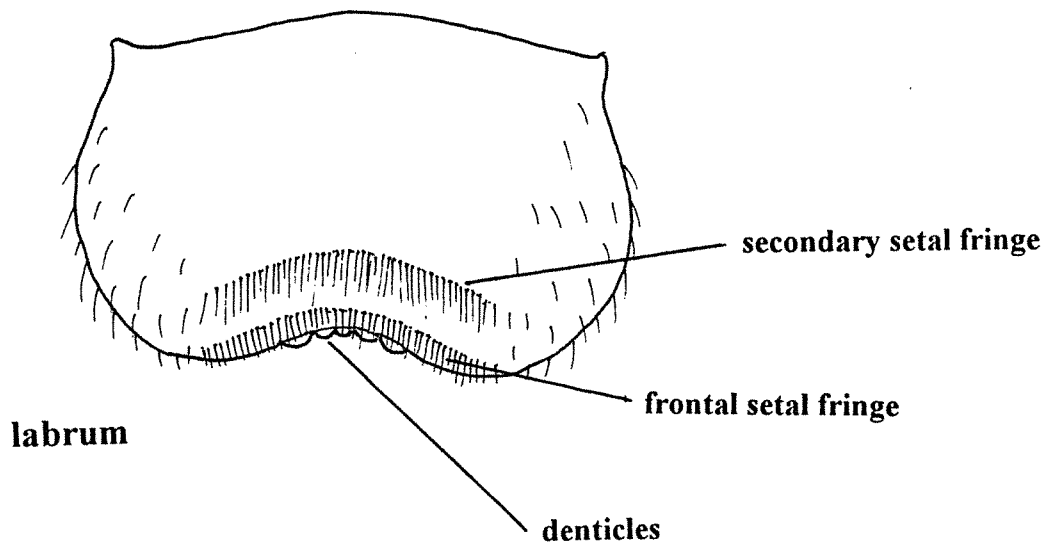
In the present work, families are treated in the same order as in *The Insects of Australia* (Peters & Campbell, 1991). For each family a short taxonomic diagnosis is given, followed by brief comments on ecology, a check list of described genera and, where necessary, a dichotomous key to genera. An attempt has been made to maximise the use of illustrations, although time constraints have prevented us including as many figures as we would have liked. Wherever possible we have placed a couplet which refers to a figure on the same double-page spread as the actual figure. Terminology used in the keys is explained in the section on structure of Australian mayfly nymphs. For a more complete discussion of mayfly structure readers should refer to Edmunds *et al* (1976). The references listed are not restricted to articles cited in the text, and an extensive bibliography of all relevant taxonomic and ecological articles on Australian mayflies has been provided. Ecological articles have only been included if mayflies are prominently mentioned.

STRUCTURE OF AUSTRALIAN MAYFLY NYMPHS

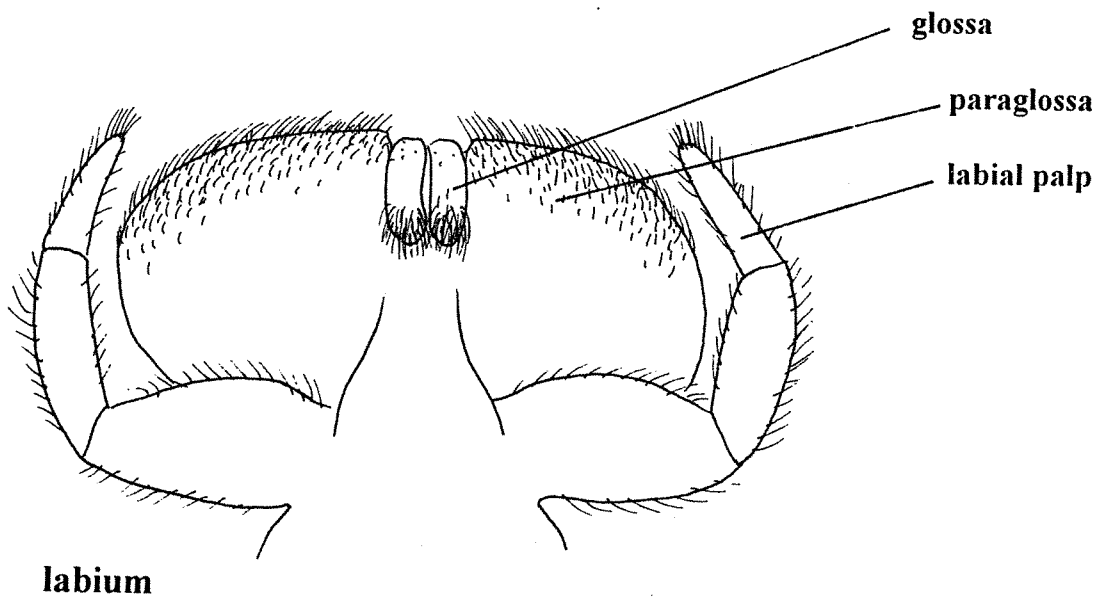
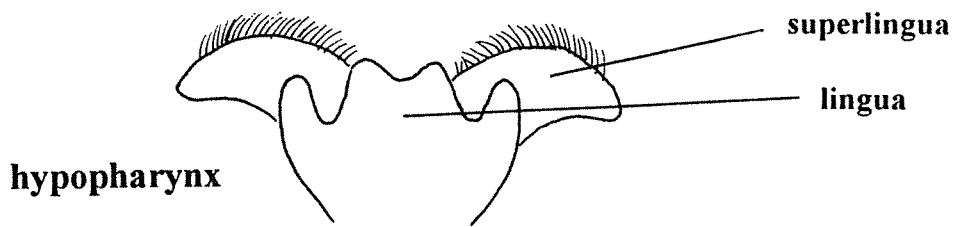
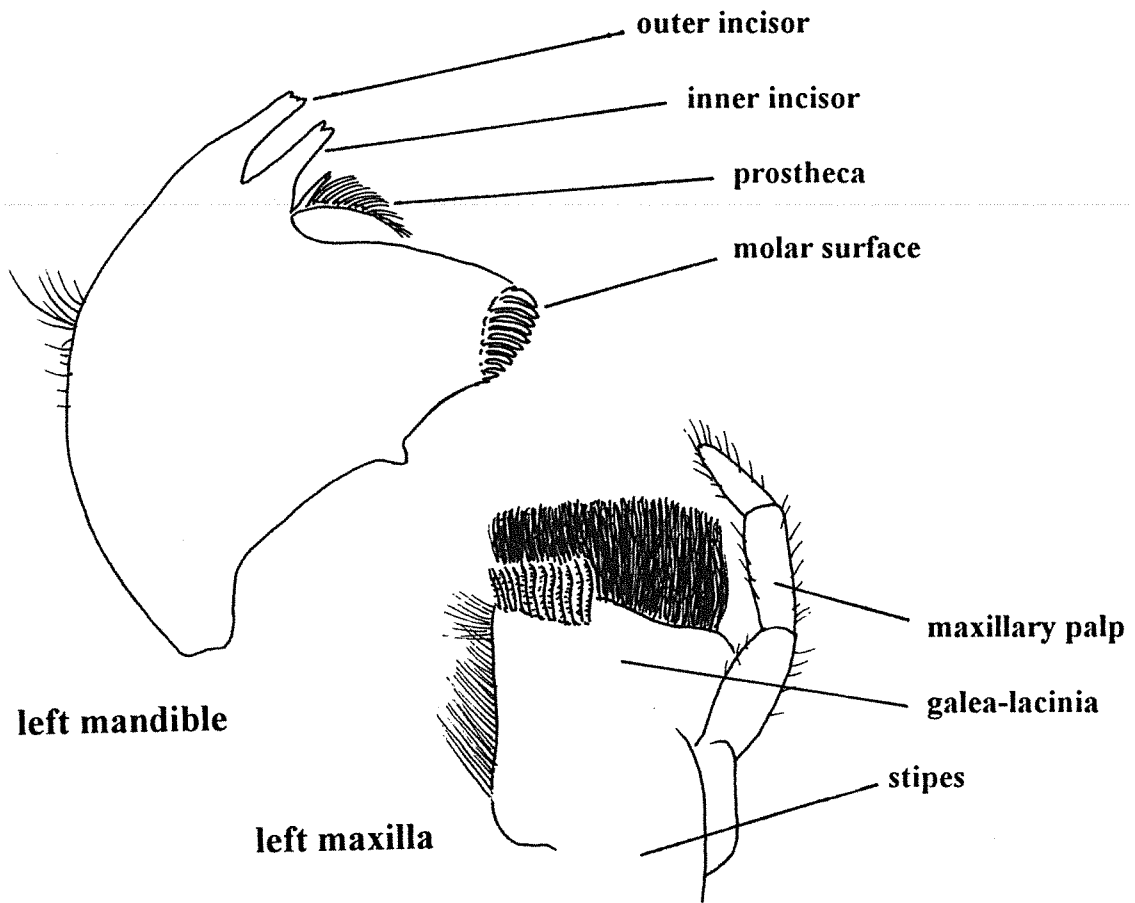
Head (Fig i). The shape and orientation of the head of mayfly nymphs is variable. The head may be *hypognathous* (Fig ii), with the long axis orientated vertically and the mouthparts directed ventrally, or *prognathous* (Fig iii), with the long axis horizontal and the mouthparts directed to the anterior. The *eyes* are moderately large, normally located close to the postero-lateral margin of the head, and may be protruding or contained within the profile of the upper surface of the head capsule. In some families the eyes are sexually dimorphic, the females possessing dark eyes which are widely separated dorsally, while males have in addition paler upper lobes which extend closer to the midline. Three *ocelli* are located between the eyes and a little to the anterior. The *antennae* arise anterior to the eyes, and range in length from about half the width of the head capsule to more than twice the width of the head capsule. The *clypeus* is located anterior to the antennae, projecting forward and forming the anterior margin of the dorsum of the head capsule. It is separated from the *frons* by a distinct suture in some families such as Siphonuridae and Baetidae, but in other families, such as Leptophlebiidae, the clypeus and frons are fused.



Mouthparts (Figs iv, v). The mouthparts are fully functional, and of considerable taxonomic importance. The most anterior structure, the *labrum* is quite variable in shape, dorso-ventrally flattened, and attached along the base to the clypeus. The anterior margin often bears a series of small *denticles*. The arrangement of setae on the upper surface can be important taxonomically; in the family Leptophlebiidae there are usually two transverse rows of setae, one close to the anterior margin (*frontal setal fringe*) and the other (*secondary setal fringe*) either located a little posterior to the frontal fringe or set back as far as midlength of the labrum. The paired *mandibles* are heavily sclerotised, and each has two (occasionally one) apical *incisors*, a broad sub-apical *molar surface*, and usually a *prosthema* located between the two areas. Posterior to the mandibles are a pair of *maxillae*, each consisting of a basal *cardo*, a *stipes* and apically a fused *galea-lacinia* bearing setae and spines of variable structure and arrangement. A *maxillary palp* of two, three or multiple segments is attached distally to the stipes, although this is rudimentary in the Family Ephemerellidae. The *hypopharynx* is located between the maxillae, near the base of the labium, and consists of a *lingua* and a *superlingua*. The most posterior structure is the *labium*, which is dorso-ventrally flattened, and consists of a basal submentum and mentum, a distal plate-like structure formed from an inner pair of *glossae* and an outer pair of *paraglossae*, and two, three or multi-segmented *labial palps*.

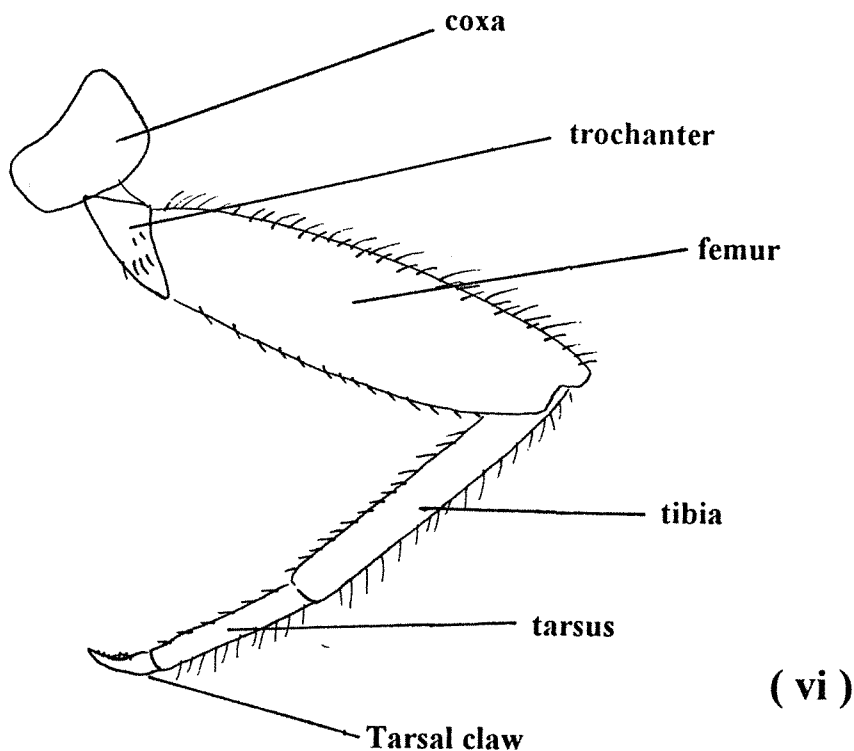


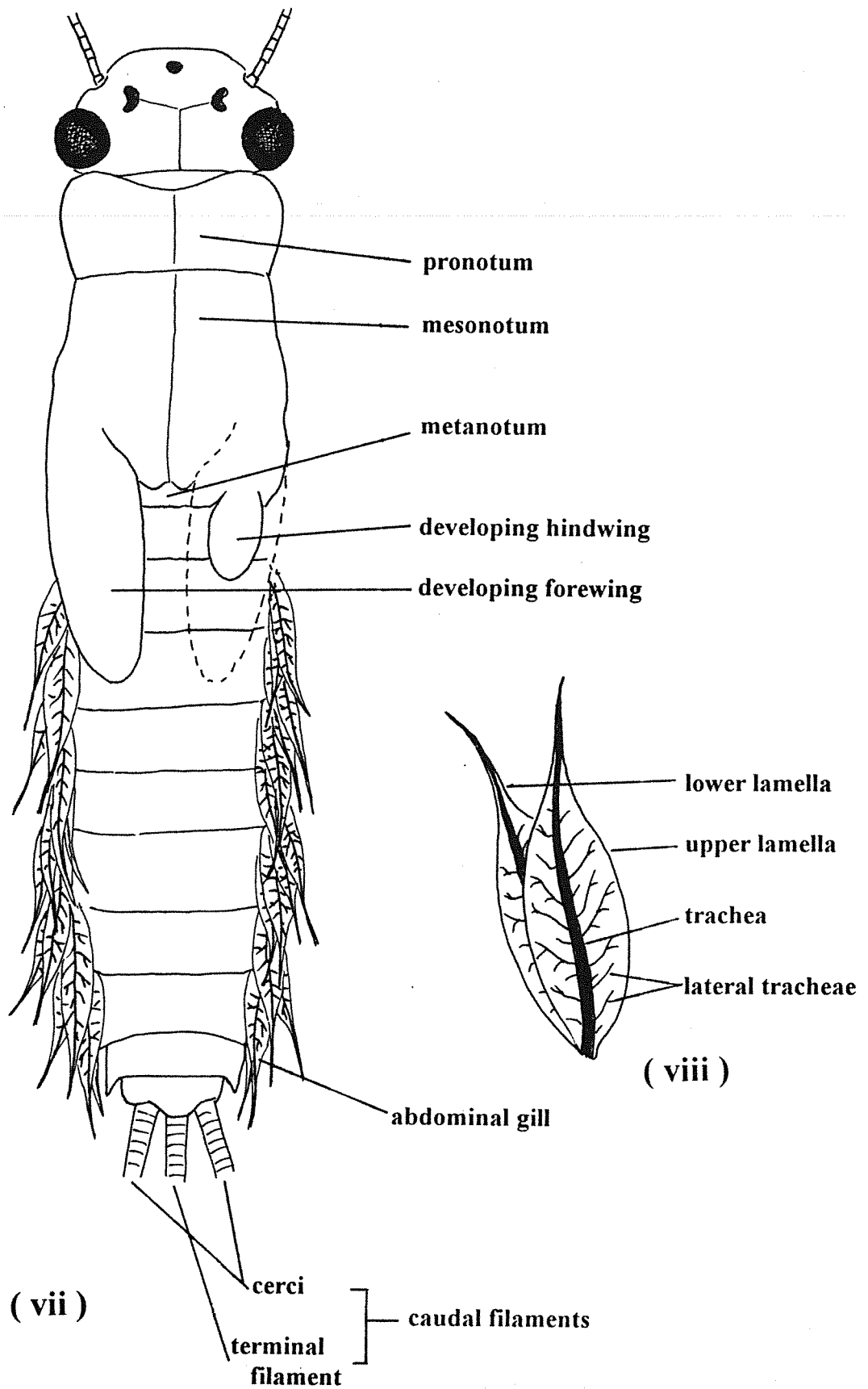
(iv)



(v)

Thorax and Abdomen (Fig vii). The thorax consists of three distinct segments, the *prothorax*, the *mesothorax* and the *metathorax*. Each thoracic segment bears a pair of legs, while the mesothorax bears the *developing forewings* and the metathorax bears the *developing hindwings*. In dorsal view the *pronotum* is usually separated from the more posterior segments by an ecdysial line, while the *mesonotum* comes to almost conceal the *metanotum* as the forewing pads develop. In the family Prosopistomatidae the mesonotum is expanded to form a carapace which covers the entire thorax and the anterior segments of the abdomen. The legs (Fig vi) are typically six-segmented, consisting of the *coxa*, *trochanter*, *femur*, *tibia*, *tarsus* and *tarsal claw*. In the genus *Mirawara* the tarsus is secondarily divided into four segments. The abdomen consists of ten segments, each divided into a dorsal *tergite* and a ventral *sternite*. The postero-lateral angles of the tergites of some segments are often produced into strong backwardly-directed spines, while there may also be dorsal spines or protruberences on some segments. Lateral *gills* are usually present on abdominal segments one to seven, although in some families these are secondarily lost from one or more segments. The gills are extremely diverse in structure, and of considerable taxonomic value. In many species the gills consist of an *upper lamella* and a *lower lamella*, each lamella with a central *trachea* and sometimes also strongly developed and branched *lateral tracheae* (Fig viii). The tracheae may be continued into one or more digitate processes which extend beyond the margin of the gill. There are diverse variations from this basic structure, including the reduction of the gills to a single lamella, the development of a tuft of branched fibrils on each gill and the development of sclerotised supporting struts on the lamellae. In the families Caenidae and Oniscigastridae one pair of gills is enlarged and sclerotised, forming *operculate gills* which overlay and protect the more posterior abdominal gills. The abdomen terminates in three multisegmented *caudal filaments*, consisting of a medial *terminal filament* and two lateral *cerci*. The caudal filaments range in length from shorter than the abdomen to more than twice the total body length, and in some families possess dense setal fringes.





KEY TO FAMILIES OF AUSTRALIAN MAYFLY NYMPHS

- 1 Nymph oval in dorsal view, upper surface strongly convex, carapace enclosing thorax and anterior segments of abdomen (Fig 9.1) **PROSOPISTOMATIDAE**
- Nymph not as above 2
- 2 Abdomen with operculate gills present on segment 1 or 2, covering more posterior gills (Figs 3.1, 8.1) 3
- Abdomen without operculate gills, all abdominal gills exposed (Figs 1.1, 4.1, 5.1, 6.11, 6.31, 7.1) 4
- 3 Operculate gills present on abdominal segment two, each gill with inner margin relatively straight, lying close to median line (Fig 8.1) ; gills present on abdominal segments 1 to 6 **CAENIDAE**
- Operculate gills present on abdominal segment one, each gill with inner margin strongly curved, not lying close to median line (Fig 3.1); gills present on abdominal segments 1 to 4 **ONISCIGASTRIDAE**
- 4 Abdominal gills present on segments 2 to 6 ; each abdominal segment with a pair of strong, backwardly directed, dorsal spines near posterior margin (Fig 7.1) **EPHEMERELLIDAE**
- Abdominal gills usually present on segments 1-7 or 2-7, never on segments 2 to 6 ; abdominal segments either without dorsal spines or projections, or with a single row only (Fig 6.11) 5
- 5 Abdominal gills with upper lamellae bifid, sclerotised and heavily spinose, lower lamellae fibrilliform (Figs 5.1, 5.2) **COLOBURISCIDAE**
- Abdominal gills with upper lamellae usually plate-like, never bifid or spinose, lower lamellae plate-like, fibrilliform or absent 6

- 6 Abdominal gills with upper lamellae plate-like, lower lamellae fibrilliform (Fig 4.4) ;
maxilla with four long, needle-like apical spines (Fig 4.3) **AMELETOPSIDAE**
- Abdominal gills not as above (Figs 1.3, 6.20, 6.36) ; maxilla without long apical spines
..... 7
- 7 Antennae very short, no longer than half length of head (Figs 1.1, 1.2) ; abdominal gills
consisting of single plate-like lamella with sclerotised support struts (Fig 1.3)
..... **SIPHONURIDAE**
- Antennae clearly longer than head (Figs 2.9, 6.37, 6.52) ; abdominal gills either with
both upper and lower lamellae or, if with a single lamella, without sclerotised support
struts 8
- 8 Terminal filament either with dense fringe of setae along both margins (Fig 2.15), or
reduced to short 6-segmented appendage (Figs 2.1, 2.2) ; all abdominal segments
without strongly developed postero-lateral spines, although short multiple spines may
be present on some segments (Fig 2.8) **BAETIDAE**
- Terminal filament with whorl of setae at apex of each segment, never with dense
fringe of setae along margins (Figs 6.16, 6.42) ; postero-lateral spines strongly
developed, at least on abdominal segments 7 to 9 (Figs 6.7, 6.24, 6.40)
..... **LEPTOPHLEBIDAE**

1 SIPHLONURIDAE

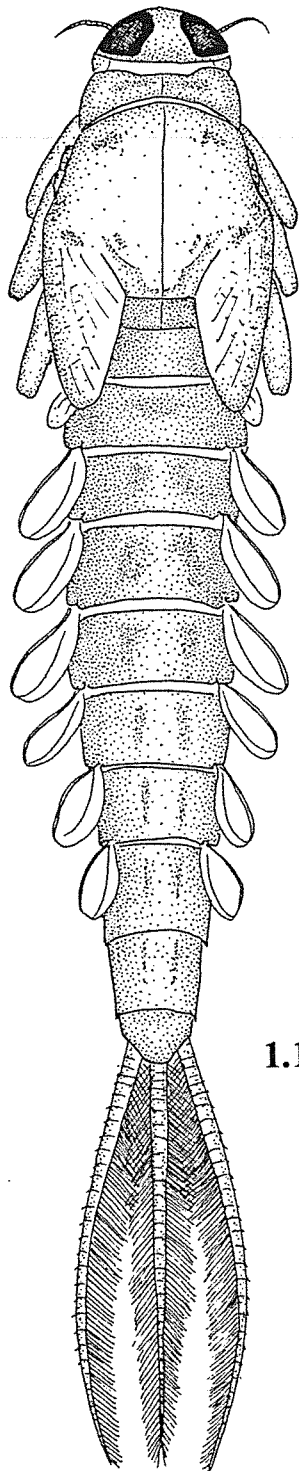
Nymphs moderately large, body length to about 15 mm. Head hypognathous ; antennae short, about half width of head ; clypeus and frons separated by distinct suture. Legs set close together, held ventral to the thorax. Abdomen long, tapering to posterior, somewhat rounded in cross section. Gills present on abdominal segments 1 to 7 ; each gill consisting of a single oval lamella, outer margin strengthened by heavily sclerotised band with series of small teeth along apical third, with additional sclerotised strut traversing the middle of the lamella, branched tracheae present but usually somewhat inconspicuous. Cerci with dense setal fringe along inner margin, terminal filament with dense fringe on both margins.

The single Australian genus is widespread in small, cool, high altitude streams in south-eastern Australia, and also occurs in some of the lakes of the Kosciusko region. It has been recorded from forest streams below the tree line, and downstream penetration may be limited by exposure to introduced trout. Information on diet and life history has been provided by Campbell (1985, 1986).

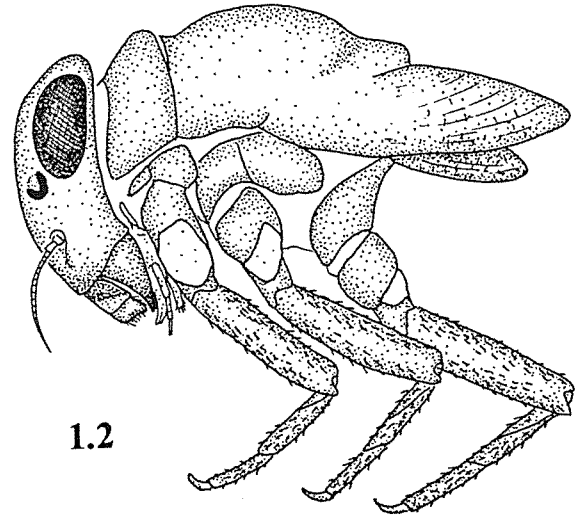
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Ameletoides Tillyard, 1933

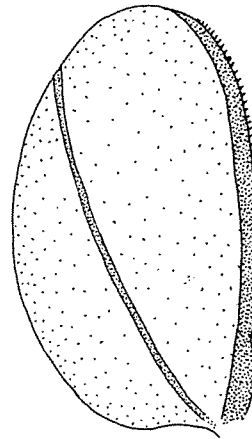
NSW, Victoria, Tasmania



1.1



1.2



1.3

Family Siphonuridae

Ameletoides sp. 1.1 whole nymph ; 1.2 head and thorax, lateral ;
1.3 abdominal gill 3.

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2 BAETIDAE

Body streamlined, small to moderate sized mayflies, body length usually less than 10mm. Head hypognathous (although there is one genus which has a prognathous head); antennae longer than width of head, usually as long as head and thorax combined. Thorax usually strongly humped, oval to circular in cross-section (dorso-ventrally flattened in one genus), hindwing pads present or absent. Abdomen without posterolateral spines; gills plate-like on segments 1-7 or 2-7. Caudal filaments usually fringed with setae, terminal filament with setal fringe on both lateral margins, cerci with inner margin only fringed.

The Baetidae occur in all States and Territories and have representatives in almost all freshwater habitats. The genera *Cloeon*, and *Centroptilum* occur in depositional zones, in macrophyte beds or still waters in rivers and in wetlands. *Bungona* also appears to occur in depositional zones in rivers, but to date has not been recorded from wetlands. All the other genera tend to occur in moving waters in the riffle habitat.

Unlike most of the Baetidae the genus *Platybaetis* from the Northern Territory is dorso-ventrally flattened and lacks fringed caudal filaments although its adult is clearly a member of the Baetidae (Suter 1992).

The current study recognises five genera that have previously been referred to *Baetis* and *Pseudocloeon*, and these are included in the key as baetid genera 1 to 5.

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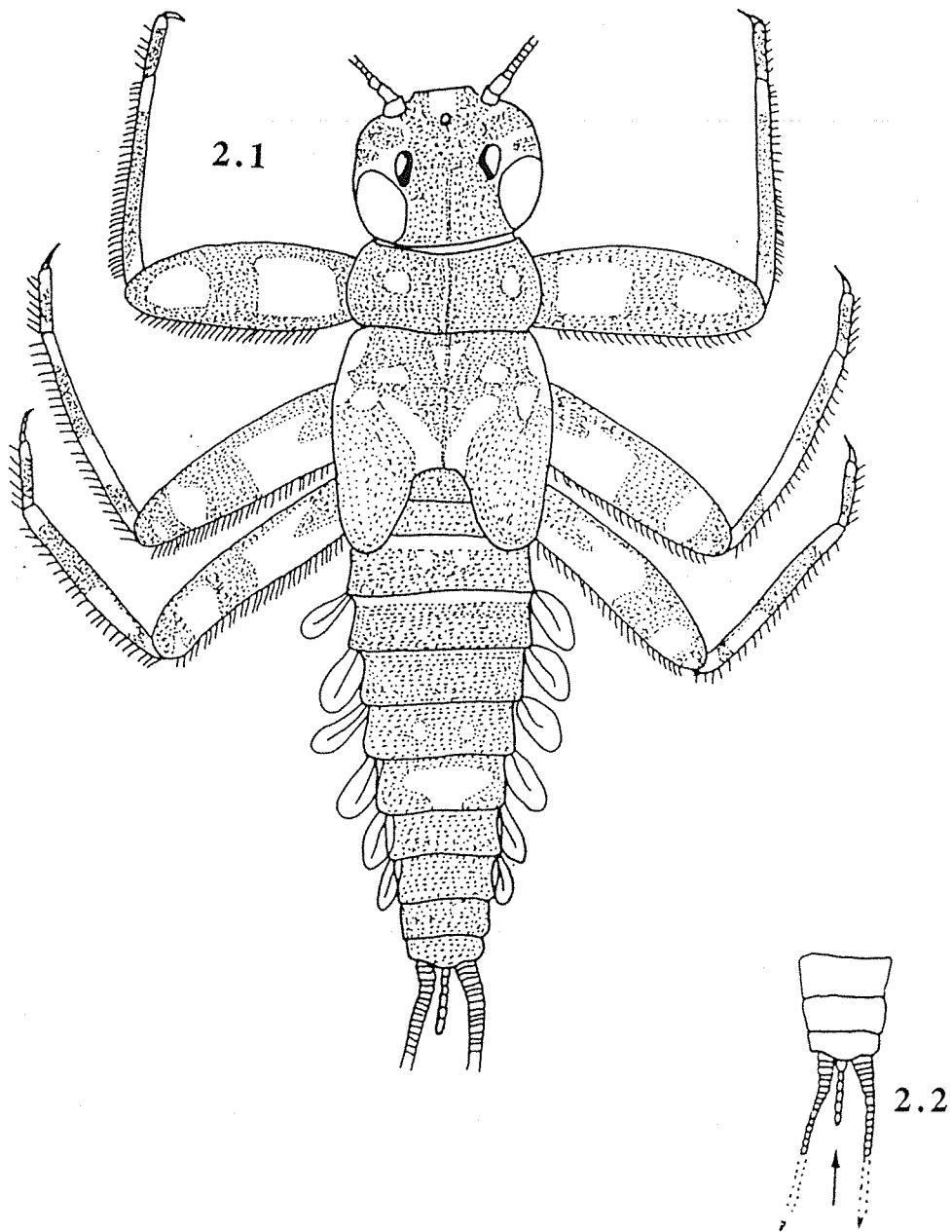
<i>Cloeon</i> Leach 1815	All Australian States and Territories
<i>Centroptilum</i> Eaton 1869	NT, Vic, Tas, Sth Aust.
<i>Platybaetis</i> Müller-Liebenau 1980	NT
<i>Bungona</i> Harker 1957	Q'land, NSW, Vic, Tas.
<i>Baetis</i> Leach 1815 (Baetid Genera 1, 2 and 4)	Described from but not represented in Australia
<i>Pseudocloeon</i> Klapalek 1905 (Baetid Genera 3 and 5)	Described from but not represented in Australia

KEY TO THE GENERA OF LATE INSTAR NYMPHS

1. Body dorso-ventrally flattened (Fig 2.1); head prognathous; gills on segments 2-7; cerci and terminal filament lacking long setae on margins (Fig 2.2) *Platybaetis*
 [Distribution: NT]

Diagnosis: Body dorso-ventrally flattened; head prognathous; mesothoracic wingpads absent; tarsal claws robust with 6-9 large teeth; gills single, plate-like on segments 2-7; caudal filaments not fringed, segments with whorls of short setae, terminal filament shorter than cerci with only 6 segments.

- Body (thorax) with oval to circular cross-section; head hypognathous (Fig 2.18, 2.31): gills on abdominal segments 1-7 (Fig 2.9); inner margins of cerci and both sides of terminal filaments fringed with setae (Fig 2.21) 2
- 2 Tarsal claws long and slender >1/3 length of tarsus (Fig 2.7, 2.13); claws lacking robust teeth but may possess two rows of fine denticles; postero-lateral margin of abdominal segments with numerous spines (Fig 2.8) 3
- Tarsal claws short <1/3 length of tarsus (Figs 2.17, 2.26, 2.27, 2.32); claws with one row of robust teeth (Fig 2.28, 2.33) or lacking robust teeth (Fig 2.26); postero-lateral margins of abdominal segments lacking spines (Fig 2.40) 4



Family Baetidae
Platybaetis sp. 2.1 whole nymph; 2.2 terminal filaments.

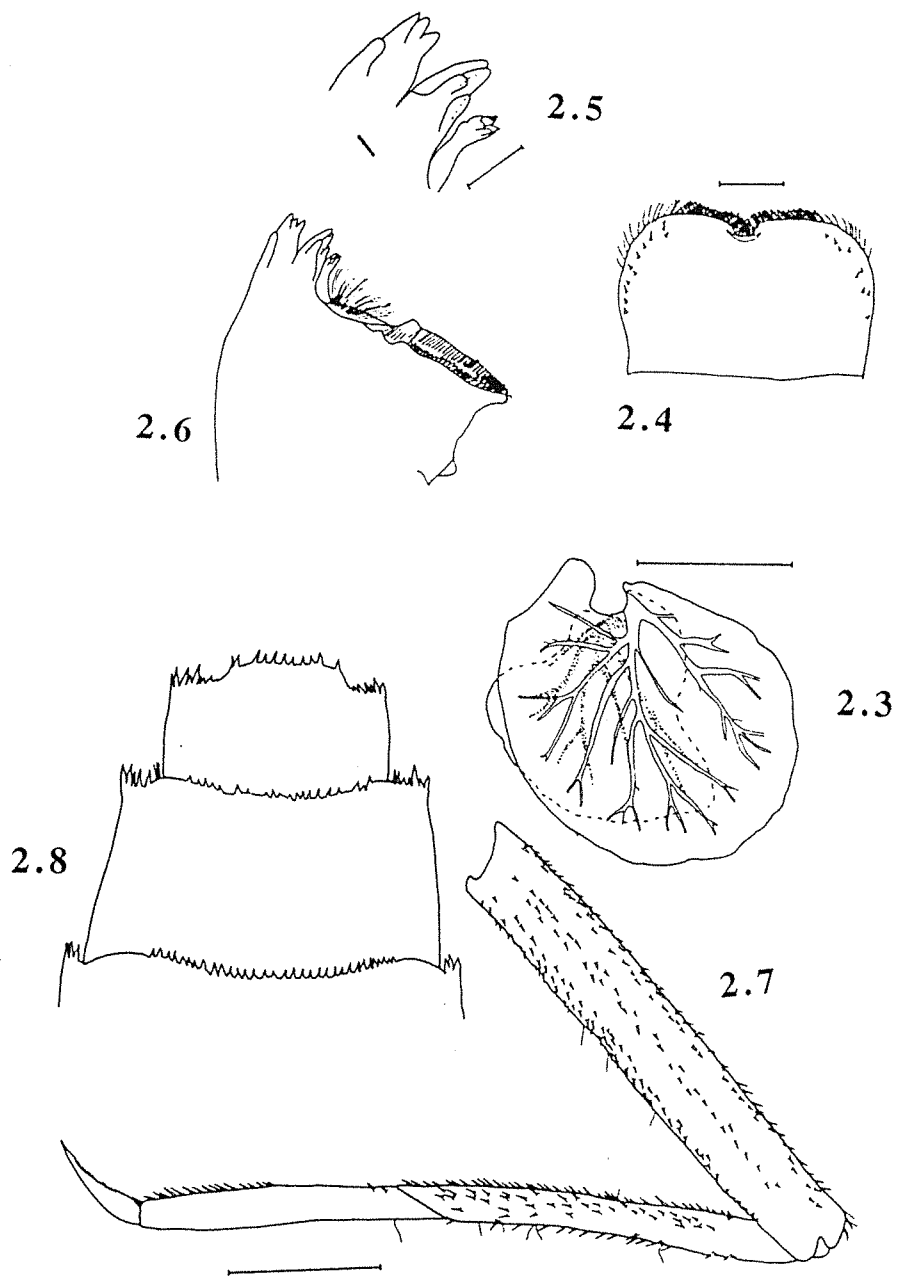
- 3 Gill lamellae double (Fig 2.3); hind wing pads absent (Fig 2.18); labrum with small central concavity (Fig 2.4); incisors of mandibles partially fused and toothed (Figs 2.5, 2.6) *Cloeon*
 [Distribution: all Australian states and territories]

Diagnosis: Head hypognathous; labrum oval with a shallow median notch; incisors of mandibles partially fused and toothed. Thorax oval to circular in cross-section; tarsal claws long and narrow, approximately half length of tarsus, with or without very fine bristles. Hind wing pads absent. Gills double, each lamella plate-like, on abdominal segments 1-7. Three caudal filaments present; terminal filament shorter than cerci and fringed on lateral margins; cerci fringed on inner margin.

- Gill lamellae single (Fig 2.14); hind wing pads present (Fig 2.31); labrum with deeply incised V-shaped notch (Fig 2.10); incisors of mandibles separate and toothed (Figs 2.11, 2.12) *Centropilum*
 [Distribution: NT, Vic, Tas, Sth Aust, SW Aust]

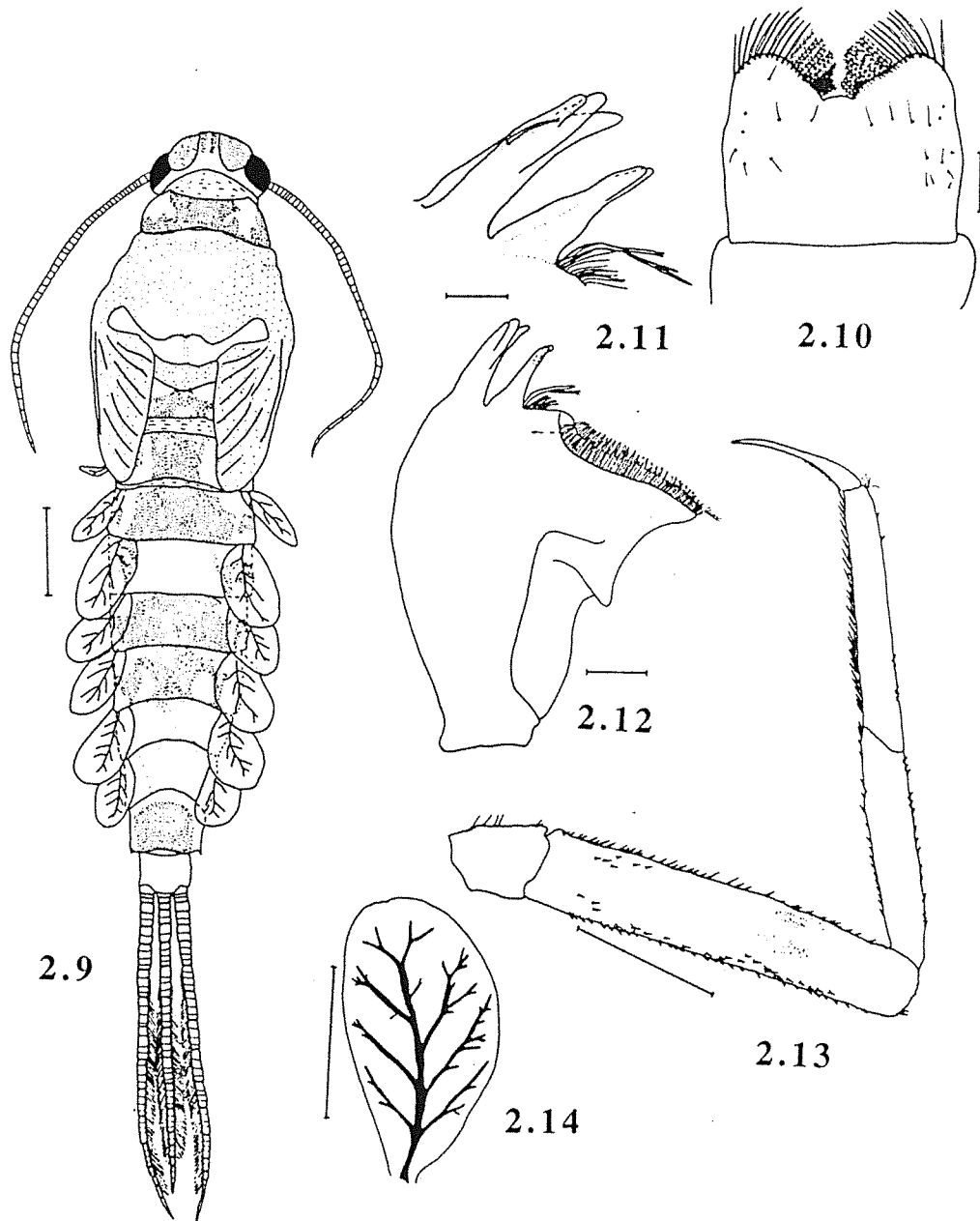
Diagnosis: Head hypognathous; labrum broad, square with a wide deep V-shaped median notch; incisors of mandibles separate and toothed. Thorax oval to circular in cross-section; tarsal claws long and narrow, approximately half length of tarsus, with or without very fine bristles. Hind wing pads present. Gills single, plate-like, on abdominal segments 1-7. Three caudal filaments present; terminal filament shorter than cerci and fringed on lateral margins; cerci fringed on inner margin.

- 4 Length of tarsus approximately equal to tibial length (Figs 2.26, 2.27, 2.32); caudal filaments not banded; terminal filament slightly shorter than cerci (Fig 2.21); ventral femoral patch on fore femora absent; metathorax with or without developing wing pads (Figs 2.18, 2.31) 6
- Length of tarsus much shorter than tibial length, approximately half to two thirds length (Fig 2.17); caudal filaments banded or not banded; metathorax without developing wing pads (Fig 2.18) 5



Family Baetidae

Cloeon sp. 2.3 abdominal gill; 2.4 labrum; 2.5 incisors and prostheca of right mandible; 2.6 right mandible; 2.7 foreleg and tarsal claw; 2.8 abdominal segments showing posterior spines.



Family Baetidae

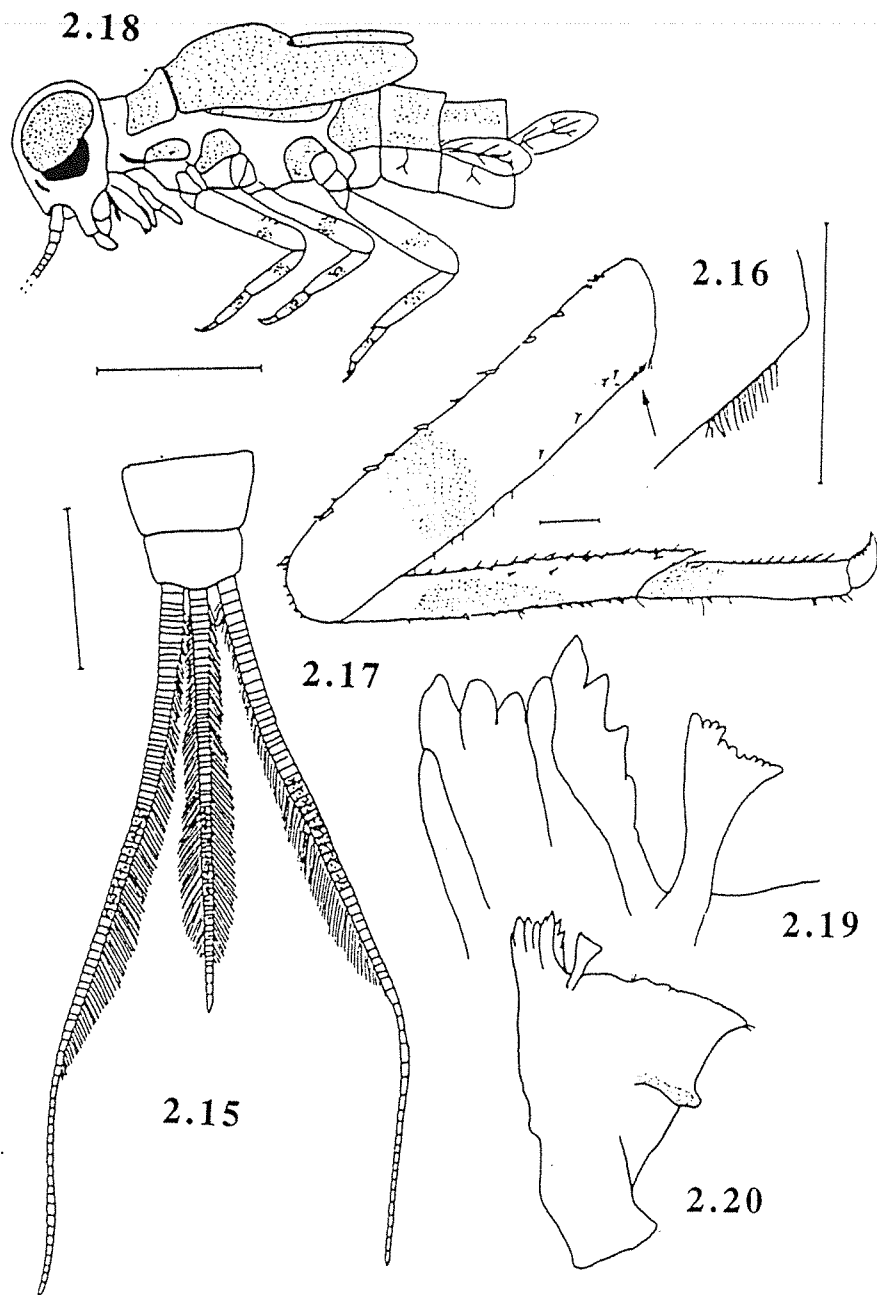
Centroptilum sp. 2.9 whole nymph; 2.10 labrum; 2.11 incisors and prostheca of right mandible; 2.12 right mandible; 2.13 foreleg and tarsal claw; 2.14 abdominal gill.

- 5 Terminal filament much shorter than cerci (Fig 2.15); ventral femoral patch present on fore femora (Fig 2.16); apex of tibiae with a clump of fine hairs; prostheca of right mandible robust and broad apically (Fig 2.20); mandibles with toothed outer incisors (Fig 2.19) **Baetid Genus 3**
 [Distribution: NT, Q'land]

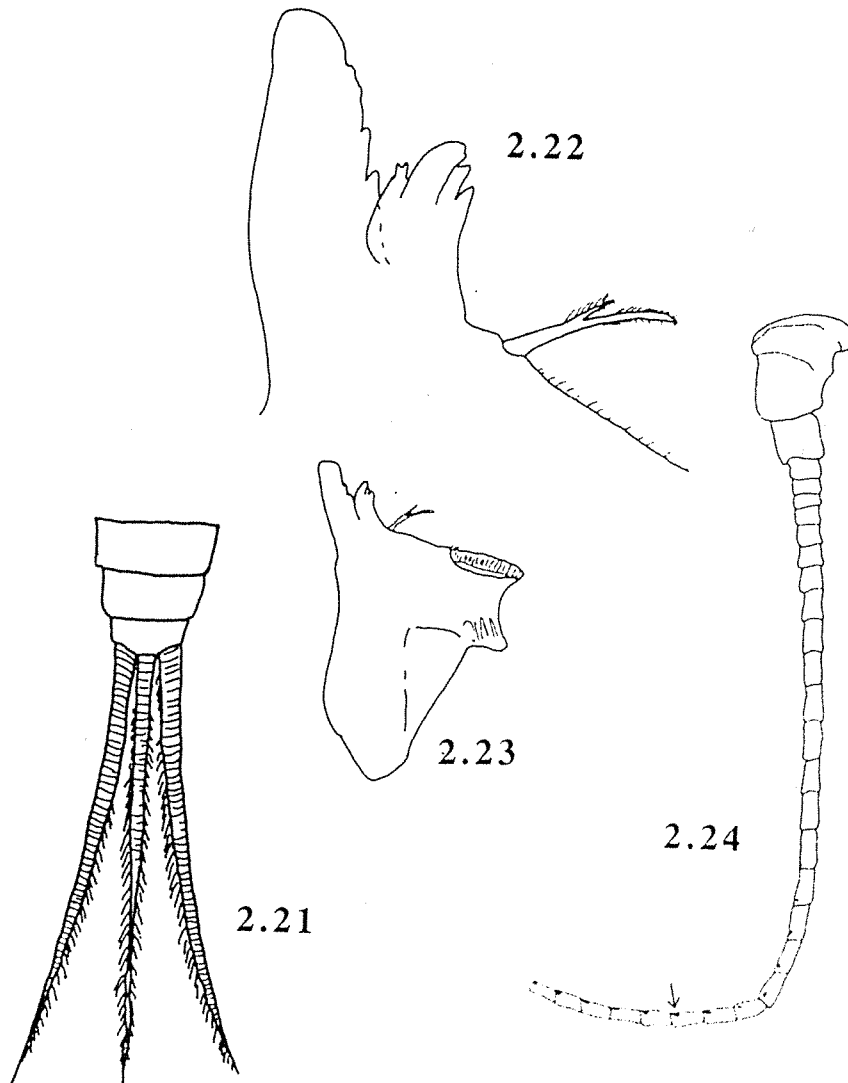
Diagnosis: Head hypognathous. Antennal filament without markings. Labrum oval, with a shallow median notch; incisors of mandibles fused and toothed; inner incisors with bristles present; prostheca of right mandible broad and triangular; margin between incisors and molars serrated, tubercle absent; mesal margin of second segment of labial palp strongly developed. Thorax oval to circular in cross-section. Ventral femoral patch present. Femora lacking fringe of long blunt setae. Tibiae without an oblique row of long fine setae; tarsi without long fine setae on outer margin. Tarsus of legs shorter (1/2 -2/3 length) than tibiae; tarsal claws short less than half length of tarsus with obvious teeth; subapical bristle absent. Hind wing pads absent. Gills single, plate-like, on abdominal segments 1-7. Three caudal filaments present; terminal filament shorter than cerci and fringed on lateral margins; cerci fringed on inner margin.

- Terminal filament shorter than cerci, but not greatly so (Fig 2.21); ventral femoral patch absent; apex of tibiae lacking clump of fine hairs; prostheca of right mandible slender and usually bifid (Fig 2.22); mandibles with shearing outer incisors (Fig 2.23) **Baetid Genus 5**
 [Distribution: Nth Q'land]

Diagnosis: Head hypognathous. Antennae with dark patches on filament segments 16-apex (Fig 2.24). Labrum oval, with a shallow median notch; incisors of mandibles fused and with a shearing surface; inner incisors without bristles; prostheca of right mandible slender and bifid or single and robust; margin between incisors and molars smooth, tubercle absent; mesal margin of second segment of labial palp strongly developed. Thorax oval to circular in cross-section. Ventral femoral patch absent. Femora lacking fringe of long blunt setae. Tibiae without an oblique row of long fine setae; tarsi without long fine setae on outer margin. Tarsus of legs shorter (1/2 -2/3 length) than tibiae; tarsal claws short less than half length of tarsus with obvious teeth; subapical bristle present. Hind wing pads absent. Gills single, plate-like, on abdominal segments 1-7. Three caudal filaments present; terminal filament shorter than cerci and fringed on lateral margins; cerci fringed on inner margin.



Family Baetidae
 Baetid Genus 3 2.15 terminal filaments; 2.16 femoral patch on foreleg;
 2.17 foreleg; 2.18 lateral view of thorax; 2.19 incisors and prostheca of right
 mandible; 2.20 right mandible.

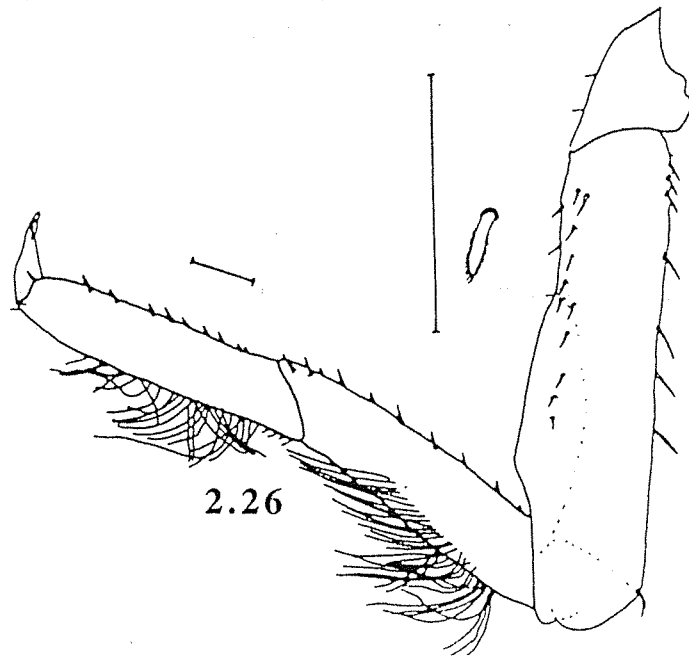
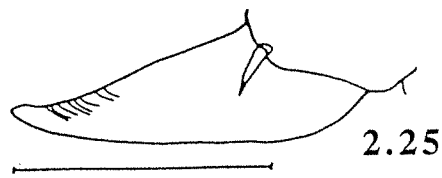


Family Baetidae
Baetid Genus 5 2.21 terminal filaments; 2.22 incisors and prostheca of right mandible; 2.23 right mandible; 2.24 antennal segments.

- 6 Tibiae of legs with an oblique line of long fine setae on basal 1/3, setal length approx 3/4 of tibial length (Fig 2.26); outer margin of tarsi with long fine setae; tarsal claws short, lacking teeth (Fig 2.25); metathorax without developing wing pads (Fig 2.18); outer margin of femora with few long setae, apex of femora with a pair of distinct sharp setae (Fig 2.26) *Bungona*
 [Distribution: Q'land, NSW, Vic, Tas]

Diagnosis: Head hypognathous. Antennae without dark patches on filament segments 16-apex. Labrum almost square, with a shallow median notch; incisors of mandibles partially fused and toothed; inner incisors without bristles; prostheca of right mandible robust and bifid; margin between incisors and molars serrated, tubercle absent; mesal margin of second segment of labial palp not developed. Thorax oval to circular in cross-section. Ventral femoral patch absent. Femora lacking fringe of long blunt setae. Tibiae with an oblique row of long fine setae on basal 1/3, setal length approximately 3/4 of tibial length; tarsi with long fine setae on outer margin. Tarsus of legs approximately equal to length of tibiae; tarsal claws very short less than a quarter length of tarsus without obvious teeth; subapical bristle absent. Hind wing pads absent. Gills single, plate-like, on abdominal segments 1-7. Three caudal filaments present; terminal filament shorter than cerci and fringed on lateral margins; cerci fringed on inner margin.

- Tibiae of legs lacking long fine setal row; tarsi lacking long fine setae (Figs 2.27, 2.32); tarsal claws long, with robust teeth (Figs 2.28, 2.33); metathorax with developing wing pads (Fig 2.31) "Baetis" 7

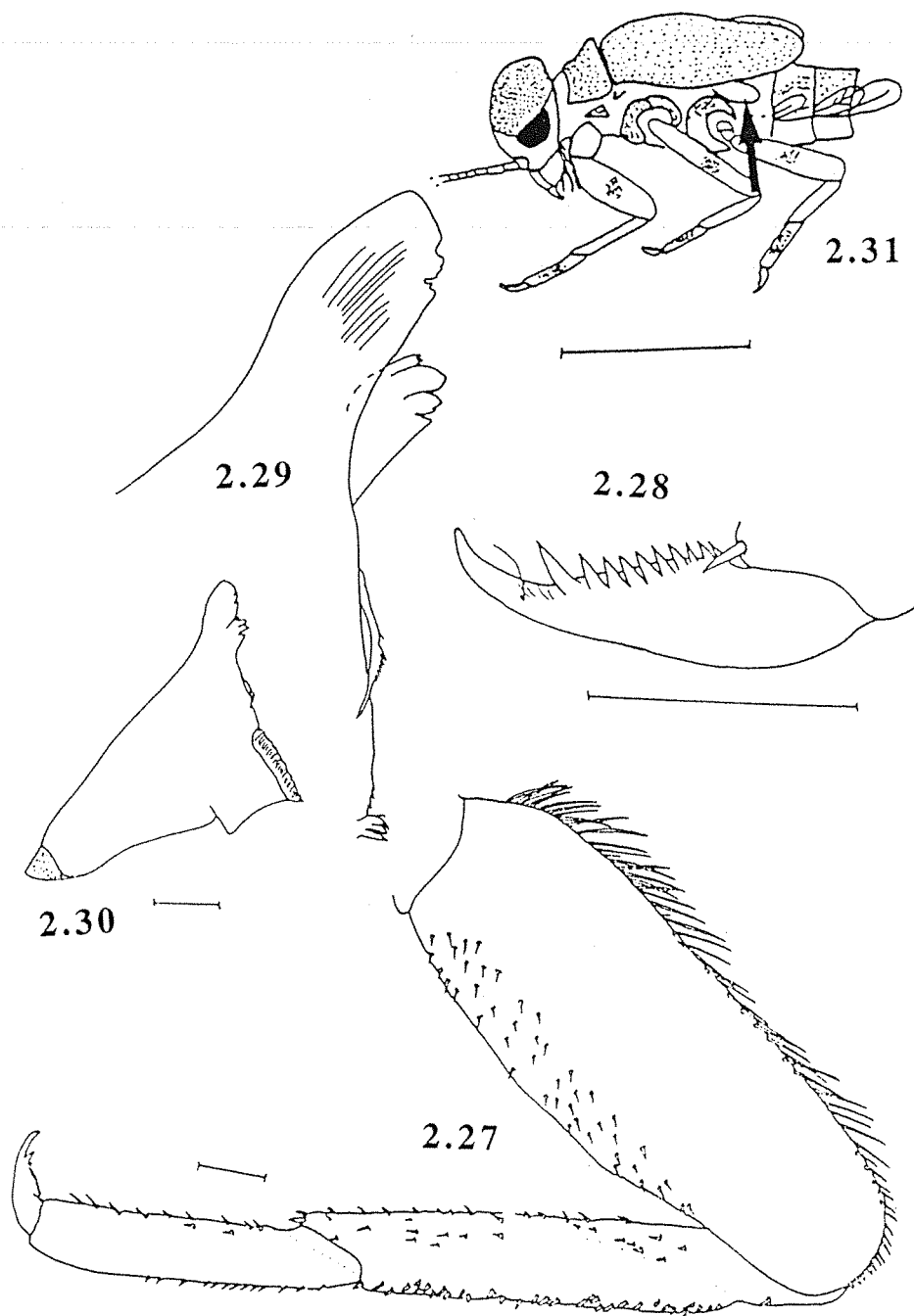


Family Baetidae
Bungona sp. 2.25 fore tarsal claw; 2.26 foreleg.

- 7 Fringe of long, blunt setae on at least the femora (Fig 2.27), usually >30 but may be <10; tarsal claws with a subapical setule (Fig 2.28) **Baetid Genus 2**
 [Distribution: NSW, Vic, Tas]

Diagnosis: Head hypognathous. Antennae without dark patches on filament. Labrum ovoid with a shallow median notch; incisors of mandibles fused and with a shearing surface (Fig 2.30); inner incisors without bristles; prosthema of right mandible slender and bifid (Fig 2.29); margin between incisors and molars serrated, tubercle absent; mesal margin of second segment of labial palp not developed. Thorax oval to circular in cross-section. Ventral femoral patch absent. Femora usually with dense fringe of long blunt setae. Tibiae without an oblique row of long fine setae; tarsi without long fine setae on outer margin. Tarsus of legs long equal length to tibiae; tarsal claws short less than half length of tarsus with obvious teeth; subapical bristle present. Hind wing pads present. Gills single, plate-like, on abdominal segments 1-7. Three caudal filaments present; terminal filament shorter than cerci and fringed on lateral margins; cerci fringed on inner margin.

- All leg segments lacking fringe of long blunt setae although may have long spine setae (Fig 2.32); tarsal claws usually lacking subapical setule (Fig 2.33) 8



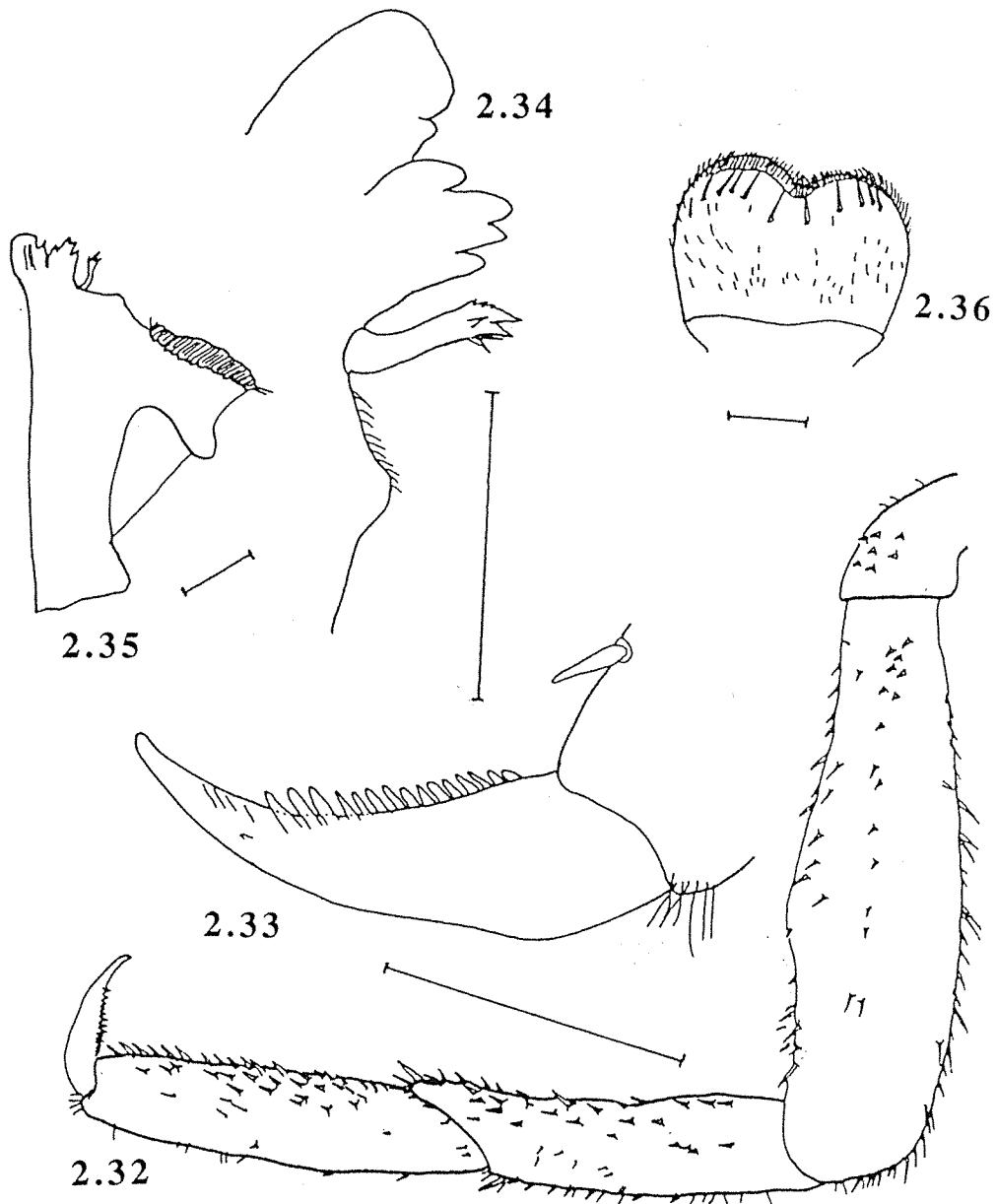
Family Baetidae
 Baetid Genus 2 2.27 foreleg; 2.28 fore tarsal claw; 2.29 incisors and prosthema of right mandible; 2.30 right mandible; 2.31 lateral view of thorax showing hind wing pad.

- 8 Right mandible with distinct tubercle between incisors and molars (Fig 2.35);
 prosthaca robust and single (Fig 2.34) **Baetid Genus 1**
 [Distribution: NSW, Vic, Tas, SA, SW Aust]

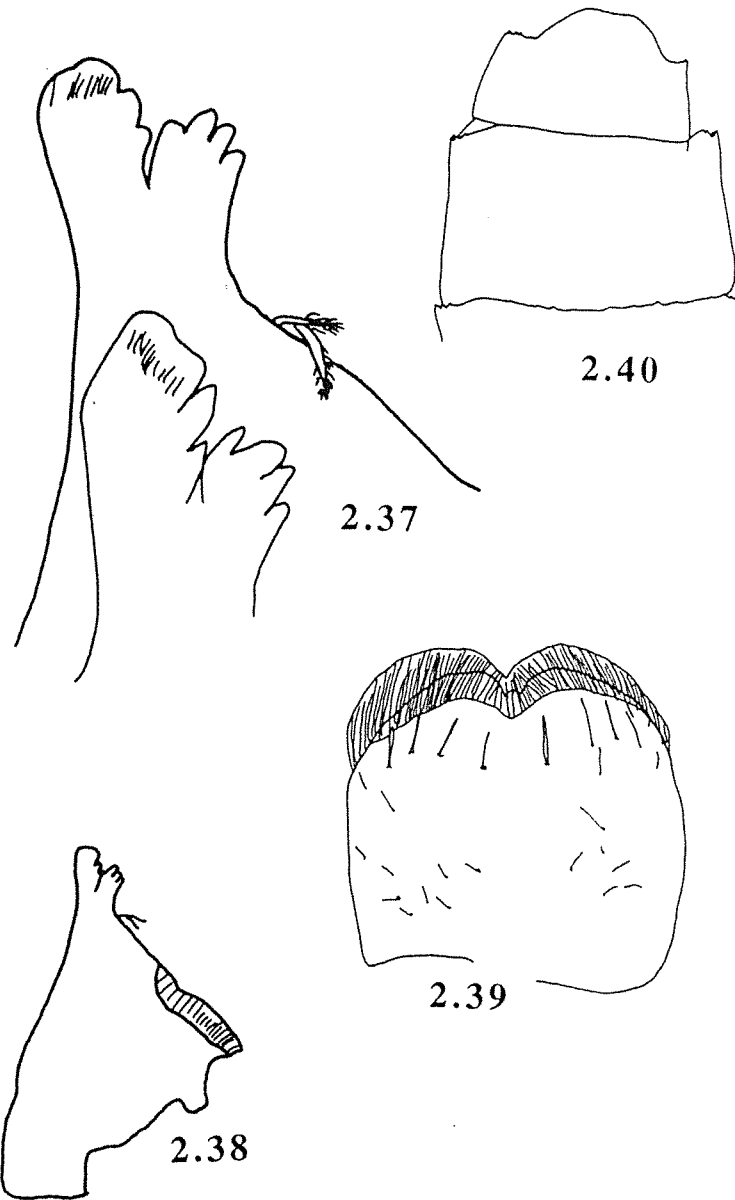
Diagnosis: Head hypognathous. Antennae without dark patches on filament. Labrum ovoid with a shallow median notch (Fig 2.36); incisors of mandibles fused and with a shearing surface; inner incisors without bristles; prosthaca of right mandible robust and single; margin between incisors and molars smooth, tubercle present; mesal margin of second segment of labial palp moderately developed. Thorax oval to circular in cross-section. Ventral femoral patch absent. Femora lacking fringe of long blunt setae. Tibiae without an oblique row of long fine setae; tarsi without long fine setae on outer margin. Tarsus of legs long equal length to tibiae; tarsal claws short less than half length of tarsus with obvious teeth; subapical bristle absent. Hind wing pads present. Gills single, plate-like, on abdominal segments 1-7. Three caudal filaments present; terminal filament shorter than cerci and fringed on lateral margins; cerci fringed on inner margin.

- Right mandible lacking tubercle between incisors and molar region (Fig 2.38);
 prosthaca slender and bifid (Fig 2.37) **Baetid Genus 4**
 [Distribution: Nth Q'land]

Diagnosis: Head hypognathous. Antennae with or without dark patches on filament segments 16-apex. Labrum almost square with a shallow median notch (Fig 2.39); incisors of mandibles fused and with a shearing surface; inner incisors without bristles; prosthaca of right mandible slender and bifid; margin between incisors and molars smooth, tubercle absent; mesal margin of second segment of labial palp strongly developed. Thorax oval to circular in cross-section. Ventral femoral patch absent. Femora lacking fringe of long blunt setae. Tibiae without an oblique row of long fine setae; tarsi without long fine setae on outer margin. Tarsus of legs long equal length to tibiae; tarsal claws short less than half length of tarsus with obvious teeth; subapical bristle present or absent. Hind wing pads present. Gills single, plate-like, on abdominal segments 1-7. Three caudal filaments present; terminal filament shorter than cerci and fringed on lateral margins; cerci fringed on inner margin.



Family Baetidae
 Baetid Genus 1 2.32 foreleg; 2.33 fore tarsal claw; 2.34 incisors and prostheca of right mandible; 2.35 right mandible; 2.36 labrum.



Family Baetidae
Baetid Genus 4 2.37 incisors and prostheca of right mandible; 2.38 right mandible; 2.39 labrum; 2.40 abdominal segment lacking lateral spines.

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3 ONISCIGASTRIDAE

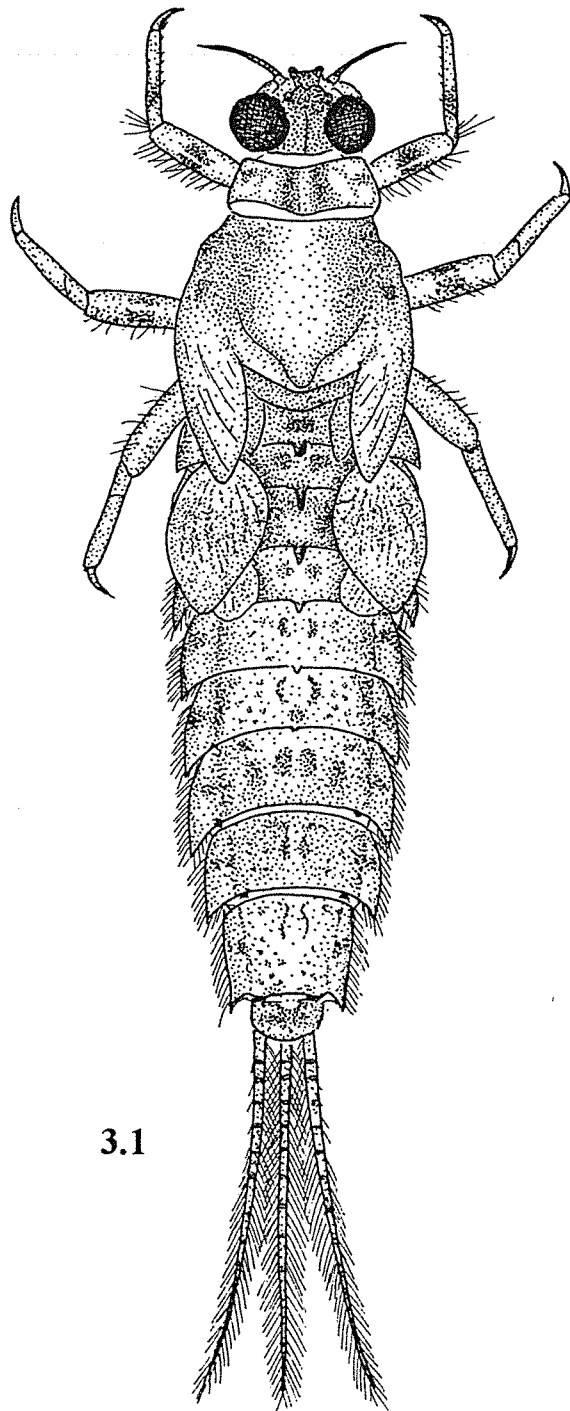
Nymphs moderate size, body length 12 - 15 mm. Head small, hypognathous, length of antenna a little less than width of head. Legs medium length, tibia shorter than tarsus, tarsal claws smooth. Abdomen dorso-ventrally flattened, segments 1 to 9 with flattened lateral flange and strongly projecting postero-lateral angle. First five (at least) abdominal segments with dorsal protuberances along midline. Gills present on abdominal segments 1 to 4, those on first segment operculate and covering the gills on segments 2 to 4. All gills with margins entire. Inner margins of operculate gills widely separated. All caudal filaments with lateral setal fringes, although setae on outer margins of cerci shorter and restricted to apical half.

Nymphs occur in standing waters and slower flowing reaches of rivers and streams, and have been recorded both from alpine sites in the Kosciusko National Park and from lowland sites near sea level. They are normally found on sandy substrates and will tolerate a small amount of silt. Prior to emergence the mature nymph crawls out of the water, and at peak times large numbers of cast skins can be found above the water line attached to the sides of boulders or large rocks. Campbell (1985) and Chessman (1986) have provided information on diet, while Campbell (1986) has reported on the life history of a species from Victoria.

CHECK LIST OF DESCRIBED AUSTRALIAN GENERA

Tasmanophlebia Tillyard, 1921

NSW, Victoria, Tasmania, Sth Aust



3.1

Family Oniscigastridae
Tasmanophlebia sp. 3.1 Whole nymph

4 AMELETOPSIDAE

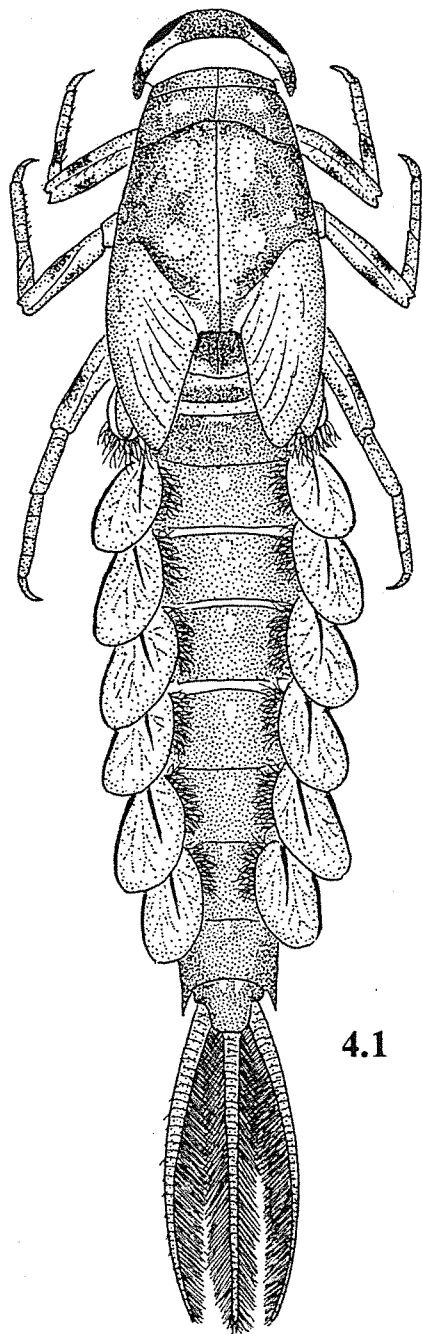
Nymphs large, body length to about 30 mm. Head flexible, prognathous / hypognathous, broad in frontal view with upper surface convex. Eyes flattened, contained within the profile of the upper surface of the head capsule. Length of antenna a little greater than width of head capsule. Mouth parts modified for predation; maxilla with four apical spines, long, curved, heavily sclerotised and needle-like. Legs of moderate length, tarsi divided into four segments, tarsal claws smooth. Abdomen oval in cross section. Gills present on abdominal segments one to seven, each gill consisting of an upper lamella and ventrally a dense basal tuft of branched fibrils. Lamella oval shaped, margin entire, with extensively branched system of tracheae; outer margin sclerotised, with a series of small spines in apical half, sclerotised strut running down the middle of lamella to about midlength. Inner margins of cerci and both sides of terminal filament bearing dense fringes of setae.

Nymphs occur in stony streams, and apparently bury into cobble substrates during the day and return to the surface at night to feed (Campbell, 1980). Information on feeding and life history has been reported by Campbell (1985, 1986).

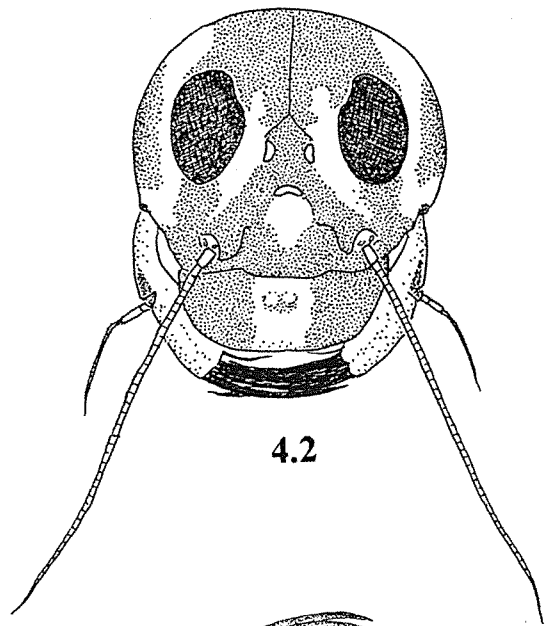
CHECK LIST OF DESCRIBED AUSTRALIAN GENERA

Mirawara Harker, 1954

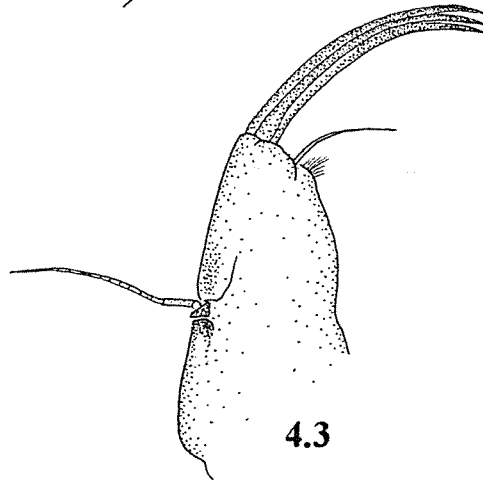
Nth Q'land, SE Q'land, NSW, Victoria



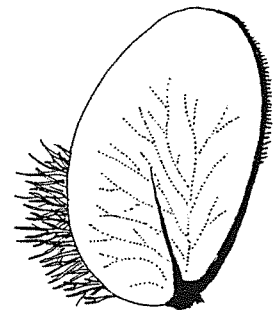
4.1



4.2



4.3



4.4

Family Ameletopsidae

Mirawara sp. 4.1 Whole nymph ; 4.2 Head, frontal view ; 4.3 Maxilla ;
4.4 Abdominal gill.

5 COLOBURISCIDAE

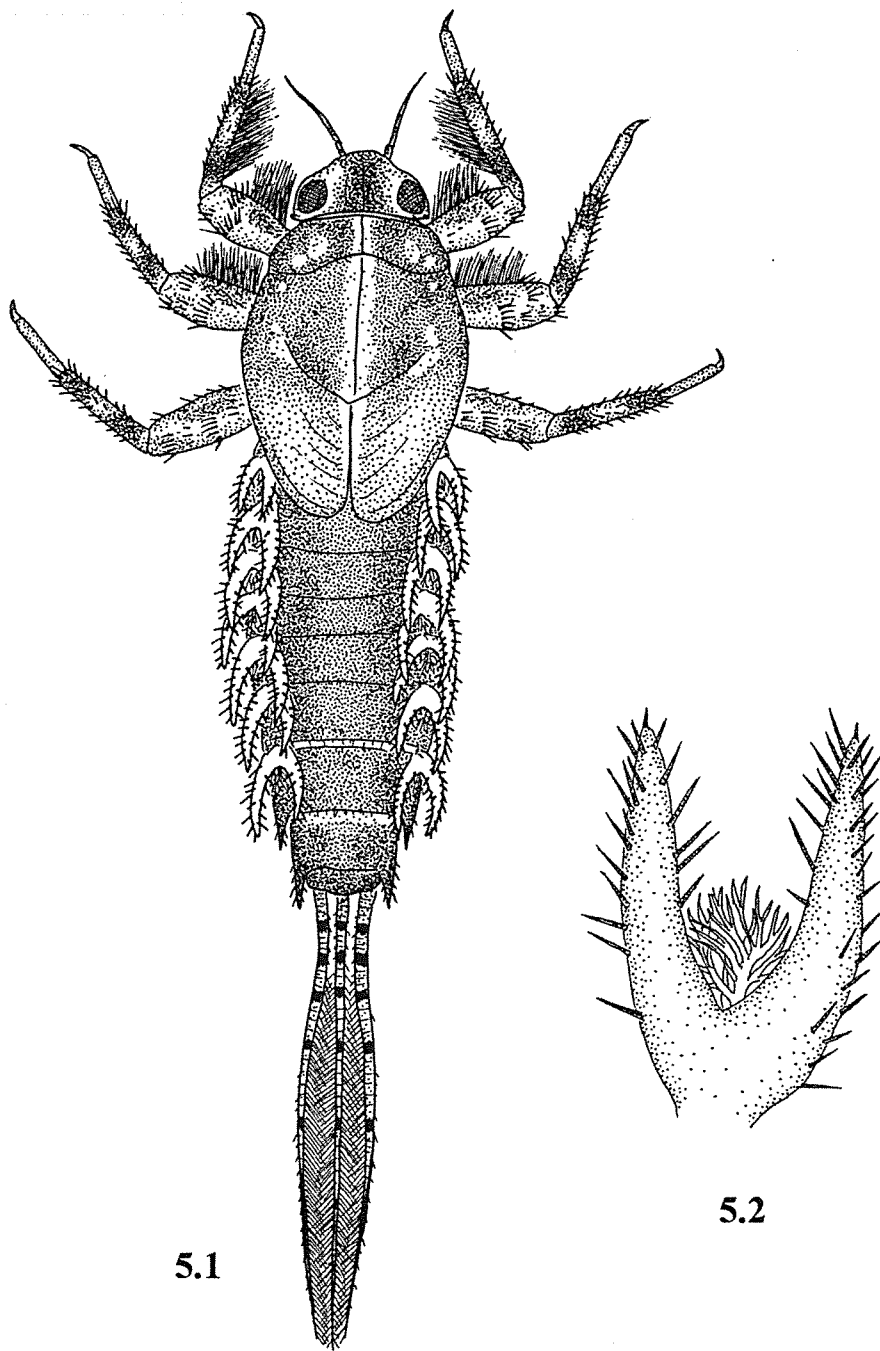
Nymphs medium to large, body length to about 20 mm. Head hypognathous, length of antennae approximately equal to width of head. Mouthparts prominent ; mandible, maxillary palp and labial palp all with brush of long setae, both maxillary palp and labial palp two segmented. Legs strongly spinose ; fore femur, fore tibia and middle femur each with dense fringe of long setae on anterior margin. Tarsal claws smooth. Gills on abdominal segments 1 to 7 ; each gill bifid , strongly spinose, with basal tuft of branched fibrils. Cerci with dense fringe of medium length setae on inner margin, scattered short setae on outer margin ; terminal filament with fringe of medium length setae on both margins.

Nymphs are restricted to fast currents, and are frequently found in quite torrential situations. They presumably avoid the fastest currents by an appropriate choice of microhabitat, and it has been reported that they can wedge between rocks using their rigid spinose gills. While they are usually found where the substrate is stony, they can also occur on submerged logs and woody material if the current is fast, and at least one species appears to prefer this substrate. Fringes of setae on the fore and midlegs are used to filter fine particles of food from suspension. Details of feeding and life-history have been provided by Campbell (1985,1986) and Chessman (1986).

CHECK LIST OF DESCRIBED AUSTRALIAN GENERA

Coloburiscoides Lestage, 1935

NSW, Victoria



5.1

5.2

Family Coloburiscidae

Coloburiscoides sp. 5.1 Whole nymph ; 5.2 Abdominal gill

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6 LEPTOPHLEBIIDAE

Small to medium size mayflies, body length ranging from about 5 mm to a little over 15 mm., of diverse morphology. Head prognathous, antennae longer than width of head. Thorax and abdomen dorso-ventrally flattened. Gills present on abdominal segments 1 to 7, each gill consisting of an upper and a lower lamella. Caudal filaments with a whorl of setae at apex of each segment, never with setal fringe.

The family Leptophlebiidae is distributed throughout Australia and is extremely diverse. Representatives having been collected from habitats as diverse as torrential alpine streams, lakes and reservoirs, meandering lowland rivers and artificial dams in semi-arid regions. Despite dominance of the Australian mayfly fauna, there have been relatively few ecological studies undertaken. Chessman (1986) has provided some information on diet, while Bailey (1981) has described the behaviour of a species of *Austrophlebioides*. Aspects of life-histories have been described by Brittain & Campbell (1991), Campbell & Holt (1984), Campbell et al (1990), Marchant et al (1983) and Suter & Bishop (1979, 1990).

With fifteen described genera and additional undescribed genera, this is the most diverse of the Australian Ephemeroptera families. Nymphs are known for all described genera with the exception of *Thraulophlebia*, which was established by Demoulin (1955) to accommodate a species from Queensland. The described adult appears very similar to adults of *Koornonga*, and the two genera may in fact be synonymous. Six undescribed genera are included in the key as Genus D, Genus K, Genus Q, Genus R, Genus S and Genus Z. It is, however, likely that additional undescribed genera are present in Australia.

CHECK LIST OF DESCRIBED AUSTRALIAN GENERA

<i>Atalomicria</i> Harker, 1954	Nth Q'land, SE Q'land, NSW, Victoria.
<i>Atalophlebia</i> Eaton, 1881	NT, Nth Q'land, SE Q'land, NSW, Victoria, Tasmania, Sth Aust.
<i>Austrophlebioides</i> Campbell & Suter, 1988	SE Q'land, NSW, Victoria, Tasmania.
<i>Bibulmena</i> Dean, 1987	SW Aust, NT.
<i>Garinjuga</i> Campbell & Suter, 1988	NSW, Victoria, Tasmania.
<i>Jappa</i> Harker, 1954	NW Aust, NT, Nth Q'land, SE Q'land, NSW, Vic.
<i>Kalbaybaria</i> Campbell, 1993	Nth Q'land
<i>Kirrara</i> Harker, 1954	NSW, Victoria.
<i>Koornonga</i> Campbell & Suter, 1988	SE Q'land, NSW, Victoria, Tasmania, Sth Aust.
<i>Neboissophlebia</i> Dean, 1988	NSW, Victoria, SW Aust.
<i>Nousia</i> Navas, 1918	SE Q'land, NSW, Victoria, Tasmania, Sth Aust.
<i>Nyungara</i> Dean, 1987	SW Aust.
<i>Thraulophlebia</i> Demoulin, 1955	SE Q'land
<i>Thraulus</i> Eaton, 1881	NW Aust, NT, Nth Q'land.
<i>Ulmerophlebia</i> Demoulin, 1955	Nth Q'land, SE Q'land, NSW, Victoria, Sth Aust.

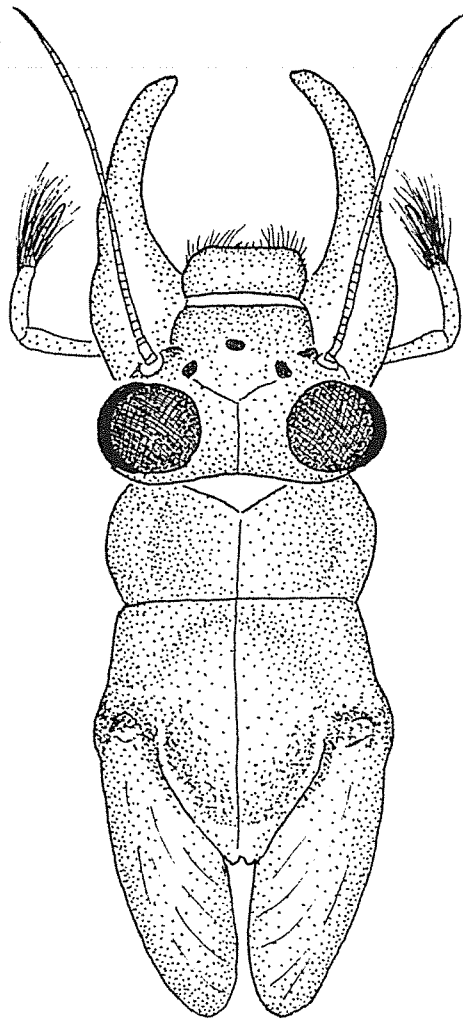
KEY TO GENERA OF LATE INSTAR NYMPHS

- 1 Abdominal gills digitate, each lamella with three or more digits (Figs 6.3, 6.5, 6.9), except upper lamella of first gill which is sometimes lanceolate (Fig 6.4) 2
- Abdominal gills either with margins entire (Figs 6.22, 6.41, 6.44) or with single apical filament (Figs 6.15, 6.17, 6.47) 4

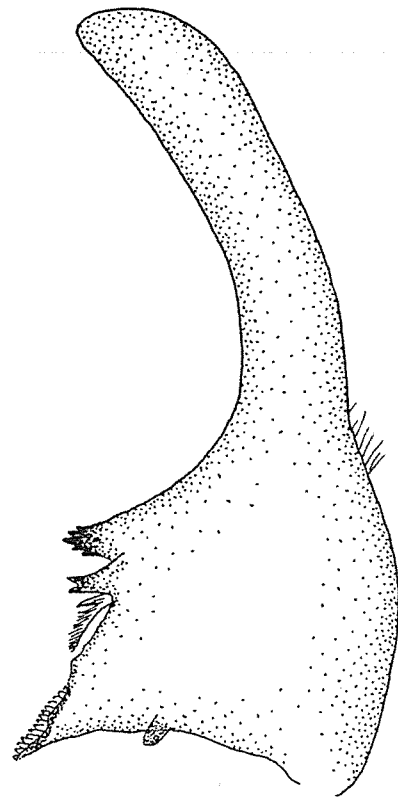
- 2 Mandible with large dorso-ventrally flattened projection (Figs 6.1, 6.2)
 *Kalbaybaria*
 [Distribution: Nth Q'land]

Diagnosis: labrum narrower than clypeus, anterior margin straight ; maxilla with palp moderately-long ; mandibles with long, dorso-ventrally flattened projection on outer margin ; labial palp with segment 3 much longer than segment 2, with dense fringe of very long setae along outer margin ; legs banded, tarsal claws with series of short ventral teeth ; abdomen with postero-lateral spines on segments 7 to 9 ; gills on abdominal segments 1 to 7, each gill consisting of an upper and a lower lamella, each lamella tridigitate.

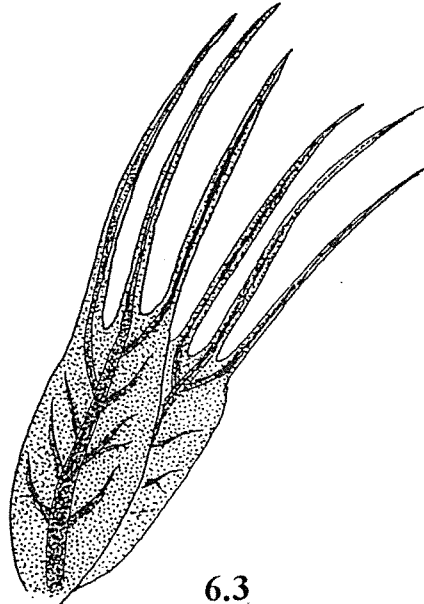
- Mandible without projection (Fig 6.8) 3



6.1



6.2



6.3

Family Leptophlebiidae

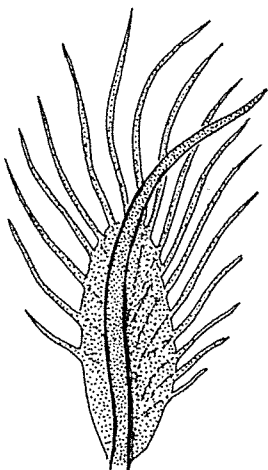
Kalbaybaria sp. 6.1 head and thorax of nymph, dorsal ; 6.2 right mandible ;
6.3 gill from third abdominal segment

- 3 Tarsal claws with moderate size ventral teeth (Fig 6.6) ; first abdominal gills with upper lamella slender and lanceolate, lower lamella digitate (Fig 6.4) *Thraulius*
 [Distribution: NW Aust, NT, Nth Q'land]

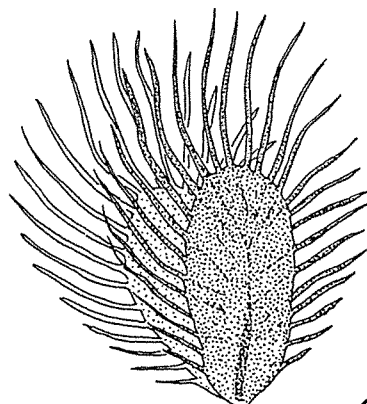
Diagnosis: labrum about same width as clypeus, anterior margin concave ; maxilla with palp moderately-short ; mandibles with outer incisors slender ; tarsal claws with series of moderate size ventral teeth ; abdomen with postero-lateral spines on segments 6 (very small) to 9 ; gills on abdominal segments 1 to 7, each gill consisting of an upper and a lower lamella, all multi-digitate except upper lamella of first gill, which is long, slender and lanceolate.

- Tarsal claws with small ventral denticles (Fig 6.10) or smooth ; first abdominal gills with both lamellae digitate *Atalophlebia*
 [Distribution: NT, Nth Q'land, SE Q'land, NSW, Victoria, Tasmania, Sth Aust]

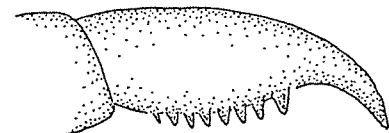
Diagnosis: Labrum narrower than clypeus, anterior margin concave, width-length ratio 2.1 to 2.5 ; mandibles with outer incisors robust, triangular, with sub-apical denticles ; maxillary palp with pinnate setae on inner margin of second segment ; labium with glossae turned under ventrally, labial palp with terminal segment sub-triangular and with a series of stout spines along inner margin ; legs banded, tarsal claws usually with a series of small ventral denticles, although one species has smooth claws ; postero-lateral spines on abdominal segments 2 to 9, although a few species have spines on segments 4 to 9 and 7 to 9 only ; gills on abdominal segments 1 to 7, each gill consisting of an upper and a lower lamella, all lamellae digitate with three or more digits.



6.4

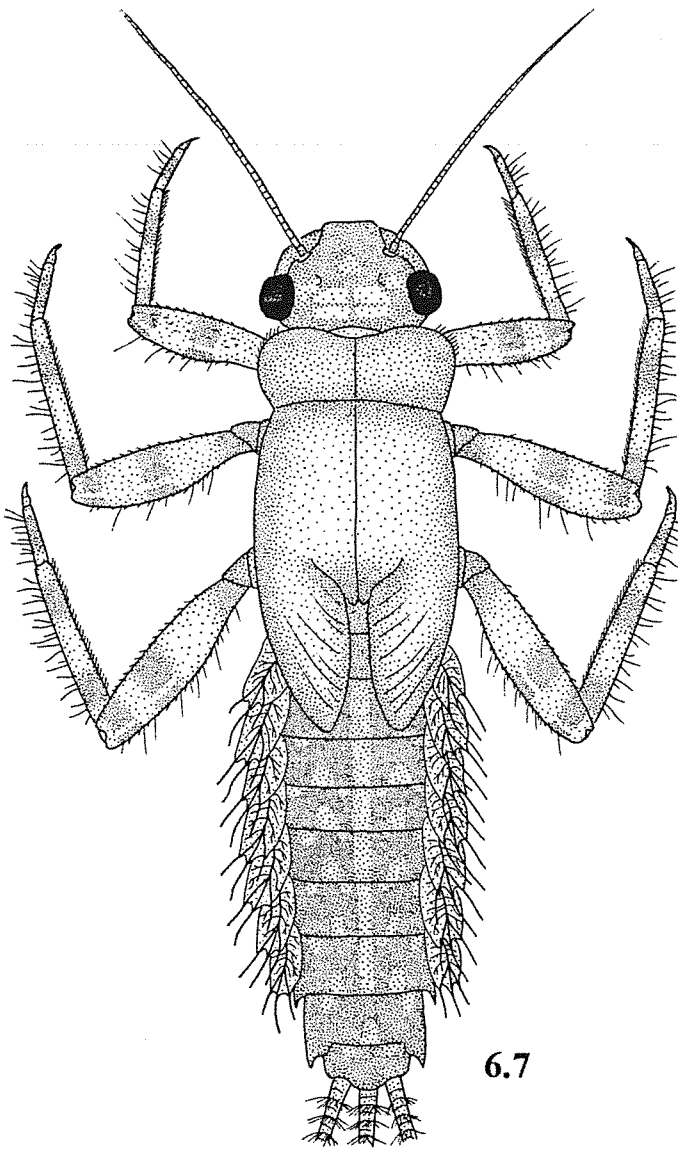


6.5

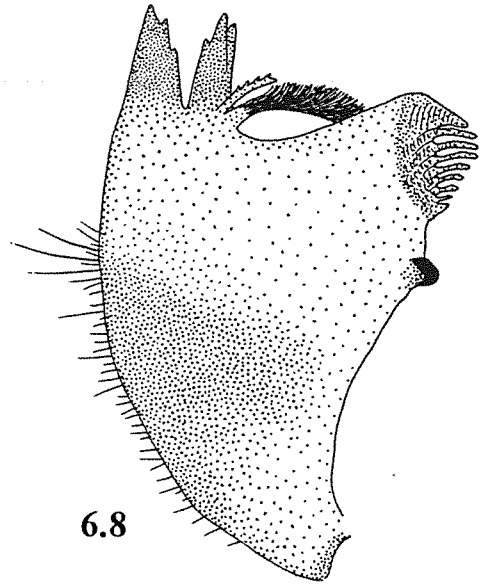


6.6

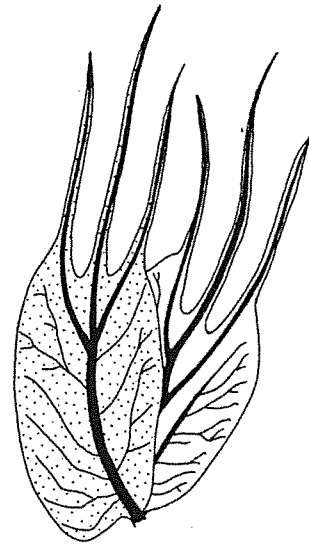
Family Leptophlebiidae
Thraulius sp. 6.4 gill from first abdominal segment ; 6.5 gill from third abdominal segment ; 6.6 fore tarsus.



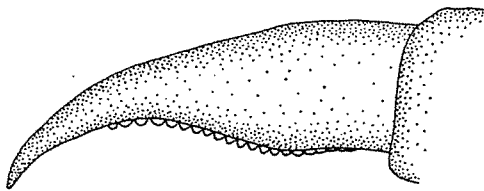
6.7



6.8



6.9



6.10

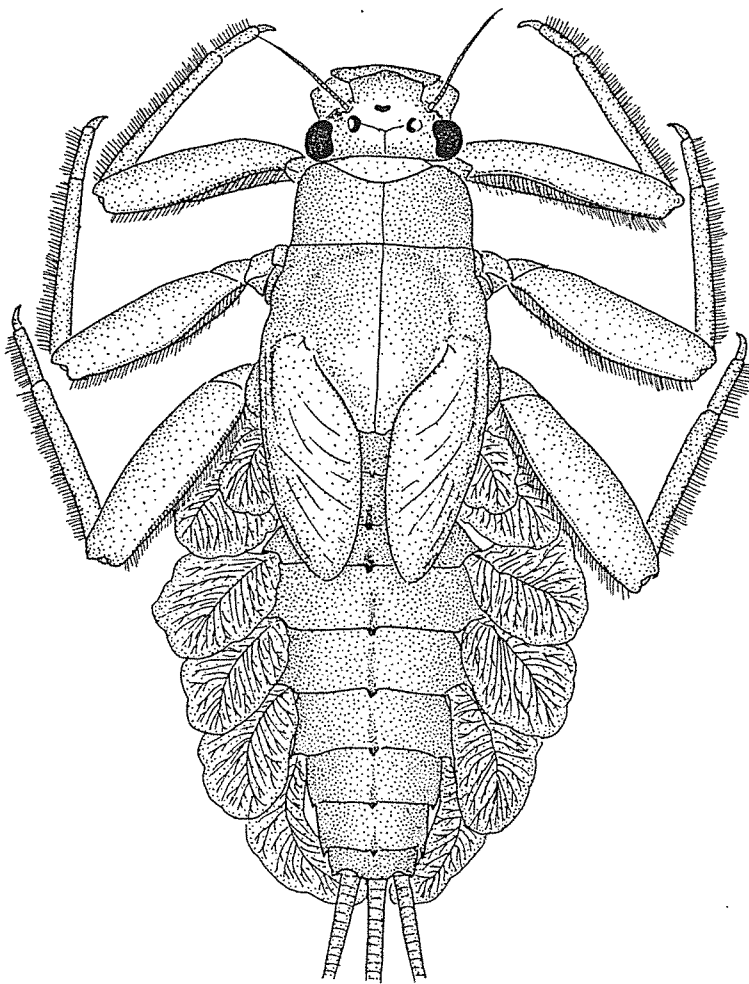
Family Leptophlebiidae

Atalophlebia sp. 6.7 whole nymph ; 6.8 left mandible ; 6.9 gill from third abdominal segment ; 6.10 fore tarsus.

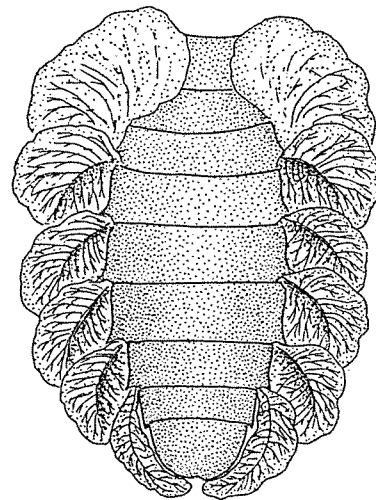
- 4 Abdominal segments 1 to 9 with median dorsal projections (Fig 6.11); abdominal gills downturned and modified to form a ventral disc (Fig 6.12) *Kirrara*
 [Distribution: NSW, Vic]

Diagnosis: labrum considerably broader than clypeus, width-length ratio about 4.0 ; mandibles with incisors slender ; legs with femora broad and flat, outer margins of femur, tibia and tarsus with dense fringe of setae, tarsal claws with ventral teeth ; median dorsal projections on abdominal segments 1 to 9 ; gills present on abdominal segments 1 to 7, dorsal lamellae plate-like, ventral lamellae greatly reduced in size, dorsal lamellae downturned to form a ventral suction disc.

- Abdominal segments without dorsal projections ; gills not modified to form a ventral disc, carried lateral or dorsal to the abdomen (Figs 6.13, 6.16, 6.31, 6.42)
 5



6.11



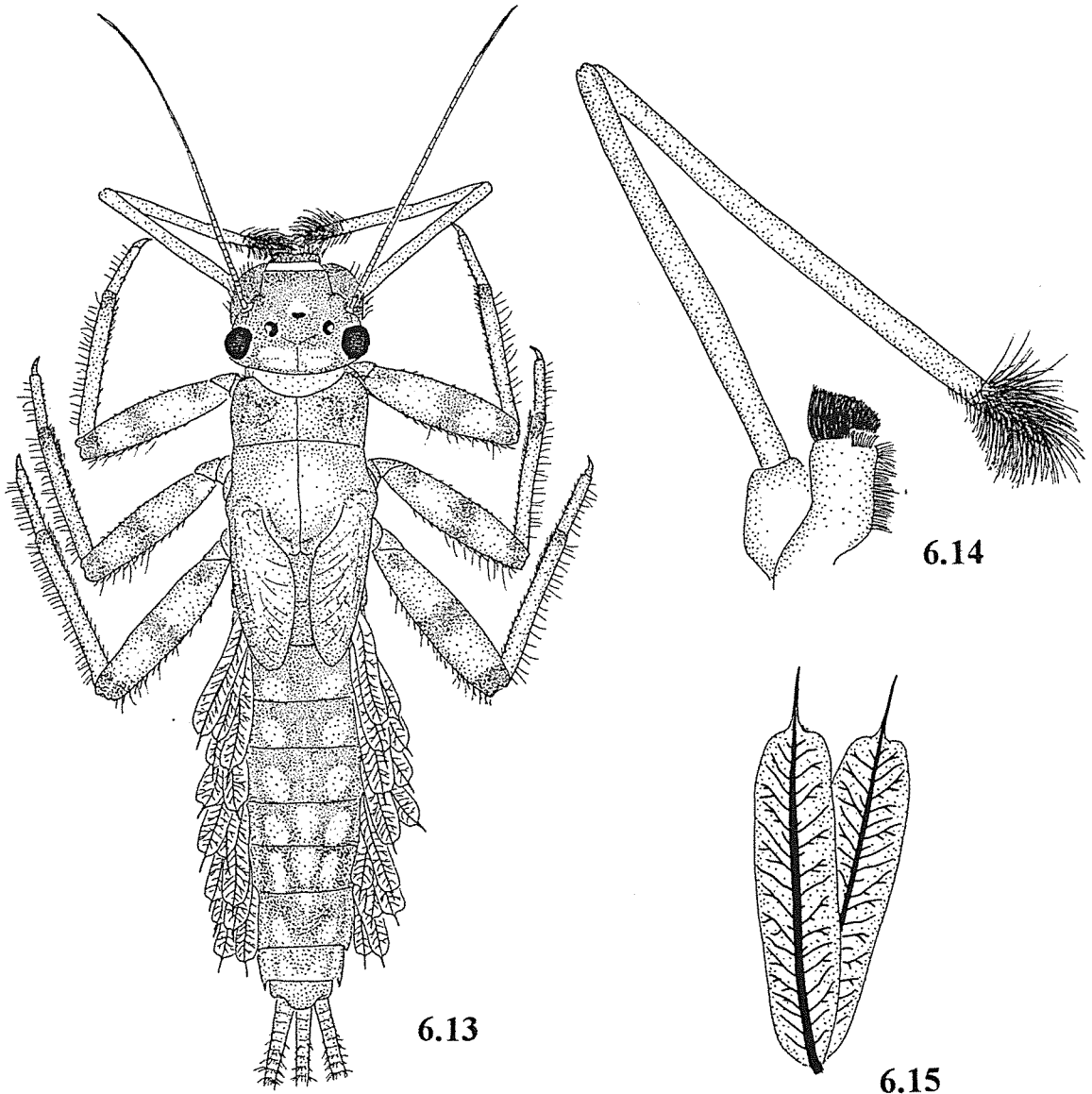
6.12

Family Leptophlebiidae
Kirrara sp. 6.11 whole nymph, dorsal ; 6.12 abdomen, ventral.

- 5 Maxillary palps elongate, considerably longer than width of the head (Figs 6.13, 6.14) *Atalomicria*
 [Distribution: Nth Q'land, SE Q'land, NSW, Vic]

Diagnosis: labrum narrower than clypeus, broadest at base, with anterior margin concave; mandible with outer incisor robust, triangular, with sub-apical denticles ; maxillary palps greatly enlarged; legs banded, tarsal claws smooth ; postero-lateral spines on abdominal segments 7-9 ; gills on abdominal segments 1 to 7, each gill with an upper and a lower lamella, each lamella long, moderately broad, with a short apical filament and numerous lateral tracheae.

- Maxillary palps not elongate, shorter than width of head 6



Family Leptophlebiidae
Atalomicria sp. 6.13 whole nymph, dorsal ; 6.14 maxilla ; 6.15 gill from third abdominal segment.

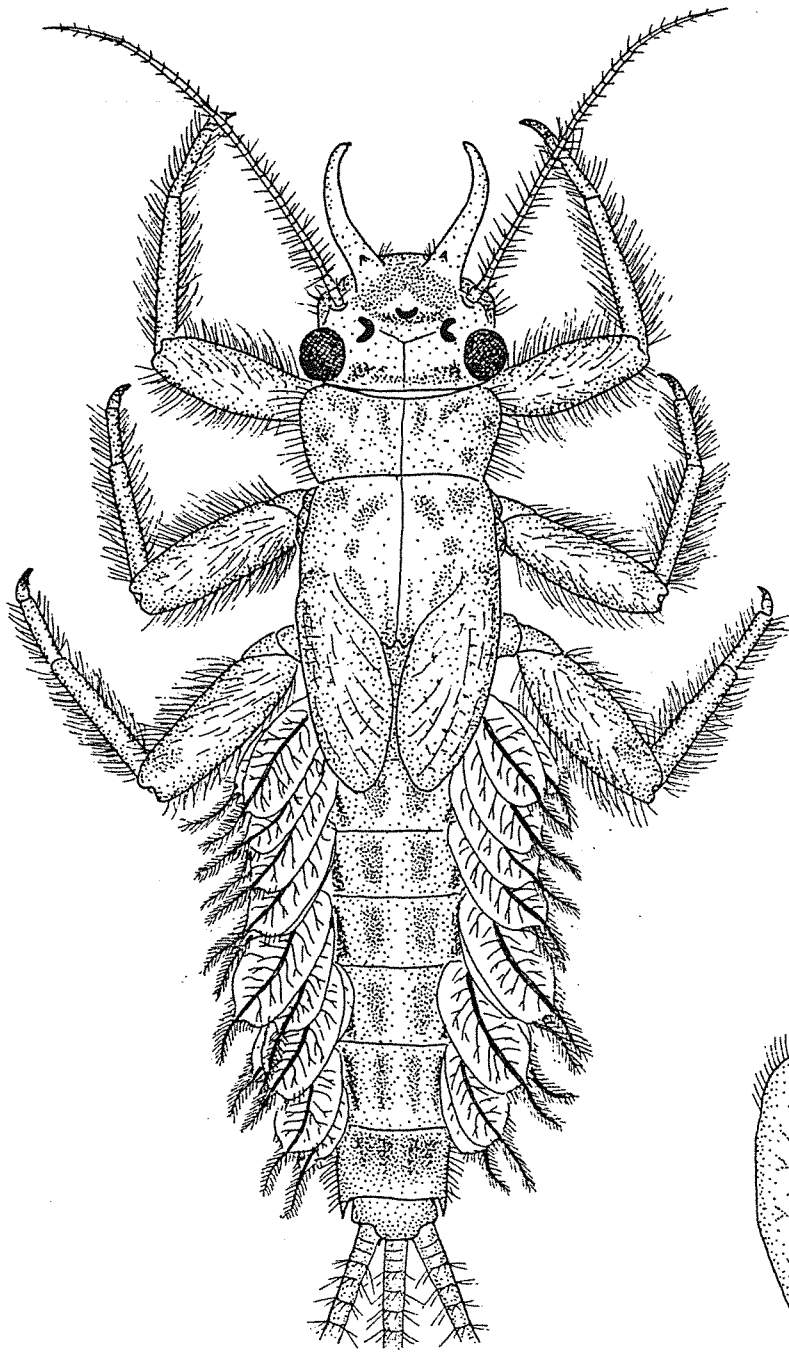
- 6 Gills with each lamella broad, with a single apical filament, densely clothed with fine setae in apical half (Fig 6.17) 7
- Gills not as above, if with a single apical filament then not densely clothed with fine setae (Figs 6.20, 6.47) 8

- 7 Head capsule with frontal horns (Fig 6.16) *Jappa*
[Distribution: NW Aust, NT, Nth Q'land, SE Q'land, NSW, Vic]

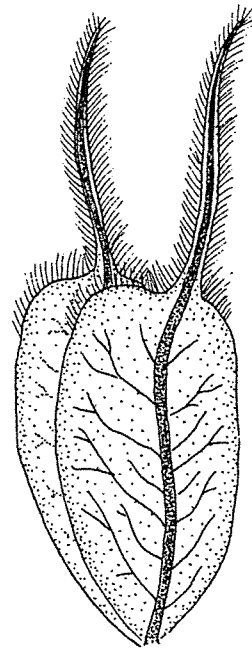
Diagnosis: head capsule with large frontal horns ; antennae heavily setose ; labrum narrower than clypeus ; maxillary palp with terminal segment short, subtriangular ; pronotum with long setae along lateral margins ; legs heavily setose, tarsal claws with small ventral denticles ; gills on abdominal segments 1 to 7, lamellae broad with a single apical filament, apical half densely clothed with fine setae.

- Head capsule without frontal horns *Ulmerophlebia*
[Distribution: Nth Q'land, SE Q'land, NSW, Vic, Sth Aust]

Diagnosis: head capsule without frontal horns ; antennae heavily setose ; labrum narrower than clypeus ; maxillary palp with terminal segment short, subtriangular ; pronotum with long setae along lateral margins ; legs heavily setose, tarsal claws with small ventral denticles ; gills on abdominal segments 1 to 7, lamellae broad with a single apical filament, apical half densely clothed with fine setae.



6.16



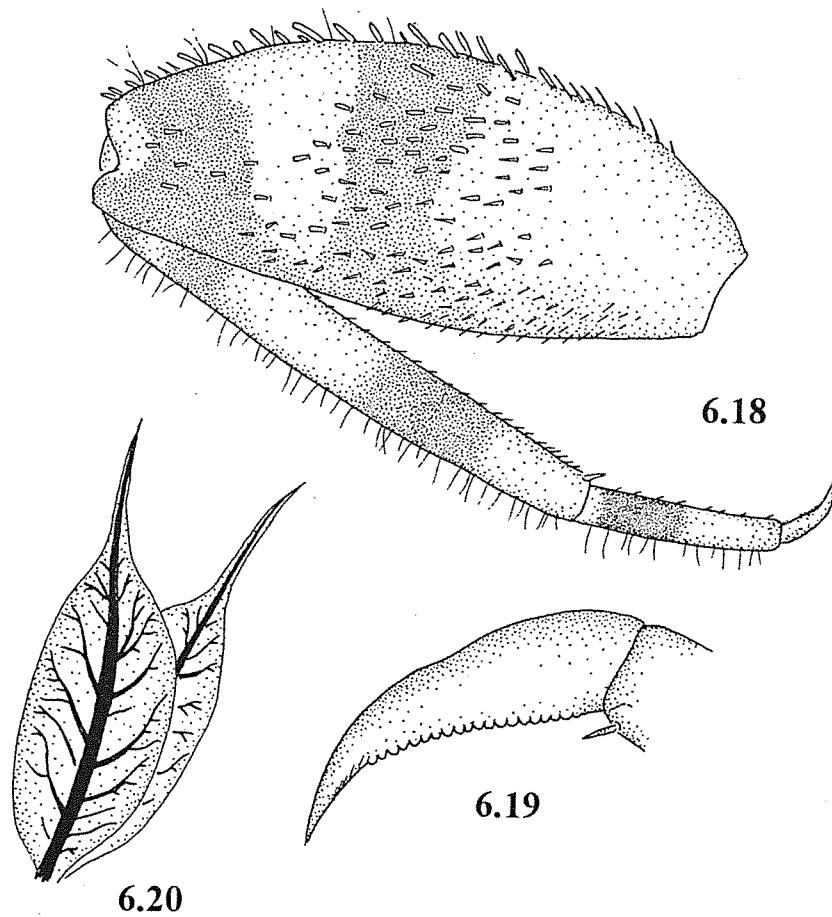
6.17

Family Leptophlebiidae
Jappa sp. 6.16 whole nymph, dorsal ; 6.17 gill from third abdominal segment.

- 8 Tarsal claws with prominent ventral teeth (Figs 6.39, 6.46) 13
- Tarsal claws smooth (Fig 6.21, 6.26) or with very small ventral denticles (Fig 6.19) 9
- 9 Tarsal claws with small ventral denticles (Fig 6.19) **Genus Q**
[Distribution: SW Australia]

Diagnosis: nymph robust ; labrum slightly wider than clypeus, anterior margin with median concavity; mandibles with outer incisor slender ; legs banded, femora broad with numerous stout setae on upper surface, tarsal claws with about twenty small ventral denticles ; gills on abdominal segments 1 to 7, each gill with both lamellae broadly lanceolate, narrowing at about 2/3 length, lateral tracheae moderately developed.

- Tarsal claws smooth (Figs 6.21, 6.26) 10

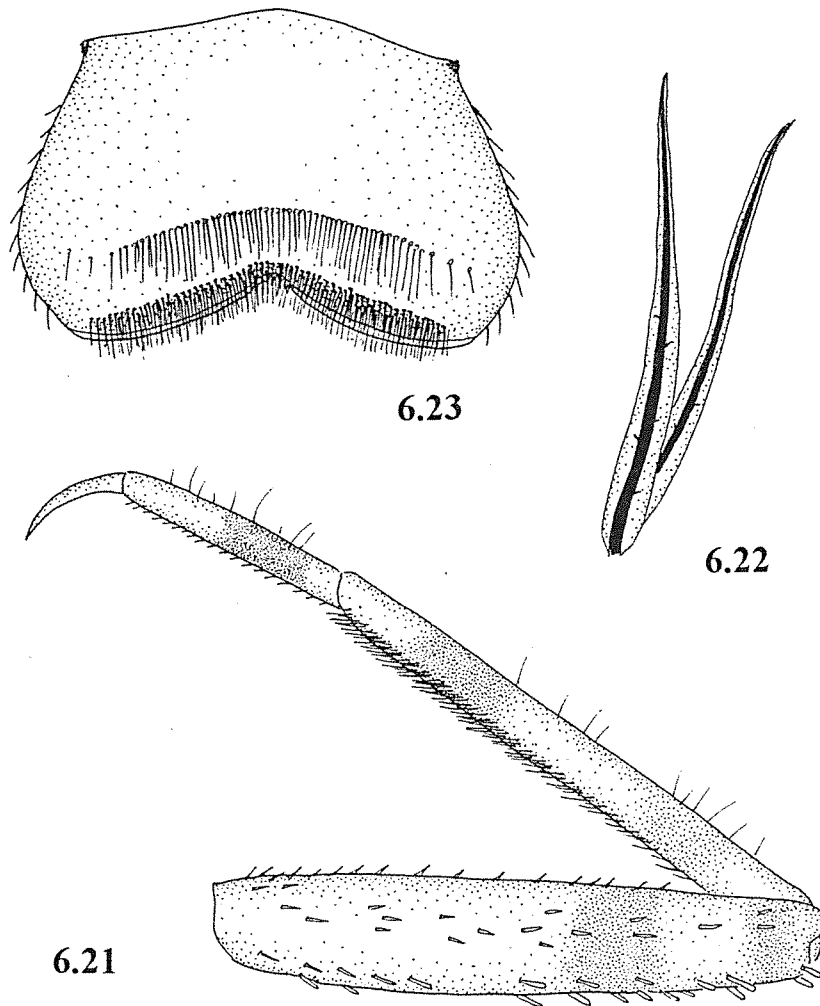


Family Leptophlebiidae
Genus Q 6.18 fore leg ; 6.19 fore tarsal claw ; 6.20 gill from third abdominal segment.

- 10 Femur long and slender, length 5-6 x width (Fig 6.21) **Genus K**
 [Distribution: Nth Q'land, NSW, Vic]

Diagnosis: nymph sprawling ; labrum slightly broader than clypeus, broadest in anterior half, anterior margin with broad V-notch ; legs with all segments long and slender, length of femora 5-6 times width, tarsal claws smooth ; gills on abdominal segments 1 to 7, lamellae long and slender, lateral tracheae virtually absent.

- Femur broad, length 3-4 x width (Figs 6.26, 6.28, 6.31) 11



Family Leptophlebiidae

Genus K 6.21 fore leg; 6.22 gill from third abdominal segment; 6.23 labrum.

- 11 Labrum relatively broad, width 2.3 to 2.5 x length along median line (Fig 6.25) ; gills very narrow, without lateral tracheae (Fig 6.27) *Neboissophlebia*
 [Distribution: NSW, Vic, SW Aust]

Diagnosis: Labrum slightly wider than frontal margin of clypeus, width 2.3 to 2.5 length along median line, secondary hair fringe located a little forward of mid length ; mandible with incisors slender ; femur broad, length 3-4 x width, tarsal claws smooth without ventral teeth ; abdomen with postero-lateral spines on segments 5 to 9 ; gills very narrow, without lateral tracheae.

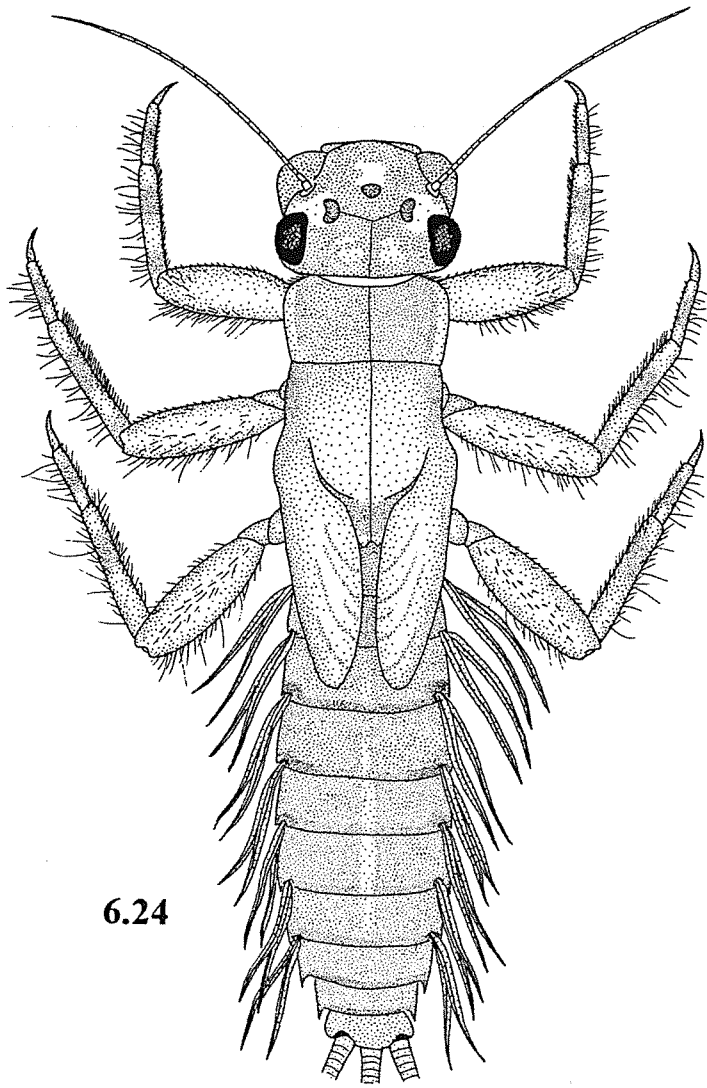
- Labrum less broad, width 1.7 to 1.9 x length along median line (Figs 6.29, 6.32) ; gills variable, ranging from broad with strongly developed lateral tracheae to narrow without lateral tracheae (Figs 6.30, 6.33) 12

- 12 Gills broad, lateral tracheae well developed ; inner margin of each lamella convoluted to form small recess near base of terminal filament (Fig 6.30) *Bibulmena*
 [Distribution: SW Aust, NT]

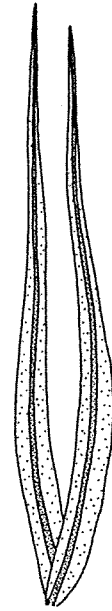
Diagnosis: Labrum slightly wider than frontal margin of clypeus, width 1.8 to 1.9 length along median line ; mandible with incisors slender ; femur broad, length 3-4 x width, tarsal claws smooth ; abdomen with postero-lateral spines on segments 6 to 9 ; gills broad, narrowing at about 2/3 length terminating in single filament, inner margin with small recess at base of filament, lateral tracheae well developed.

- Gills narrow to moderate, lateral tracheae either absent or reduced to a few short branches radiating from central trachea ; inner margin of lamella never with recess (Fig 33) **Genus S**
 [Distribution: SW Aust]

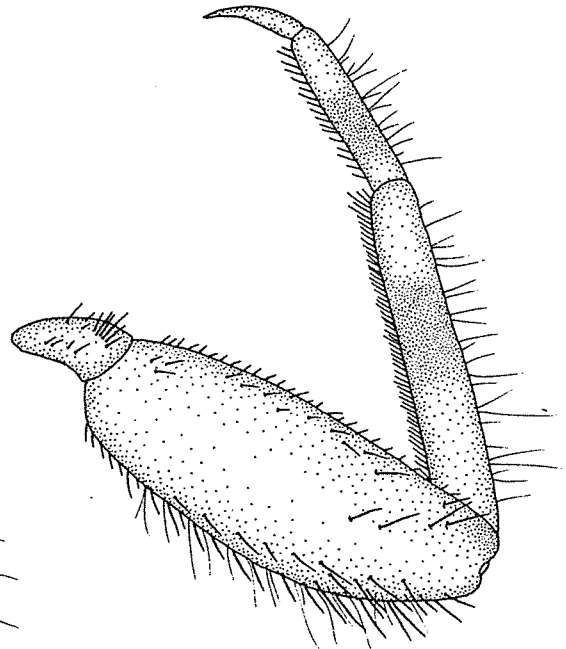
Diagnosis: Labrum slightly wider than frontal margin of clypeus, width 1.7 to 1.8 length along median line ; mandible with incisors slender ; femur broad, length 3-4 x width , tarsal claws smooth ; gills linear or moderately lanceolate, lateral tracheae poorly developed.



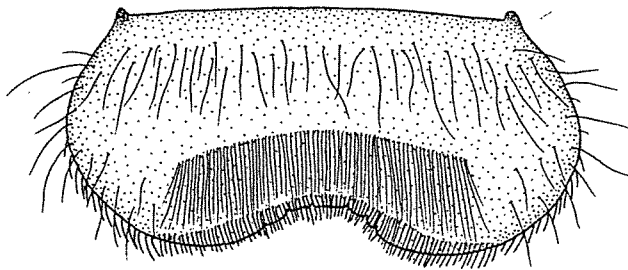
6.24



6.27



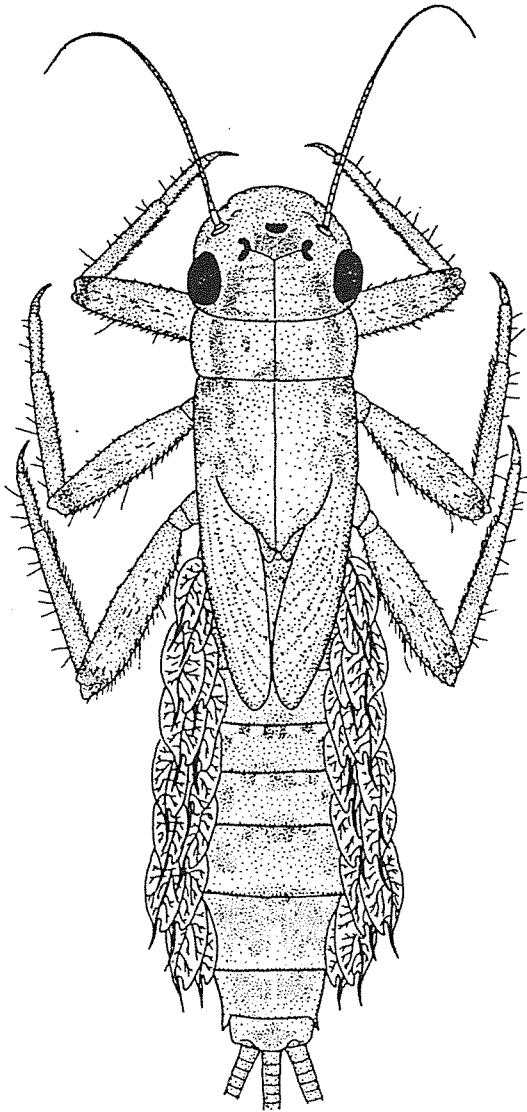
6.26



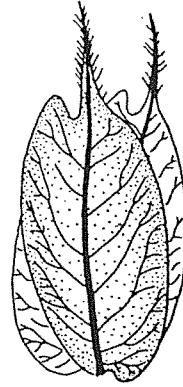
6.25

Family Leptophlebiidae

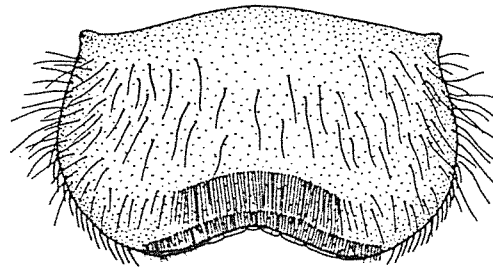
Neboissophlebia sp. 6.24 whole nymph ; 6.25 labrum ; 6.26 foreleg ;
6.27 gill from third abdominal segment.



6.28



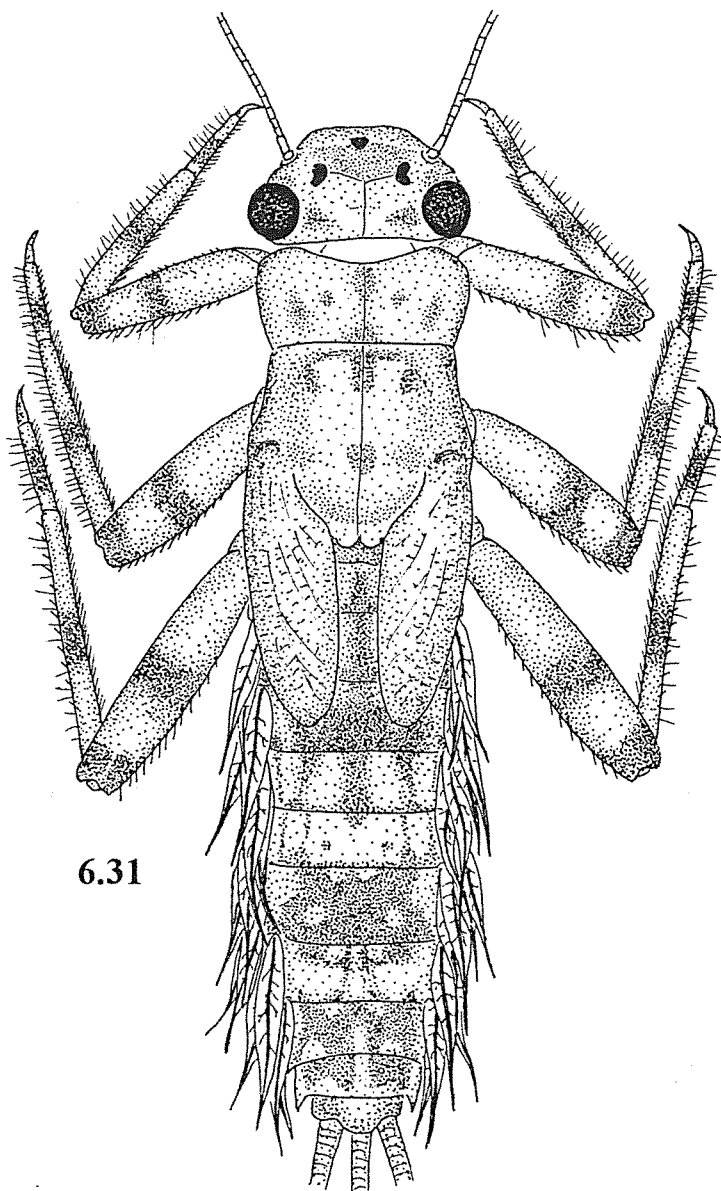
6.30



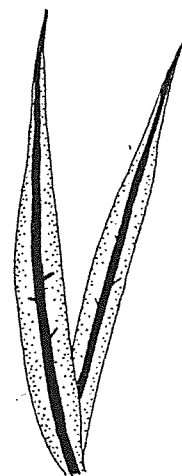
6.29

Family Leptophlebiidae

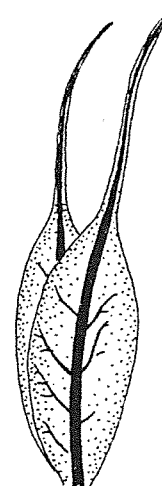
Bibulmena sp. 6.28 whole nymph; 6.29 labrum; 6.30 gill from third abdominal segment.



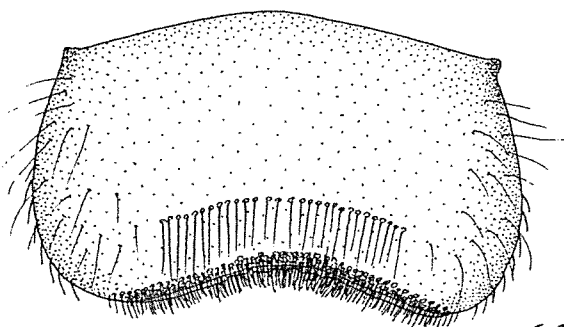
6.31



6.33



6.34



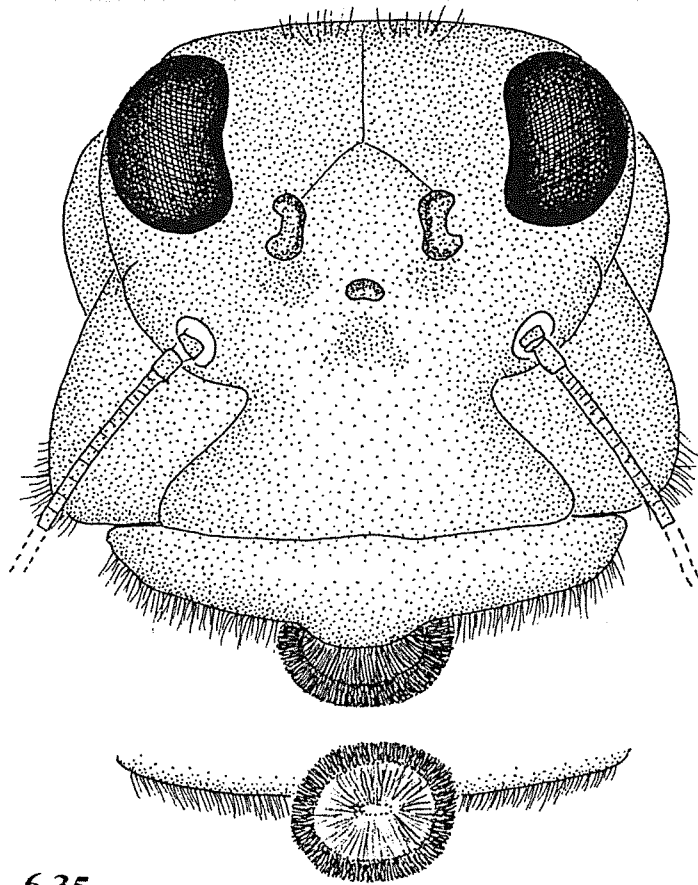
6.32

Family Leptophlebiidae
Genus S 6.31 whole nymph; 6.32 labrum; 6.33 gill from third abdominal segment; 6.34 gill from third abdominal segment.

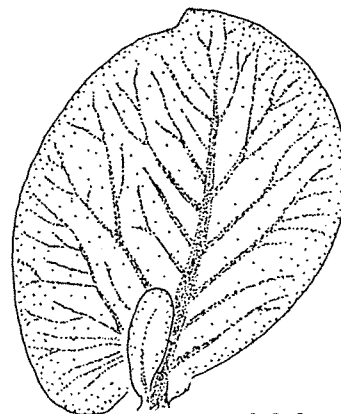
- 13 Labrum broad, considerably broader than frontal margin of clypeus ; width of labrum 2.7 or more times length along the median line (Figs 6.35, 6.38, 6.43) 14
- Labrum not broad, subequal or only slightly broader than width of frontal margin of clypeus ; width of labrum 1.5 to 2.2 times length along the median line (Figs 6.49, 6.53, 6.57) 16
- 14 Labrum with frontal setae modified to form round suction disc (Fig 6.35) ; gills with upper lamella very large, ovate, lower lamella small (Fig 6.36) **Genus T**
 [Distribution: Nth Q'land]

Diagnosis: Labrum very broad, frontal setae dense, modified to form a medial round suction disc ; lateral margins of clypeus strongly diverging to anterior ; mandible with strongly angular outer margin, incisors slender ; legs with femora flattened, dense fringe of setae along outer margin of femur, tibia and tarsus. tarsal claws with ventral teeth ; gills with upper lamellae very large, ovate, lower lamellae small.

- Labrum usually without suction disc (Figs 6.38, 6.43) ; gills linear or lanceolate, lamellae of similar size (Figs 6.41, 6.44) 15



6.35



6.36

Family Leptophlebiidae

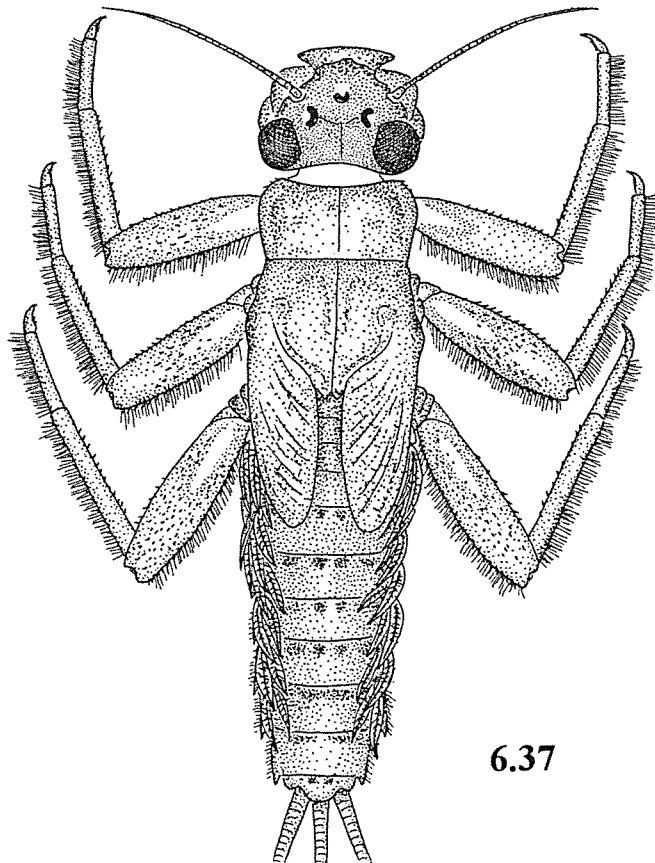
Genus T 6.35 head, dorsal, and ventral view of suction disc ; 6.36 gill from third abdominal segment.

- 15 Labrum with shallow concavity or narrow notch on anterior margin (Fig 6.38) ; postero-lateral spines on abdominal segments 2 to 9 (Fig 6.40) ; gills lanceolate, lateral tracheae strongly developed (Fig 6.41) *Austrophlebioides*
 [Distribution: Nth Q'land, SE Q'land, NSW, Vic, Tas]

Diagnosis: Labrum considerably broader than anterior margin of clypeus, width about 3 x length along median line ; mandible with incisors slender ; tarsal claws with ventral teeth ; abdominal segments 2 to 9 with acute postero-lateral spines, lateral margins with fringe of fine setae ; gills lanceolate, lateral tracheae well developed.

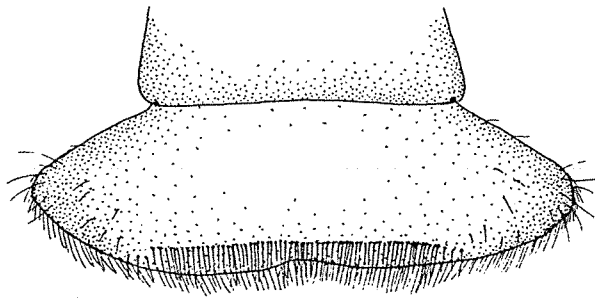
- Labrum with broad, deep V-notch on anterior margin (Fig 6.43) ; postero-lateral spines on abdominal segments 6 to 9 ; gills very narrow, without lateral tracheae (Fig 6.44) **Genus Z**
 [Distribution: Victoria]

Diagnosis: Labrum broader than anterior margin of clypeus, width about 2.7 x length along median line, anterior margin with broad, deep V-notch ; tarsal claws with ventral teeth ; postero-lateral spines on abdominal segments 6 to 9 ; gills linear, without lateral tracheae.

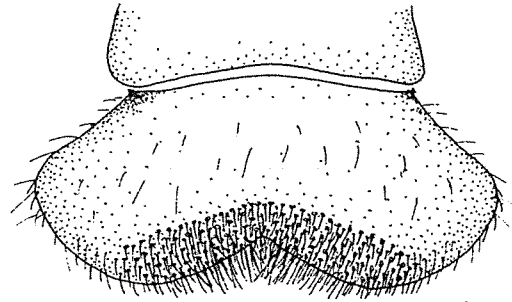


6.37

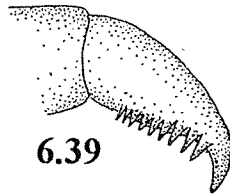
Family Leptophlebiidae
Austrophlebiodes sp. 6.37 whole nymph.



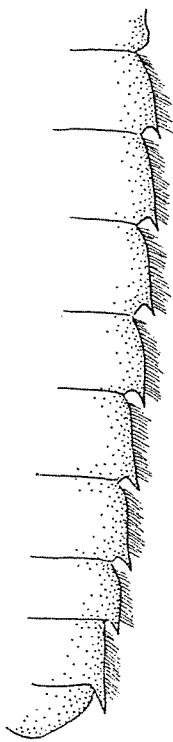
6.38



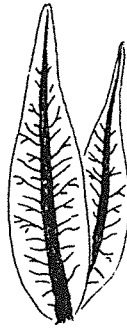
6.43



6.39



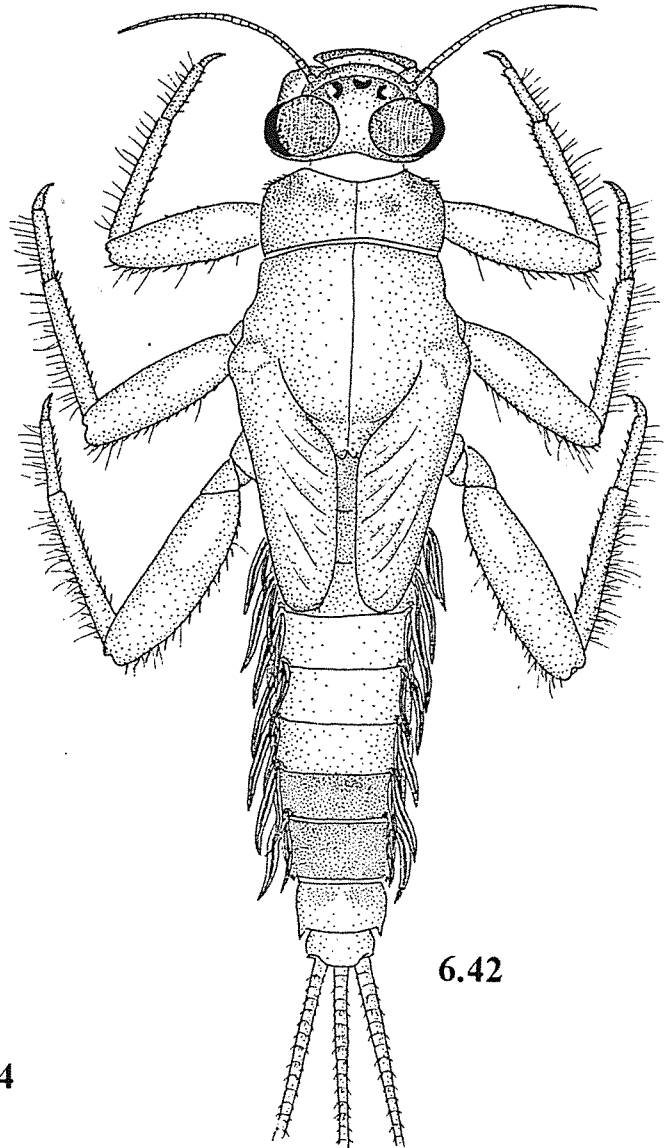
6.40



6.41



6.44



6.42

Family Leptophlebiidae

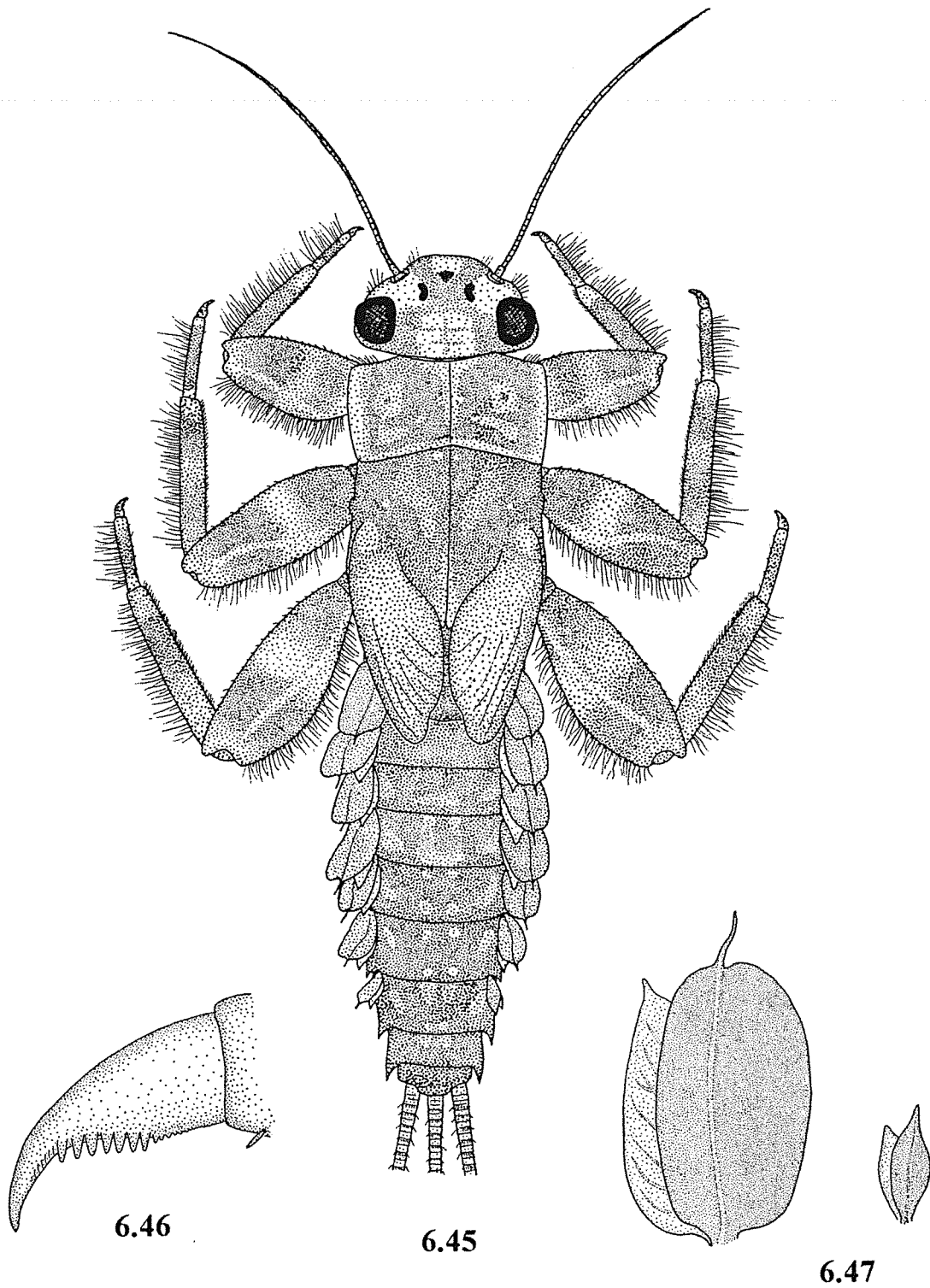
Austrophlebiodes sp. 6.38 labrum ; 6.39 tarsal claw ; 6.40 lateral margin of abdomen ; 6.41 gill from third abdominal segment ;

Genus Z 6.42 whole nymph ; 6.43 labrum ; 6.44 gill from third abdominal segment.

- 16 Abdominal gills with upper lamellae broad, dark, bearing single short apical filament (Fig 6.47) ; gills on abdominal segments 6 and 7 considerably smaller than gills on segment 3 *Garinjuga*
 [Distribution: NSW, Vic, Tas]

Diagnosis: Labrum a little broader than clypeus, width 1.6 to 1.8 length along median line ; mandible with incisors slender ; legs robust, femur with longitudinal ridge along upper surface, tarsal claws with ventral teeth ; postero-lateral spines on abdominal segments 6 to 9 ; gills with upper lamellae broad, dark, with short apical filament, lower lamellae smaller, paler, broadly lanceolate, gills on abdominal segments 6 and 7 considerably smaller than gills on segments 3-5.

- Abdominal gills narrow, lanceolate (Figs 6.51, 6.54); gills on abdominal segments 6 and 7 usually not much smaller than gills on segment 3 17



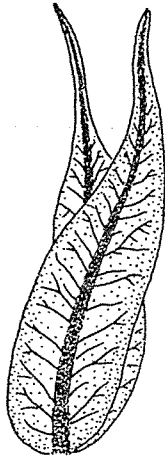
Family Leptophlebiidae

Garinjuga sp. 6.45 whole nymph ; 6.46 tarsal claw ; 6.47 gills from third and seventh abdominal segments.

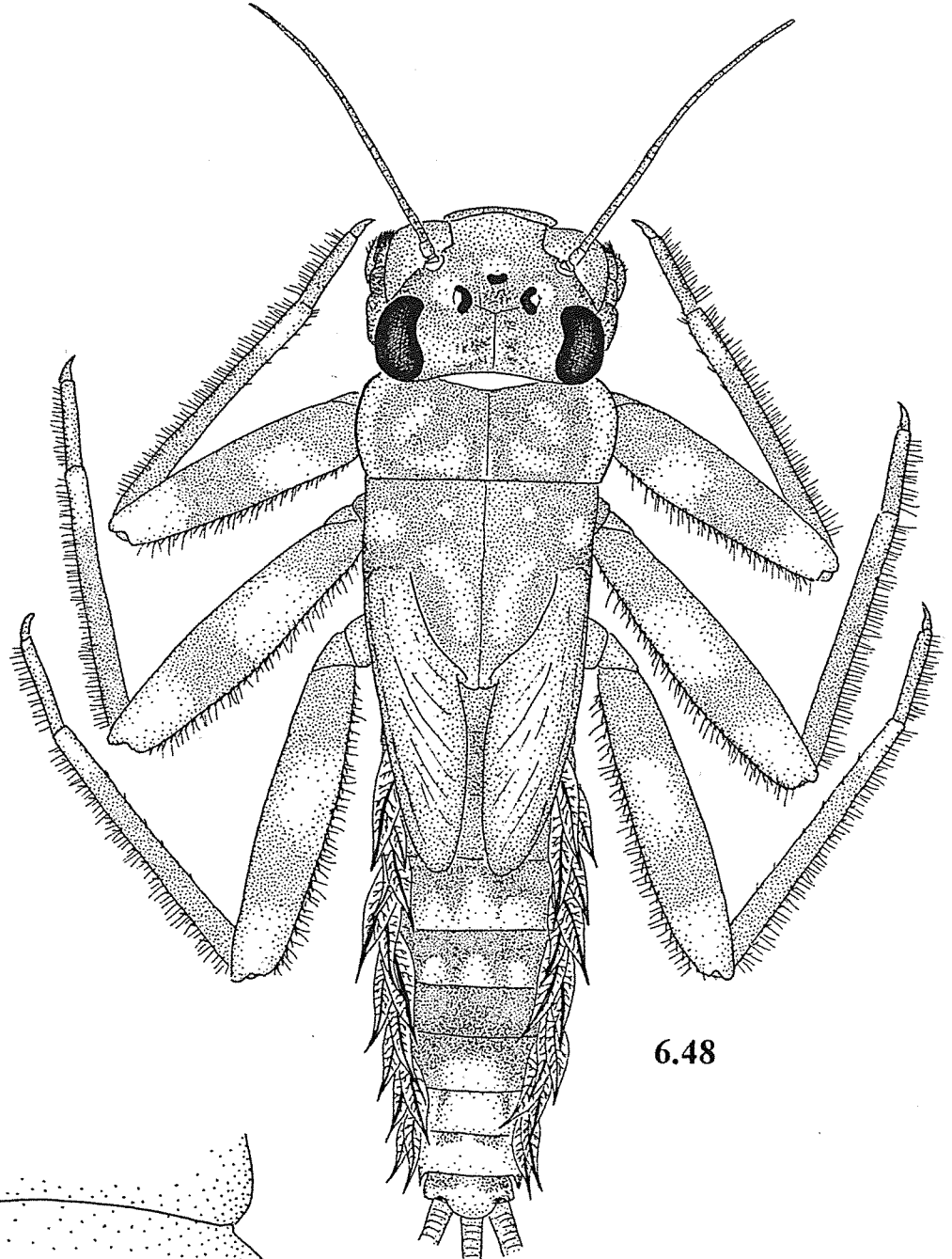
- 17 Labrum with narrow, deep notch in anterior margin beneath overhang (Fig 6.49) ;
 postero-lateral spines on abdominal segments 2 to 9 **Genus D**
 [Distribution: NSW, Vic, Tas]

Diagnosis: Labrum a little broader than clypeus, width a little over 2 x length along median line, anterior margin with narrow, deep notch beneath an overhang ; mandibles with incisors slender ; legs with femora moderately flattened, tarsal claws with prominent ventral teeth ; postero-lateral spines on abdominal segments 2 to 9 ; gills lanceolate, lateral tracheae well developed ; caudal filaments long, about 2 x body length.

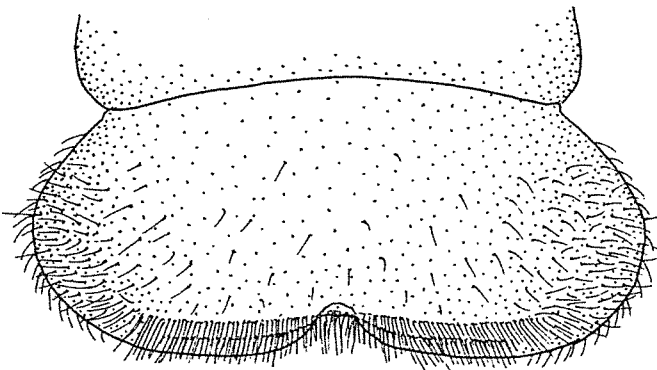
- Labrum without notch in anterior margin, although often with shallow concavity (Figs 6.53, 6.58) ; postero-lateral spines usually only present on abdominal segments 4,5 or 6 to 9 18



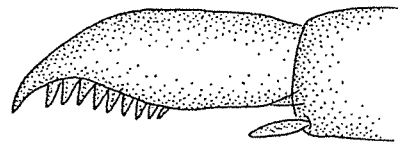
6.51



6.48



6.49



6.50

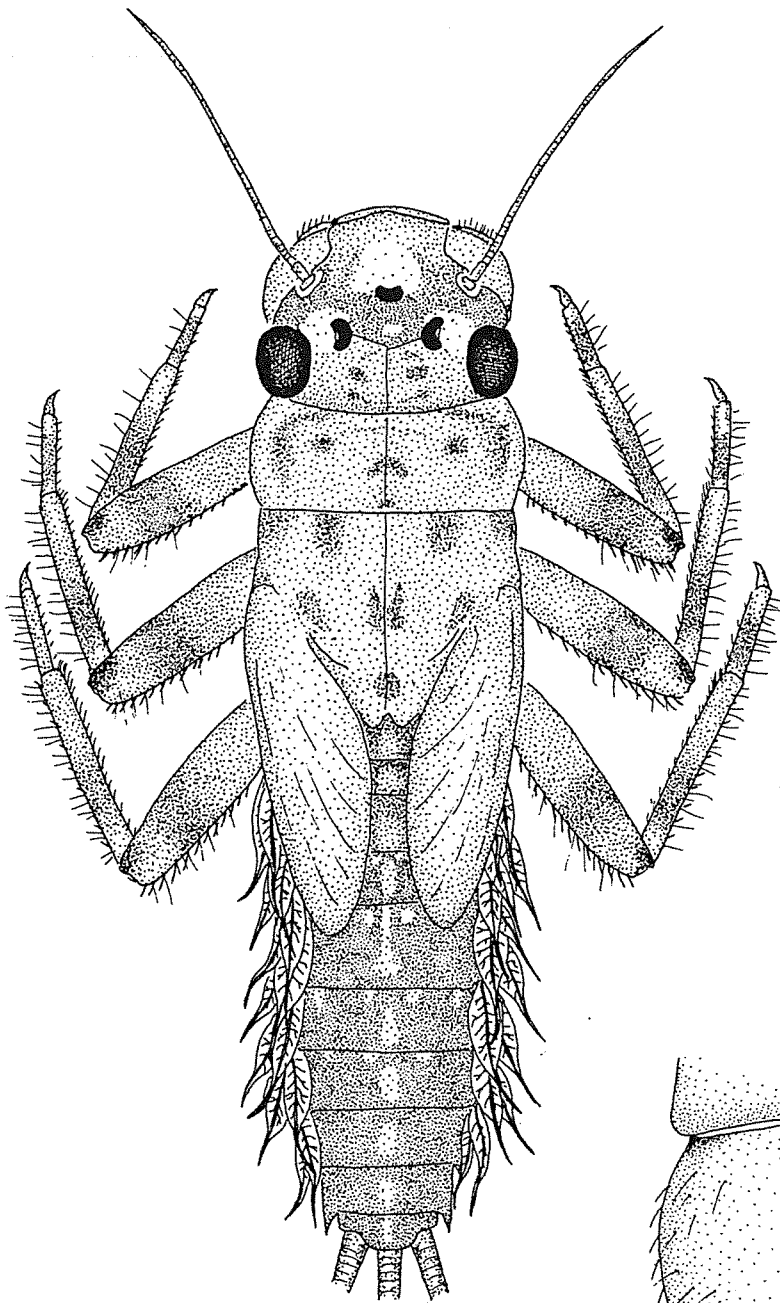
Family Leptophlebiidae

Genus D 6.48 whole nymph; 6.49 labrum; 6.50 tarsal claw; 6.51 gill from third abdominal segment.

- 18 Labrum with secondary hair fringe < 0.2 width of labrum, projecting
conspicuously beyond the anterior margin (Fig 6.53) *Koorrnonga*
[Distribution: Nth Q'land, SE Q'land, NSW, Vic, Tas, Sth Aust]

Diagnosis: Labrum slightly broader than clypeus, secondary setal fringe close to anterior margin, projecting beyond anterior margin as conspicuous tuft, length of fringe less than 0.2 x width of labrum ; mandibles with incisors slender ; tarsal claws with prominent ventral teeth ; postero-lateral spines on abdominal segments 6 to 9 ; gills lanceolate, narrowing at about 2/3 length, lateral tracheae well developed.

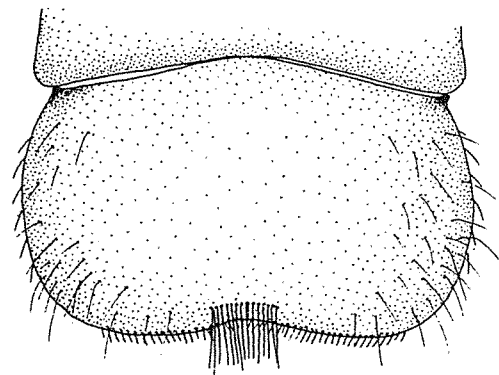
- Labrum with secondary hair fringe extending at least 0.5 width of labrum, not projecting conspicuously beyond the anterior margin (Fig 6.55, 6.58), or without secondary hair fringe but with broad field of setae close to anterior margin of labrum (Fig 6.57) 19



6.52



6.54



6.53

Family Leptophlebiidae

Koornonga sp 6.52 whole nymph; 6.53 labrum; 6.54 gill from third abdominal segment.

- 19 Eastern Australia *Nousia*
 [Distribution: SE Q'land, NSW, Vic, Tas, Sth Aust]

Diagnosis: Labrum subequal or slightly wider than clypeus, secondary hair fringe extending at least 0.5 width of labrum, close to anterior margin but not projecting conspicuously beyond anterior margin ; mandible with incisors slender ; tarsal claws with ventral teeth, progressively larger apically ; gills lanceolate, sometimes narrowly so, lateral tracheae ranging from poorly to moderately developed.

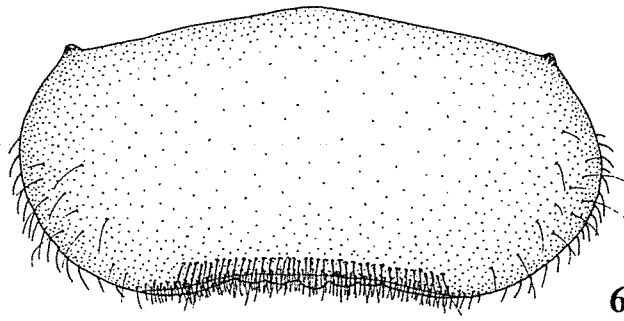
- South-western Australia 20

- 20 Width of labrum a little greater than 2 x length along median line ; denticles on anterior margin broad based, extending across at least 0.4 width of labrum ; without secondary hair fringe, but with broad band of setae close to anterior margin of labrum (Fig 6.57) *Nyungara*
 [Distribution: SW Aust]

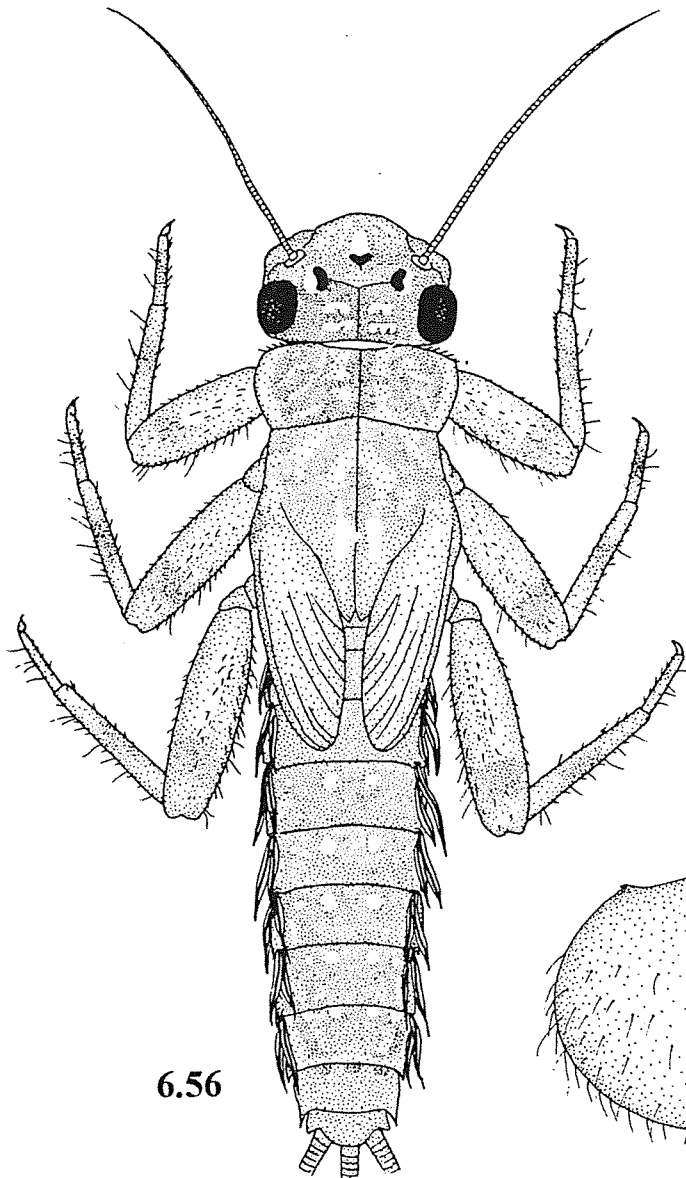
Diagnosis: Width of labrum a little greater than 2 x length along median line, denticles on anterior margin broad based, extending across at least 0.4 width of labrum, without secondary hair fringe but with broad band of setae close to anterior margin of labrum ; mandible with incisors slender ; tarsal claws with ventral teeth, progressively larger apically ; gills lanceolate, evenly tapered, without lateral tracheae.

- Width of labrum about 1.7 x length along median line ; denticles on anterior margin narrow based, extending across about 0.2 width of labrum ; secondary hair fringe present, set back from anterior margin about 0.15 of labrum length (Fig 6.58) **Genus R**
 [Distribution: SW Aust]

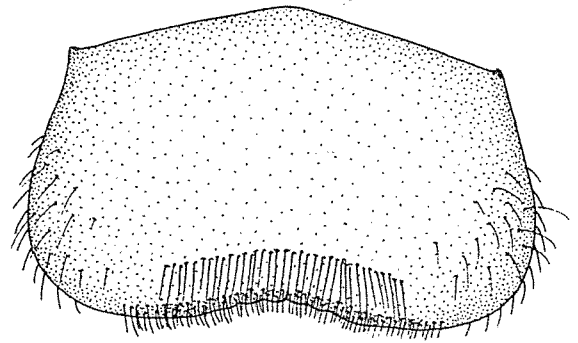
Diagnosis: Width of labrum about 1.7 x length along median line, denticles on anterior margin narrow based, extending across less than 0.2 width of labrum, secondary hair fringe present, set back from anterior margin about 0.15 of labrum length ; tarsal claws with ventral teeth, progressively larger apically ; gills narrow, linear, without lateral tracheae.



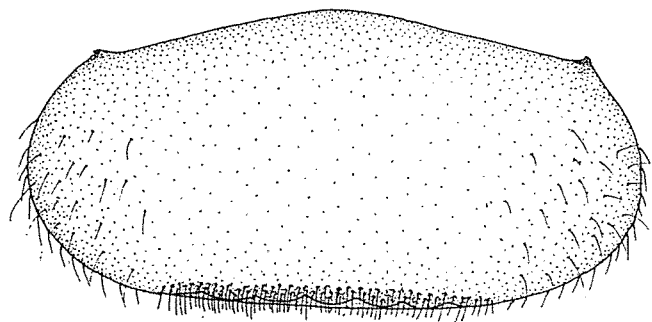
6.55



6.56



6.58



6.57

Family Leptophlebiidae

Nousia sp. 6.55 labrum; *Nyungara* sp. 6.56 whole nymph; 6.57 labrum ;
Genus R 6.58 labrum.

7 EPHEMERELLIDAE

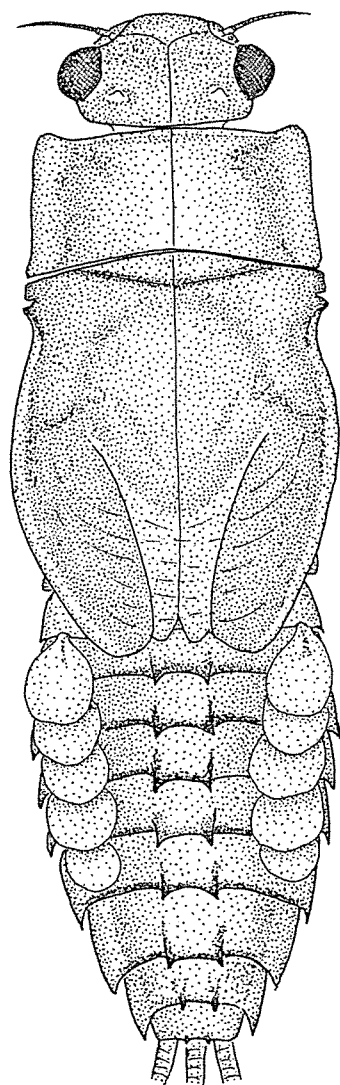
Nymph robust, heavily sclerotised, body length to about 10 mm. Head with pair of small dorsal protrubences ; antennae slender, length less than width of head capsule ; maxilla with palp rudimentary. Pronotum subrectangular, narrowing slightly to anterior, corners somewhat angular. Fore femur with outer margin broadly expanded in apical half ; all tibiae sub-triangular in cross section, with three acute longitudinal ridges ; tarsal claws with 4-5 ventral teeth. Abdomen broad, dorso-ventrally flattened. Abdominal segments 1 to 10 each with a pair of strong backwardly directed dorsal spines near posterior margin. Abdominal segments 2 to 9 with postero-lateral spines. Gills present on abdominal segments 2 to 6 ; each gill with upper lamella oval, plate-like, and lower lamella divided into two branches, each branch bearing a linear series of small overlapping lobes.

The family was first recorded from Australia by Riek (1963), from a small forest stream in Lamington National Park in south-eastern Queensland. Nymphs are also known from a forest stream in far northern New South Wales, but the family appears to have a very limited distribution. Nothing is known about ecology or life history.

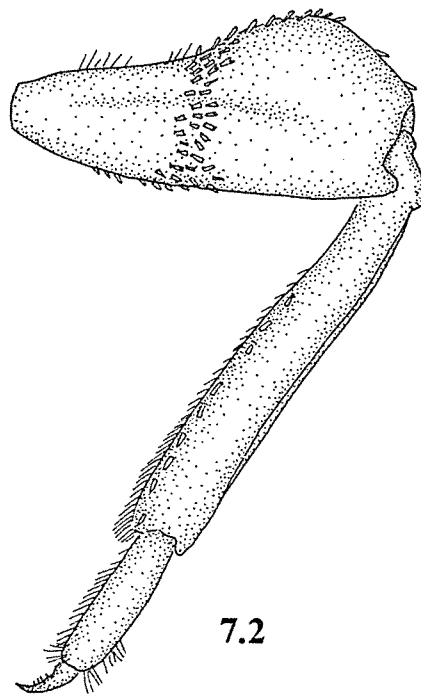
CHECK LIST OF DESCRIBED AUSTRALIAN GENERA

Ephemerellina (*Austremerella*) Riek, 1963

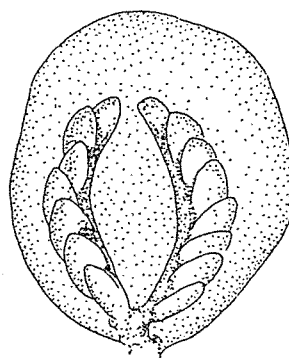
SE Q'land, northern NSW



7.1



7.2



7.3

Family Ephemerellidae

Ephemerellina (Austremerella) sp. 7.1 head, thorax and abdomen, dorsal ;
7.2 foreleg ; 7.3 gill from abdominal segment three.

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8 CAENIDAE

Small mayflies with body length rarely greater than 6mm. The nymphs are brown and sprawling, with distinct operculate gills on the second abdominal segment. Head prognathous, antennae longer than head width. Thorax and abdomen dorso-ventrally flattened, hind wing pads are absent. Gills are present on abdominal segments 1-6. First gills are monofilamentous, second gills are operculate and rectangular in shape, not fused at mid-line; gills on segments 3-6 with multifid tracheal filaments. Three caudal filaments present with whorls of setae at apex of segments, not fringed with setae.

Only two genera have been described from Australia, *Tasmanocoenis* Lestage and *Wundacaenis* Suter. Nymphs of *Tasmanocoenis* are usually found in slow flowing streams, wetlands and pools, particularly in depositional zones where there is a build up of fine particulate organic material. They are also found under bark, logs and rocks. In intermittent streams in the arid zone nymphs can be found in riffles and pools. *Wundacaenis* can occur in shallow flowing water particularly where aquatic plants are present.

The current study has identified an additional three genera, and these are included in the key as Genus B, Genus C and Genus D.

CHECK LIST OF DESCRIBED AUSTRALIAN GENERA

<i>Tasmanocoenis</i> Lestage 1930	All Australian States and Territories
<i>Wundacaenis</i> Suter 1993	NW Aust, NT, Q'land, NSW, probably Vic.

KEY TO THE GENERA OF LATE INSTAR NYMPHS

- 1 Mesonotum with distinct rounded or angular lobes on antero-lateral margins (Fig 8.1); sternite of 9th abdominal segment triangular with apex truncated and concave (Fig 8.3); body, legs and gill covers with complex anastomosed microtrichia (Fig 8.4); legs banded on tibiae and tarsi (Fig 8.2)

.....*Wundacaenis*

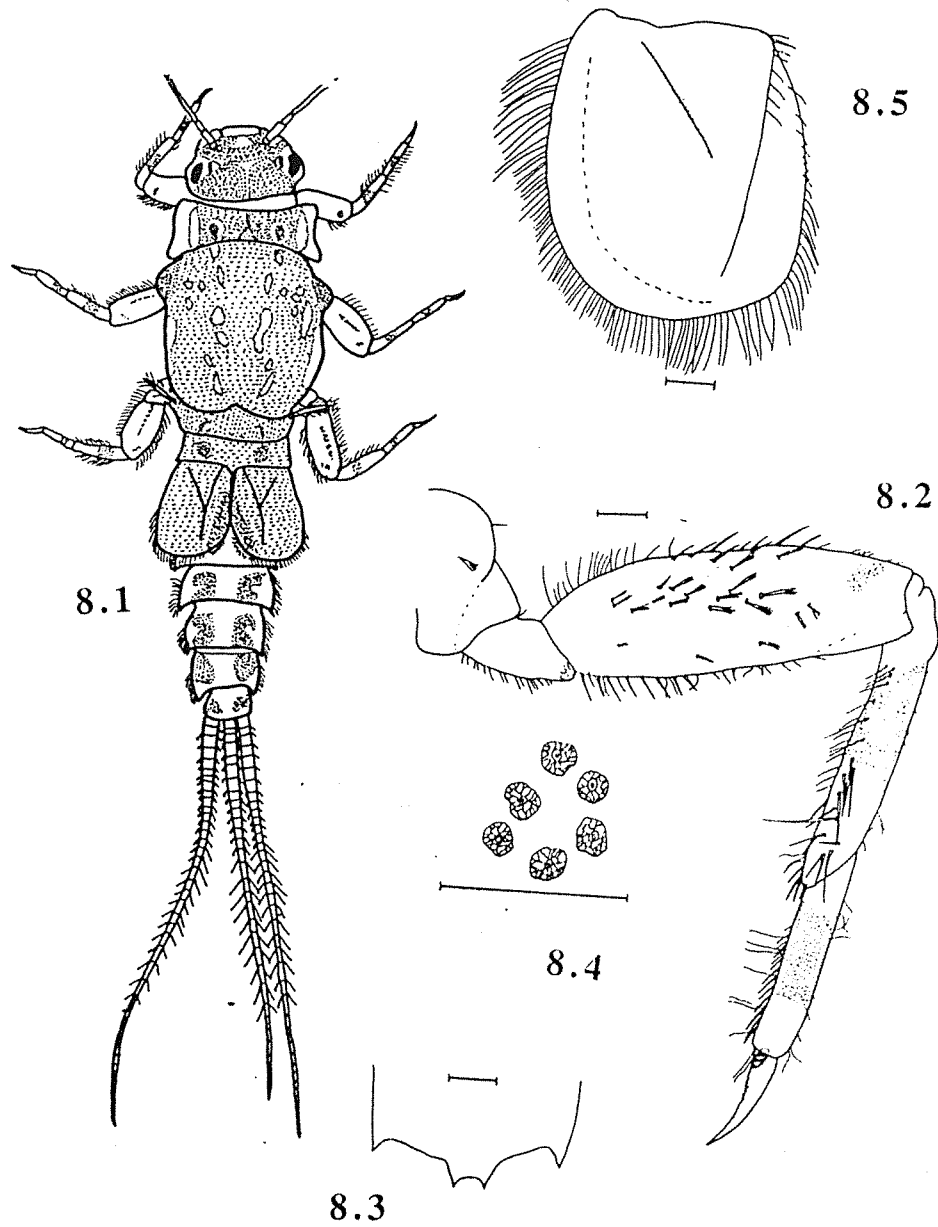
[Distribution: NW Aust, NT, Q'land, NSW, probably Vic]

Diagnosis: Mesonotum with distinct rounded or angular lobes on anterolateral margin margins; head without distinct lobes beneath antennae; tuft of setae near anterior margin of eye absent; seta absent on abdominal segment 1; sternite of abdominal segment IX triangular with posterior margin truncated and concave, ventral lobe absent; postero-lateral spines on abdomen well developed; gill cover with mesal ridge extending almost to posterior margin (Fig 8.5); body, legs and gill cover with complex anastomosed microtrichia; tibiae and tarsi banded; fore femora lacking a well developed transverse row of setae; tarsal claws with <6 basal teeth, hind tarsal claw may have a comb of bristles.

- Mesonotum lacking anterolateral lobes (Fig 8.16); sternite of 9th abdominal segment rounded, usually convex but may be slightly concave on posterior margin (Figs 8.8, 8.13, 8.19); legs usually not banded 2

- 2 Gill covers with a strongly developed mesal ridge extending almost to posterior margin (Figs 8.10, 8.15); generally not hairy; head with angular lobes beneath antennae (Fig 8.21); 3

- Gill covers with weakly developed mesal ridge, just extending into posterior half of cover (Figs 8.20, 8.23); body generally appears hairy; head with rounded anterior margin, lacking lobe beneath antennae (Fig 8.17) or with developed lobe 4



Family Caenidae

Wundacaenis sp. 8.1 whole nymph; 8.2 foreleg and tarsal claw; 8.3 ninth abdominal sternite; 8.4 microtrichia on gill cover; 8.5 gill cover.

- 3 Body, legs and gill covers lacking setae but covered with multifid microtrichia (Fig 8.6); nymph appears fuzzy; tarsal claws of all legs with >8 obvious teeth (Fig 8.7); 9th abdominal sternite concave posteriorly and without a ventral lobe (Fig 8.8); femora of foreleg without transverse row of setae (Fig 8.9)

..... **Caenid Genus C**

[Distribution: NSW, Vic]

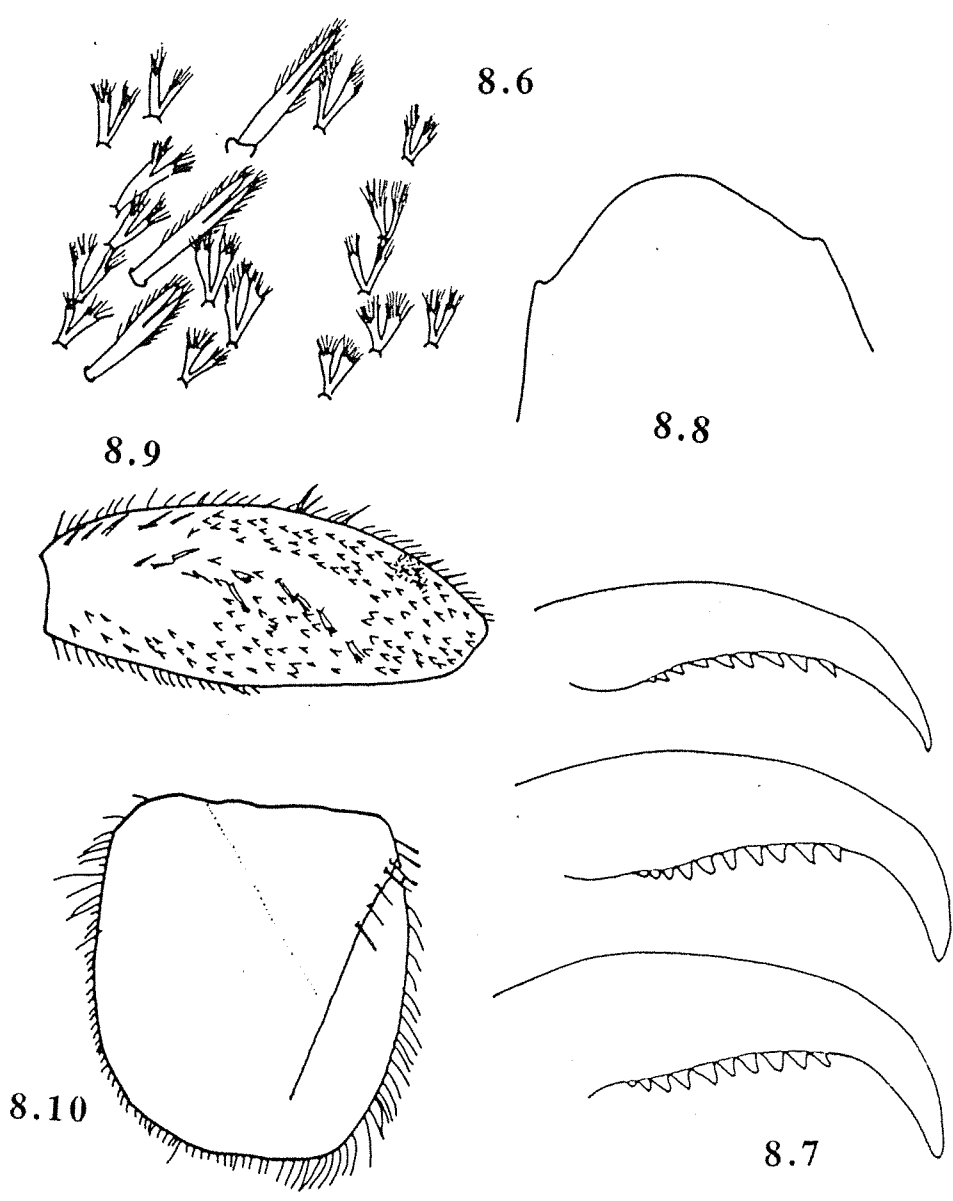
Diagnosis: Mesonotum without distinct rounded or angular lobes on anterolateral margins; head with distinct lobes beneath antennae; tuft of setae near anterior margin of eye absent; setae absent on abdominal segment I; sternite of abdominal segment IX with concave posterior margin, ventral lobe absent; postero-lateral spines on abdomen absent; gill cover with strongly developed mesal ridge extending almost to posterior margin of cover; body, legs and gill cover with complex multifid microtrichia; tibiae and tarsi not banded; fore femora without a transverse row of setae; tarsal claws with >8 basal teeth, hind tarsal claw lacking a comb of bristles.

- Body legs and gill covers with distinct setae (Fig 8.11); tarsal claws of all legs with <6 teeth, hind tarsal claw also with a comb of fine bristles (Fig 8.12); 9th abdominal sternite slightly concave posteriorly and with a ventral lobe present (Fig 8.13); femora of foreleg with a transverse row of setae (Fig 8.14)

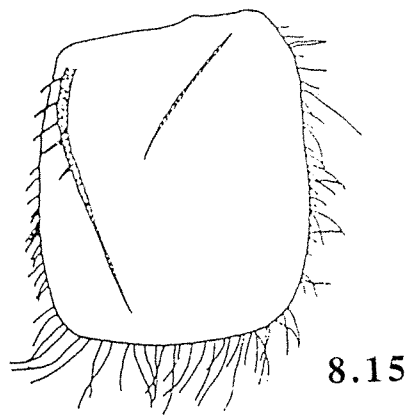
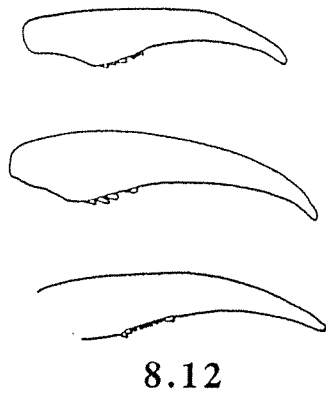
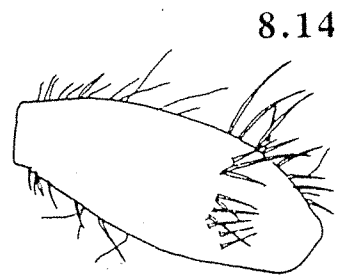
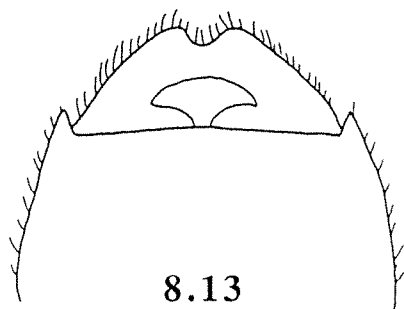
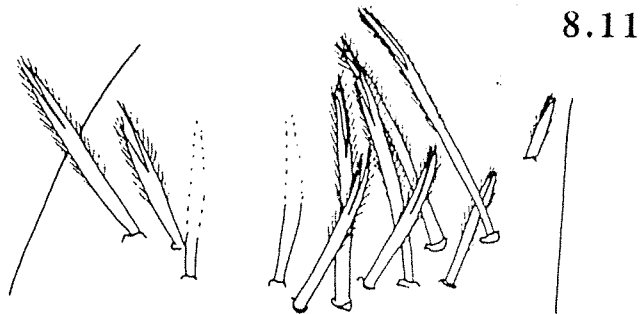
..... **Caenid Genus D**

[Distribution: NSW, Vic]

Diagnosis: Mesonotum without distinct rounded or angular lobes on anterolateral margins; tuft of setae near anterior margin of eye present; setae absent on abdominal segment I; sternite of abdominal segment IX rounded, with convex posterior margin which may have a slight indentation, ventral lobe present; postero-lateral spines on abdomen weakly developed; gill cover with strongly developed mesal ridge extending almost to posterior margin; body, legs and gill cover with short spines, lacking complex microtrichia; tibiae and tarsi not banded; fore femora with a well developed transverse row of setae; tarsal claws with <6 basal teeth, hind tarsal claw may have a comb of bristles.



Family Caenidae
 Caenid Genus C 8.6 microtrichia on surface of foreleg femur; 8.7 tarsal claws; 8.8 ninth abdominal sternite; 8.9 foreleg femur; 8.10 gill cover.



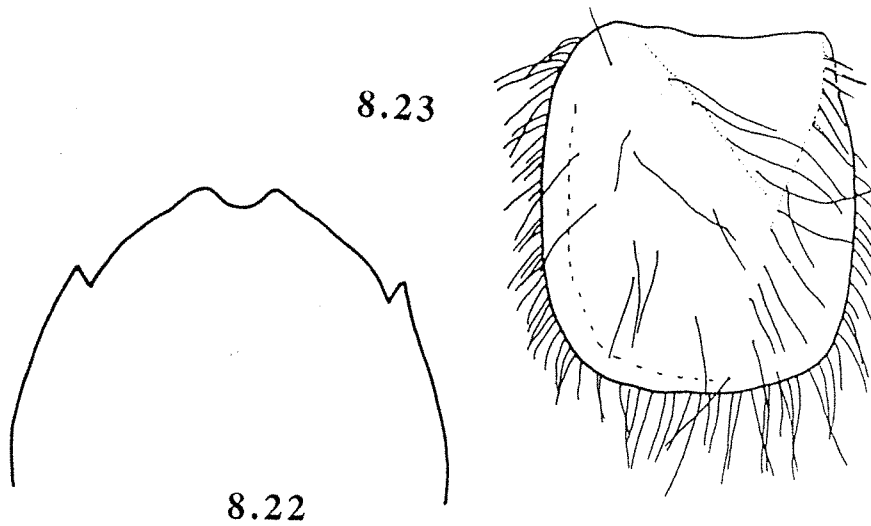
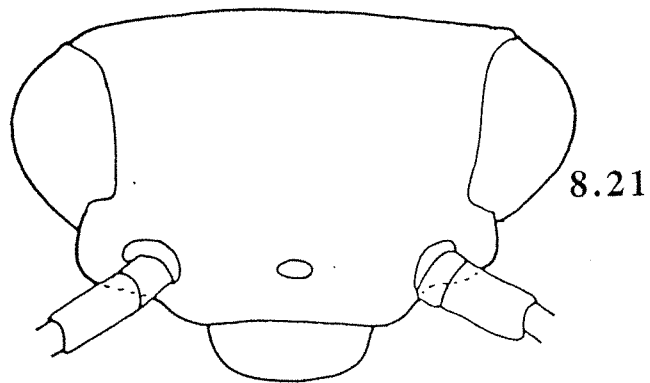
Family Caenidae
Caenid Genus D 8.11 setae on foreleg femur; 8.12 tarsal claws; 8.13 ninth abdominal sternite with ventral lobe; 8.14 foreleg femur; 8.15 gill cover.

- 4 Head with developed lobe beneath antennae (Fig 8.21); sternite of abdominal segment IX with concave posterior margin (Fig 8.22) **Caenid Genus B**
 [Distribution: NSW, Vic]

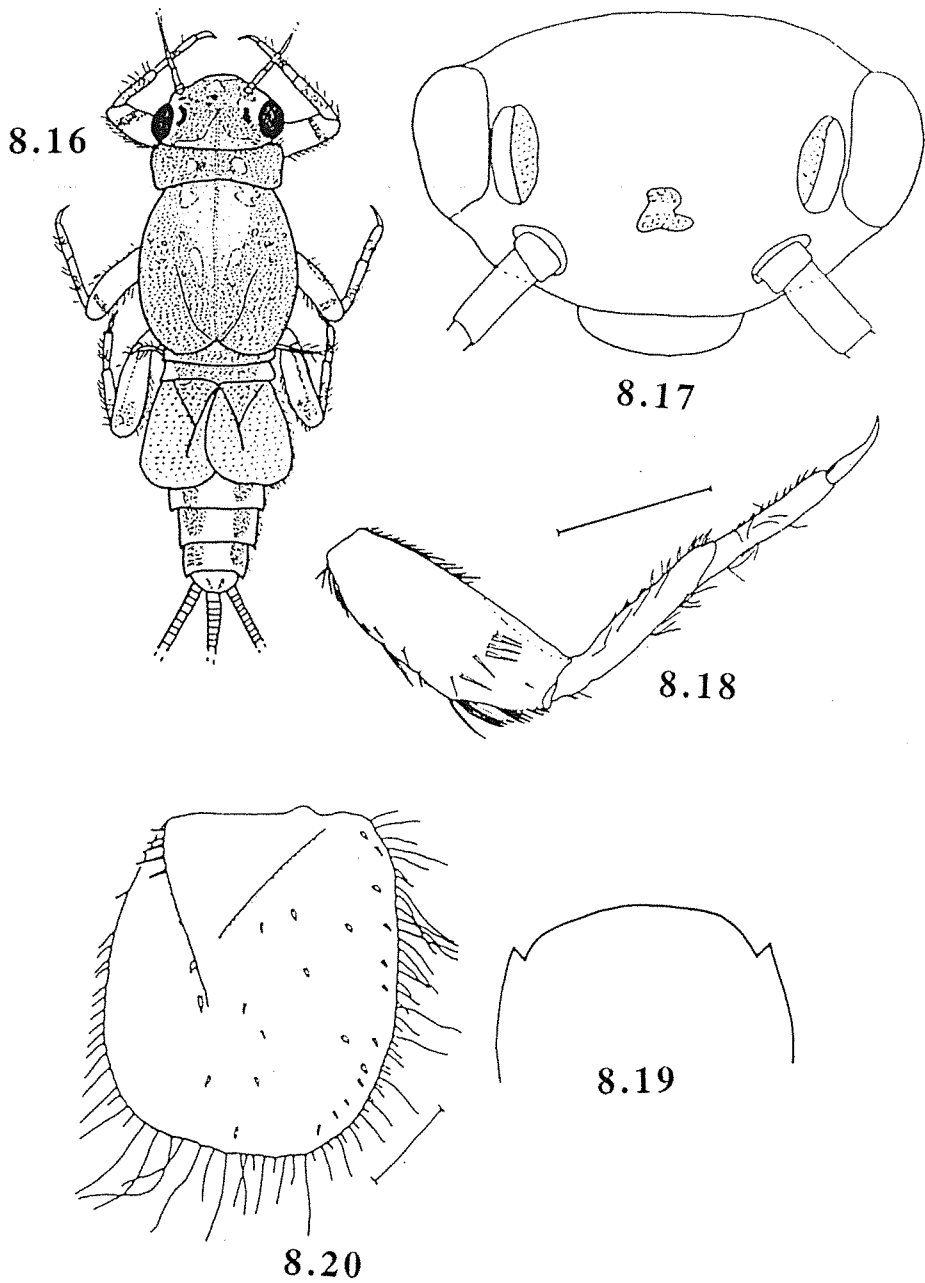
Diagnosis: Mesonotum without distinct rounded or angular lobes on anterolateral margins; head with distinct lobes beneath antennae; tuft of setae near anterior margin of eye present; seta present or absent on abdominal segment I; sternite of abdominal segment IX rounded, concave apically, ventral lobe absent; postero-lateral spines on abdomen weakly developed; gill cover with mesal ridge extending into posterior half of cover; body, legs and gill cover with setae, lacking complex microtrichia; tibiae and tarsi not banded; fore femora with a well developed transverse row of setae; tarsal claws with >6 basal teeth, hind tarsal claw may have a comb of bristles.

- Head without lobes, front of head rounded and convex (Fig 8.17); sternite of abdominal segment IX with convex posterior margin (Fig 8.18)
 *Tasmanocoenis*
 [Distribution: All Australian States and Territories]

Diagnosis: Mesonotum without distinct rounded or angular lobes on anterolateral margins; head without distinct lobes beneath antennae; tuft of setae near anterior margin of eye present; seta present or absent on abdominal segment I; sternite of abdominal segment IX rounded, with convex posterior margin which may have a slight indentation, ventral lobe absent; postero-lateral spines on abdomen well developed; gill cover with mesal ridge extending into posterior half of cover; body, legs and gill cover with setae, lacking complex microtrichia; tibiae and tarsi may be banded; fore femora with a well developed transverse row of setae; tarsal claws with <6 basal teeth, hind tarsal claw may have a comb of bristles.



Family Caenidae
Caenid Genus B 8.21 head; 8.22 ninth abdominal sternite; 8.23 gill cover.



Family Caenidae

Tasmanocoenis sp. 8.16 whole nymph; 8.17, head; 8.18 foreleg; 8.19 ninth abdominal sternite; 8.20 gill cover.

9 PROSOPISTOMATIDAE

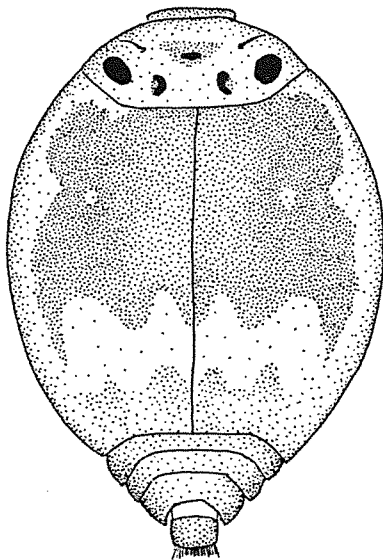
Nymphs small, body length to about 4 mm. Body form extremely modified. Upper surface strongly convex, ventral surface flat. Oval in dorsal view, with carapace enclosing thorax and anterior segments of abdomen. Head broad with convex upper surface, eyes depressed, antennae short, less than 1/4 width of head. Labium modified to form flat ventral shield.

Pearson and Penridge (1979) first recorded the Family from drift samples collected in northern Australia, and speculated that the nymphs inhabit inaccessible biotopes such as large rocks or boulders in rapidly flowing or deep water.

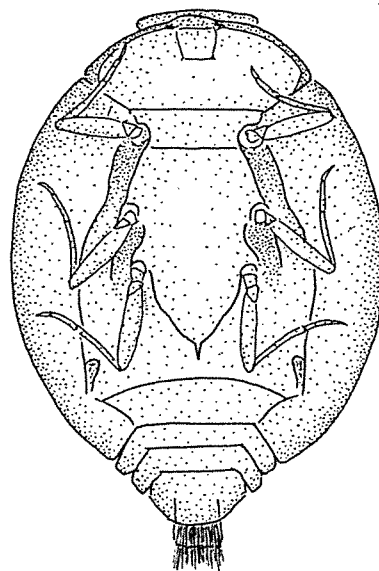
CHECK LIST OF DESCRIBED AUSTRALIAN GENERA

Prosopistoma Latrielle, 1833

Nth Q'land



9.1



9.2

Family Prosopistomatidae

Prosopistoma sp. 9.1 whole nymph, dorsal ; 9.2 whole nymph, ventral.

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