# PRELIMINARY KEYS FOR THE IDENTIFICATION OF AUSTRALIAN MAYFLY NYMPHS OF THE FAMILY LEPTOPHLEBIIDAE

John C. Dean

Identification Guide No. 20

COOPERATIVE RESEARCH CENTRE FOR FRESHWATER ECOLOGY

The Murray-Darling Freshwater Research Centre

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**Cooperative Research Centre for Freshwater Ecology**
**Identification Guide No. 20**

**Presented at the Taxonomy Workshop held at**
**The Murray-Darling Freshwater Research Centre**
**February, 1999**

Identification Guide Series edited by John H. Hawking.

First published 1999 by the Cooperative Research Centre for Freshwater Ecology, Ellis Street, Thurgoona, NSW 2640.

National Library of Australia Cataloguing-in-Publication

Dean, John Charles, 1946-.
Preliminary keys for the identification of Australian Mayfly nymphs of the family Leptophlebiidae.

Bibliography.
ISBN 1 876144 21 1
ISSN 1321-280X

1. Mayflies - Larvae - Australia - Identification. 2. Leptophlebiidae - Larvae - Australia - Identification. I. Cooperative Research Centre for Freshwater Ecology (Australia). II. Title. (Series : Identification Guide (Cooperative Research Centre for Freshwater Ecology (Australia)); no. 20).

595.7340994

Front Cover Top: *Atalophlebia* sp., nymph.
Left: *Nousia* sp., nymph.
Right: *Jappa* sp., nymph.
Bottom: *Kirrara* sp., nymph.
*Photographs by John H. Hawking*

# CONTENTS

# PRELIMINARY KEYS FOR THE IDENTIFICATION OF AUSTRALIAN MAYFLY NYMPHS OF THE FAMILY LEPTOPHLEBIIDAE


## Abstract

With sixteen described genera, additional undescribed genera and in excess of sixty described species, the family Leptophlebiidae is the most diverse of the Australian mayfly families. After a brief introduction to nymphal morphology and terminology, keys are presented for the identification of genera and known species and voucher species. Twenty-three genera and about 100 species are keyed and illustrated, and geographical distributions noted. A conservative approach to recognition of voucher species has been adopted, and it is acknowledged that at least some will represent complexes of two or more biological species. For most genera, an assessment is made of the current state of species level taxonomy.


## INTRODUCTION

The family Leptophlebiidae, with sixteen described genera, additional undescribed genera and in excess of 60 described species, is the most diverse of the Australian mayfly families. Dean & Suter (1996) provided a key to genera, both described and undescribed, which were recognised at that time, but recent clarification of the status of several undescribed genera and the discovery of additional genera has rendered their key out-of-date.

Although about 100 species are included in the present work, it should be emphasised that this is a progress report, and that it is likely many taxa remain unknown. It is almost certain that species occur in Australia in addition to those examined during this study. Nymphs of probable additional species have been examined, but have not been included in the keys because the material has been damaged, poorly preserved or too immature, and often only available as a single nymph. Throughout this work the approach to species recognition has been conservative. In quite a number of instances I believe that I have lumped valid species, and the resulting 'voucher species' probably represent complexes of two or more biological species. Few named species are included in keys, and this predominance of 'voucher species' is a reflection of the fact that most early taxonomic descriptions are based on adults only. Even when descriptions of nymphs are available they are usually inadequate for confident species recognition. Until detailed taxonomic investigations have been undertaken, coupled with extensive rearing and association of nymphs with adults, formal identification of most nymphs will not be possible.

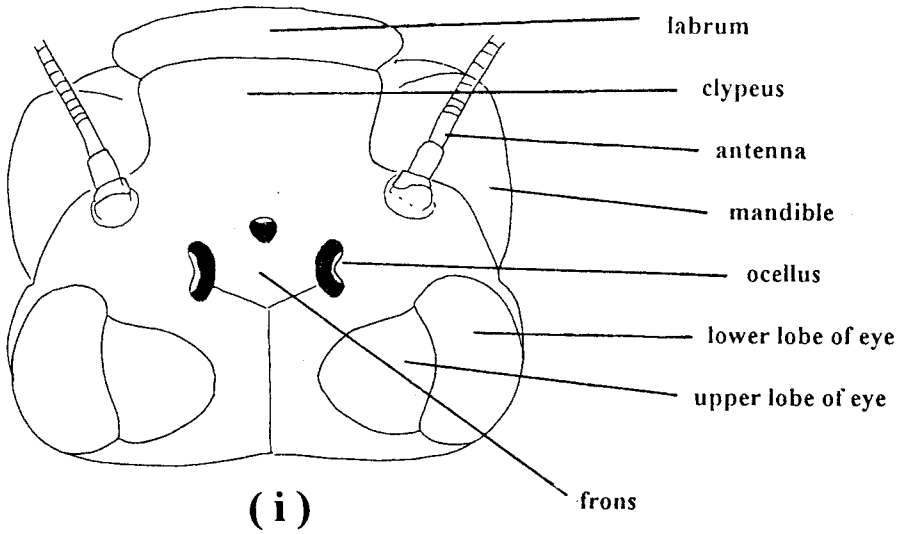
At the outset it is important to realise that the keys have been developed for later instar nymphs, and problems could occur when trying to separate early instars of closely related species.

## MORPHOLOGY AND TERMINOLOGY

A brief introduction to morphology and terminology has been presented by Dean & Suter (1996), and sections relevant to Leptophlebiidae are repeated here with some expansion. The more basal setal fringe on the upper surface of the labrum, formerly called the secondary setal fringe, in the present work is referred to as the sub-apical fringe.

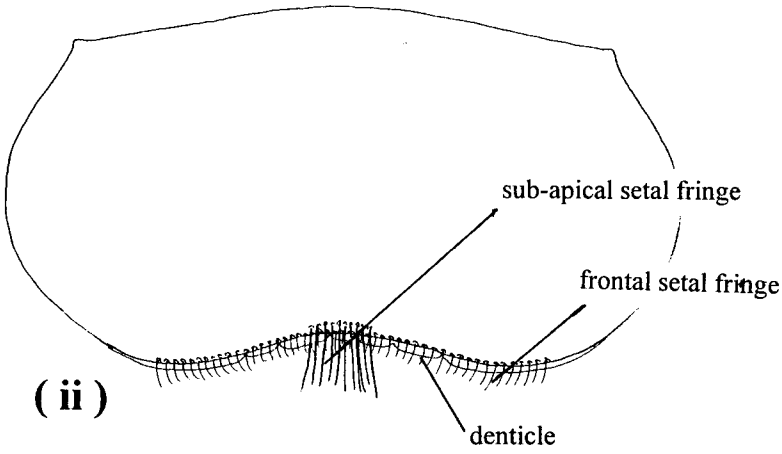
**Head** (Fig i). The head of leptophlebiid mayflies is prognathous, with the long axis parallel to the body and the mouthparts directed to the anterior. The *eyes* are moderately large, located close to the postero-lateral margin of the head, and are sexually dimorphic. The females possess dark eyes 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 a little more than the width of the head capsule to more than half the length of the body. The *clypeus* is located anterior to the antennae, projecting forward and forming the anterior margin of the dorsum of the head capsule.

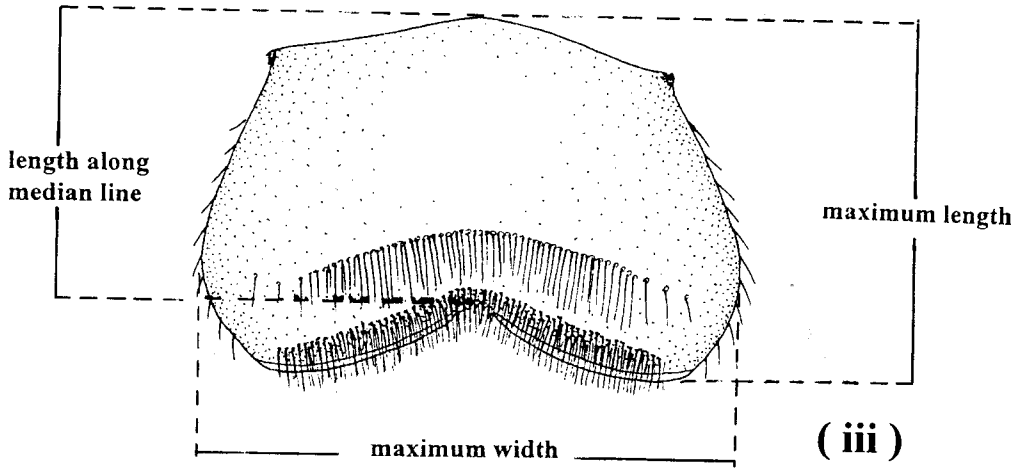
**Mouthparts** The mouthparts are fully functional. The most anterior structure, the *labrum* (Figs ii, iii) is quite variable in shape, and is of considerable taxonomic value. It is dorso-ventrally flattened, and attached along the base to the clypeus. The anterior margin usually bears a series of small *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 (*sub-apical setal fringe*) either located a little posterior to the frontal fringe or

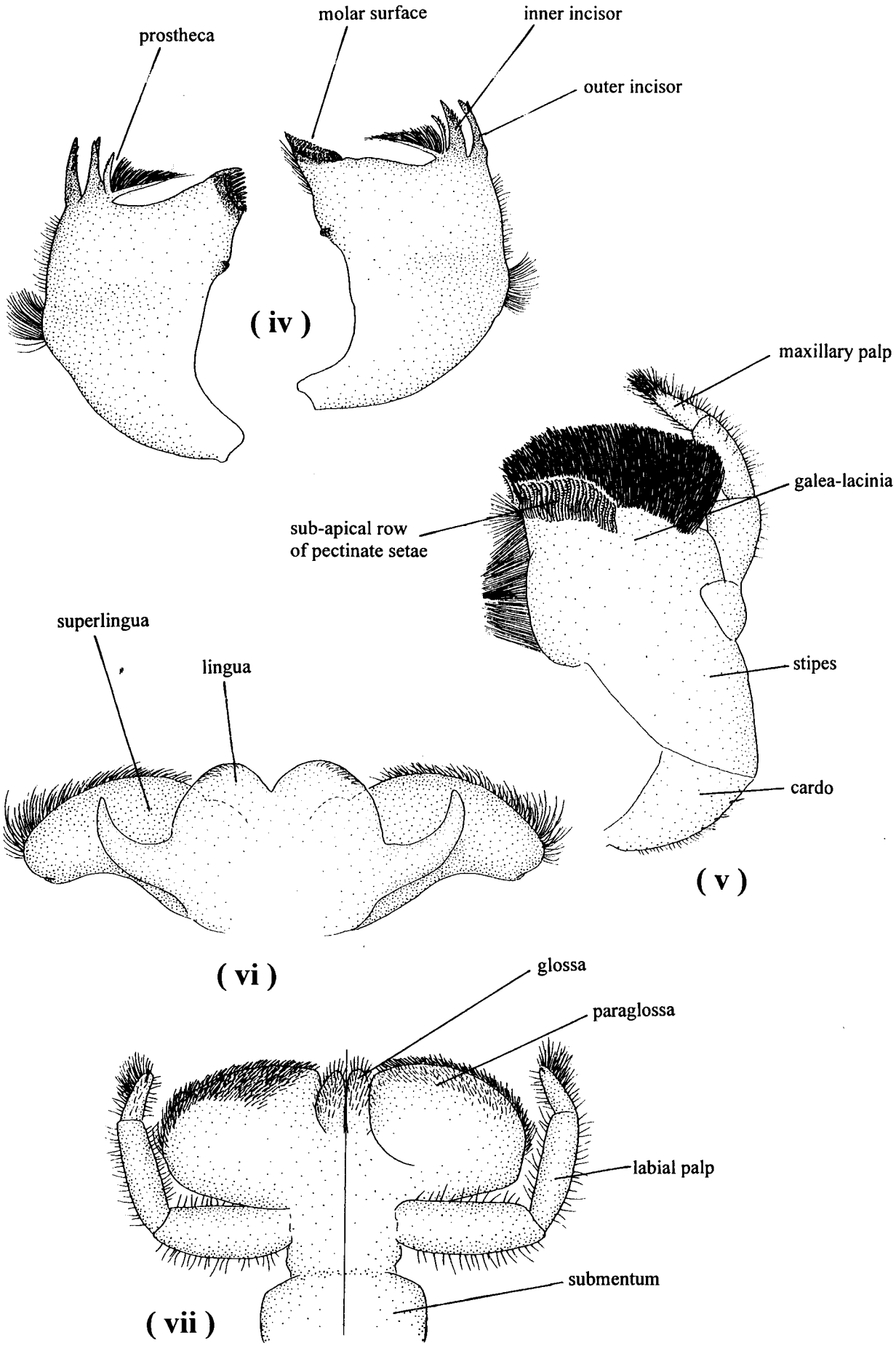



(i)

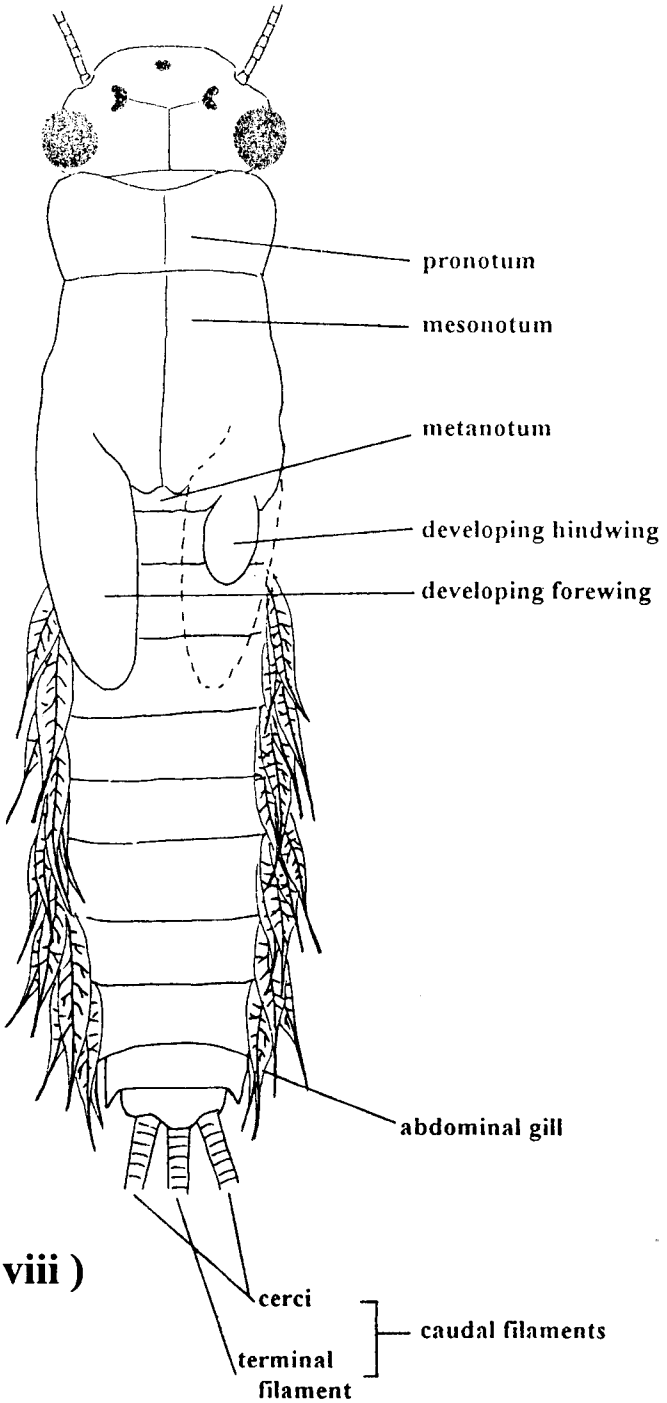
set back as far as midlength of the labrum. In some taxa the setae of the frontal fringe are arranged as a narrow band rather than a single row, while in several species the frontal setae are modified to form a suction disc. The width:length ratio of the labrum is often useful for species discrimination. The paired *mandibles* (Fig iv) are heavily sclerotised, and each has two apical *incisors*, a broad *molar surface*, and a *prostheca* located between the two areas. Posterior to the mandibles are a pair of *maxillae* (Fig v), each consisting of a basal *cardo*, a *stipes* and apically a fused *galea-lacinia* bearing setae and spines of variable structure and arrangement. On the ventral surface a *sub-apical row of pectinate setae* can be of diagnostic value. A *maxillary palp* of three segments arises from the outer margin of the stipes. The *hypopharynx* (Fig vi) 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* (Fig vii), which is dorso-ventrally flattened, and consists of a basal *submentum*, a distal plate-like structure formed from an inner pair of *glossae* and an outer pair of *paraglossae*, and a pair of three segmented *labial palps*.



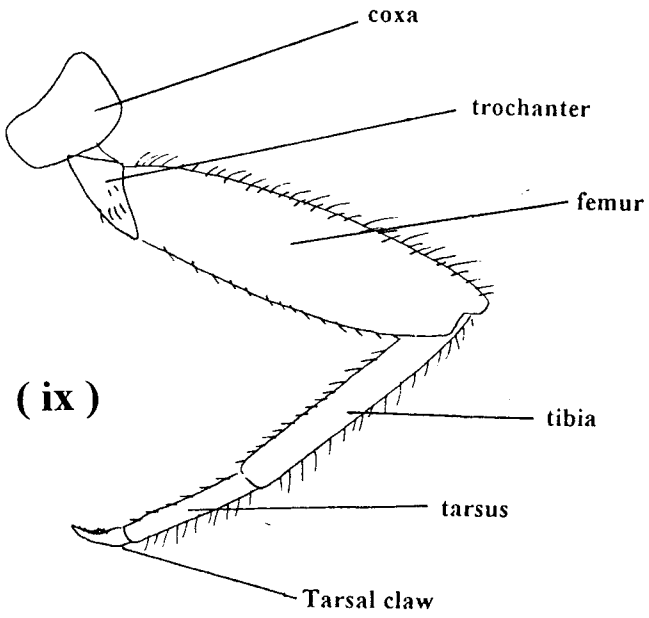

prostheca
molar surface
inner incisor
outer incisor
( iv )
maxillary palp
galea-lacinia
sub-apical row
of pectinate setae
stipes
cardo
( v )
superlingua
lingua
( vi )
glossa
paraglossa
labial palp
submentum
( vii )

**Thorax and Abdomen** (Fig viii). 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 separated from the more posterior segments by an ecdysial line, while the *mesonotum* comes to almost conceal the *metanotum* as the forewing pads develop. The legs (Fig ix) are typically six-segmented,

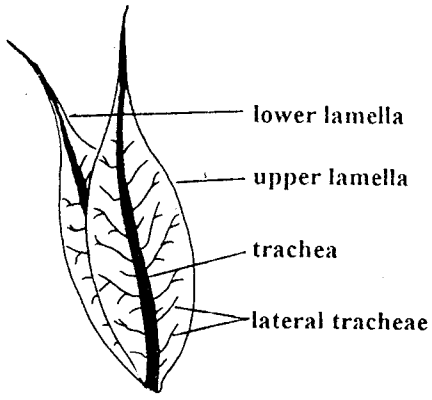



**( viii )**

consisting of the *coxa, trochanter, femur, tibia, tarsus* and *tarsal claw.* Arrangements of setae and spines can be of taxonomic importance at both the generic and species level. The abdomen consists of ten segments, each divided into a dorsal tergite and a ventral sternite. The postero-lateral angles of the tergites of at least some segments are produced into strong backwardly-directed spines, and the number of segments thus affected can be of taxonomic value. Each *abdominal tergum* bears a transverse row of spines close to the posterior margin, and the size and arrangement of these can also be diagnostic. Lateral *gills* are present on abdominal segments one to seven. The gills are diverse in structure and consist of an *upper lamella* and a *lower lamella.* Each lamella has a central *tracheae* and usually also strongly developed and branched *lateral tracheae* (Fig x). The tracheae may be continued into one or more digitate processes which extend beyond the margin of the gill. 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 a little longer than the abdomen to more than 3x the total body length.




( ix )




( x )

## GENERIC TAXONOMY

Generic taxonomy in the present work differs from that presented by Dean & Suter (1996). The taxa previously referred to as 'Genus D' has now formally been described as *Tillyardophlebia* (Dean, 1997), the species previously referred to 'Genus T' is now considered to belong in *Kirrara* (Christidis, in press), while a species from south-western Australia previously placed in 'Genus R' is here transferred to *Nousia*. Furthermore, although they have been kept separate in the present work, it now seems likely that 'Genus K' and 'Genus S' are synonomous. Four additional undescribed genera, not recorded by Dean & Suter (1996), are included in the present work. The identity of *Thraulophlebia* has still not formally been resolved, and it is not included in the generic key.

### Checklist and Distributions of Described Australian Genera

| | |
|---|---|
| *Atalomicria* Harker, 1954 | N Qld, SE Qld, NSW, Vic |
| *Atalophlebia* Eaton, 1881 | Australia wide |
| *Austrophlebioides* Campbell & Suter, 1988 | NW Aust, NT, N Qld, SE Qld, NSW, Vic, Tas |
| *Bibulmena* Dean, 1987 | SW Aust |
| *Garinjuga* Campbell & Suter, 1988 | NSW, Vic, Tas |
| *Jappa* Harker, 1954 | NW Aust, NT, N Qld, SE Qld, NSW,Vic |
| *Kalbaybaria* Campbell, 1993 | N Qld |
| *Kirrara* Harker, 1954 | N Qld, NSW, Vic |
| *Koorrnonga* Campbell & Suter, 1988 | N Qld, SE Qld, NSW, Vic, Tas, Sth Aust |
| *Neboissophlebia* Dean, 1988 | N Qld, NSW, Vic, SW Aust |
| *Nousia* Navas, 1918 | SE Qld, NSW, Vic, Tas, Sth Aust, SW Aust |
| *Nyungara* Dean, 1987 | SW Aust |
| *Thraulophlebia* Demoulin, 1955 | SE Qld |
| *Thraulus* Eaton, 1881 | NW Aust, NT, N Qld |
| *Tillyardophlebia* Dean, 1997 | NW Aust, NT, N Qld, SE Qld, NSW, Vic, Tas |
| *Ulmerophlebia* Demoulin, 1955 | N Qld, SE Qld, NSW, Vic |

### Checklist and Distributions of Undescribed Australian Genera

| | |
|---|---|
| Genus K | N Qld, NSW, Vic, Tas |
| Genus O | SE Qld, NSW |
| Genus P | NW Aust, NT |
| Genus Q | SW Aust |
| Genus S | SW Aust |
| Genus V | NW Aust, NT |
| Genus W | Tas |
| Genus Z | Vic, Tas |

## Key to Genera of late-instar nymphs

1 Abdominal gills digitate, each lamella with three or more digits (Figs 13,43,100,178), except upper lamella of first gill which is sometimes lanceolate (Fig 177) ..... 2

- Abdominal gills either with margins entire (Figs 57,101,121,187) or with single apical filament (Figs 4,76,81,85), sometimes with a pair of short apical projections flanking the apical filament (Fig 224) ..... 4

2(1) Mandible with large dorso-ventrally flattened projection (Figs 98,99) ..... ***Kalbaybaria***
[Distribution: N Qld]

- Mandible without projection (Fig 11) ..... 3

3(2) Tarsal claws with moderate size ventral teeth (Fig 179) or smooth (Fig 182); first abdominal gills with upper lamella slender and lanceolate, lower lamella digitate (Fig 177) ..... ***Thraulus***
[Distribution: NW Aust, NT, N Qld]

- Tarsal claws with small ventral denticles (Figs 12,29) or smooth (Fig 26); first abdominal gills with both lamellae digitate ..... ***Atalophlebia***
[Distribution: Australia wide]

4(1) Maxillary palps elongate, considerably longer than width of the head (Figs 1,3) ..... ***Atalomicria***
[Distribution: N Qld, SE Qld, NSW, Vic]

- Maxillary palps not elongate, shorter than width of head ..... 5

5(4) Gills with each lamella broad, with a single apical filament, densely clothed with fine setae in apical half (Figs 85,204,207); all legs densely setose (Fig 82) ..... 6

- Gills not as above, if with a single apical filament then not densely clothed with fine setae (Figs 76,81,224); legs not densely setose ..... 7

6(5) Head capsule with frontal horns (Fig 82) ..... ***Jappa***
[Distribution: NW Aust, NT, N Qld, SE Qld, NSW, Vic]

- Head capsule without frontal horns ..... ***Ulmerophlebia***
[Distribution: N Qld, SE Qld, NSW, Vic, Sth Aust]

7(5) Gill lamellae with a single apical filament, flanked by a pair of short apical projections (Fig 224) ..... **Genus P**
[Distribution: NW Aust, NT]

- Gill lamellae either without an apical filament (Figs 57,101,187) or with a filament which is not flanked by a pair of short projections (Figs 76, 81) ..... 8

8(7) Tarsal claws smooth (Figs 75,210) or with very small ventral denticles (Fig 227) ..... 9

- Tarsal claws with prominent ventral teeth (Figs 54,80,116,173) ..... 14

9(8) Tarsal claws with small ventral denticles (Fig 227) ..... **Genus Q**
[Distribution: SW Aust]

Kuninga Dean 2000

- Tarsal claws smooth (Figs 75, 210) ..... 10

10(9) Labrum relatively broad, width 2.3 to 2.5 x length along median line (Fig 119); gills very narrow, without lateral tracheae (Fig 121) ..... ***Neboissophlebia***
[Distribution: N Qld, NSW, Vic, SW Aust]

- Labrum less broad, width 1.7 to 1.9 x length along median line (Figs 73,213,232); gills variable, ranging from broad with strongly developed lateral tracheae to narrow without lateral tracheae (Figs 76,212,231) ..... 11

11(10) Gills broad, lateral tracheae strongly developed; inner margin of each lamella convoluted to form small recess near base of terminal filament (Fig 76) ..... ***Bibulmena***
[Distribution: SW Aust]

- Gills narrow to moderately broad, lateral tracheae varying from almost absent to moderately developed (Figs 212,215,233); inner margins of lamellae never with recess ..... 12

12(11) Legs very slender, length of femora 5-6x width (Figs 210,229); abdominal terga with minute scattered spines along posterior margin, length of individual spines 0.005 mm or less (Fig 211); mainland Australia and Tasmania ..... 13

- Legs more robust, length of femora 3-4x width (Figs 240,243); abdominal terga with row of moderately-long spines along posterior margin, length of individual spines 0.05 mm or more (Fig 241); Tasmania ..... **Genus W**
[Distribution: Tasmania]

13(12) Eastern Australia ..... **Genus K**
[Distribution: N Qld, NSW, Vic, Tas]

Loamaggalangta Dean et al 1999

- Western Australia ..... **Genus S**
[Distribution: SW Aust]

14(8) Labrum considerably broader than frontal margin of clypeus; width of labrum 2.5 (or more) x length along the median line (Figs 50,52,103,245); tarsi with ventral spine(s) in apical third considerably longer than more basal spines (Figs 54,104,246) ..... 15

- Labrum less than, subequal to or slightly broader than width of frontal margin of clypeus; width of labrum usually 1.5 to 2.4 x length along the median line (Figs 78,106,134,158,188), with the exception of 'Genus O' where the ratio is almost 3x (Fig 217); tarsi with ventral spines sub-equal in length (Figs 79,111,184,218) ..... 17

15(14) Abdominal gills downturned and modified to form a ventral disc (Fig 102); gills with upper lamella large, ovate, lower lamella very small or absent (Fig 105) ..... **Kirrara**
[Distribution: N Qld, NSW, Vic]

- Gills not modified to form a ventral disc, carried lateral or dorsal to the abdomen (Figs 51,244); each gill with upper and lower lamella subequal in size (Figs 57,71,247) ..... 16

16(15) Labrum with shallow concavity or narrow notch on anterior margin (Figs 52,62); postero-lateral spines *usually* present on abdominal segments 2 to 9; gills lanceolate, lateral tracheae *usually* strongly developed (Figs 57, 71) ..... ***Austrophlebioides***
[Distribution: NW Aust, NT, N Qld, SE Qld, NSW, Vic, Tas]

- Labrum with broad, deep V-notch on anterior margin (Fig 245); postero-lateral spines on abdominal segments 6 to 9 ; gills very narrow, without lateral tracheae (Fig 247) ..... **Genus Z**
[Distribution: Vic, Tas]

17(14) Abdominal gills with upper lamellae broad, dark, bearing single short apical filament (Fig 81); gills on abdominal segments 6 and 7 considerably smaller than gills on segment 3 ..... ***Garinjuga***
[Distribution: NSW, Vic, Tas]

- Abdominal gills usually narrow, lanceolate (Figs 107,117,128,219), sometimes broader (Fig 140); gills on abdominal segments 6 and 7 usually not much smaller than gills on segment 3 ..... 18

18(17) Labrum narrower than clypeus but very short, width almost 3x length along median line (Fig 217); legs short, stubby (Fig 218) ..... **Genus O**
[Distribution: SE Qld, northern NSW]

- Labrum subequal or a little broader than clypeus, not particularly short, width 2.4 or less x length along median line (Figs 110,123,153,170,188,234) ..... 19

19(18) Labrum with narrow, deep notch in anterior margin beneath overhang (Figs 188,191,197,234) ..... 20

- Labrum with anterior margin straight or shallowly concave (Figs 115,123,145,170), or if notch present then middle denticle strongly projecting into notch (Figs 153,156,158) ..... 21

Manggabora Dean + Suter 2004

20(19) Maxilla with about 10 pectinate setae in sub-apical row on ventral surface (Fig 235) ..... **Genus V**
[Distribution: NW Aust, NT]

- Maxilla with 25-30 pectinate setae in sub-apical row on ventral surface ..... ***Tillyardophlebia***
[Distribution: NW Aust, NT, N Qld, SE Qld, NSW, Vic, Tas]

21(19 ) Labrum with sub-apical setal fringe about 0.2x width of labrum, located close to anterior margin and projecting conspicuously beyond the margin (Figs 106,115) ..... ***Koorrnonga***
[Distribution: N Qld, SE Qld, NSW, Vic, Tas, Sth Aust]

- Labrum with sub-apical setal fringe extending about 0.5x width of labrum, not projecting conspicuously beyond the anterior margin (Figs 124,132,156), or without sub-apical setal fringe but with broad field of setae close to anterior margin of labrum (Fig 170) ..... 22

22(21) Labrum with well defined sub-apical setal fringe (Figs 124,132,145,158) ..... ***Nousia*** (in part)
[Distribution: SE Qld, NSW, Vic, Tas, Sth Aust, SW Aust]

- Labrum with sub-apical setal fringe absent or ill defined and merged with narrow band of setae close to anterior margin (Figs 148,171) ..... 23

23(22) Gill membrane unpigmented; south-western Australia ..... ***Nyungara***
[Distribution: SW Aust]

- Gill membrane darkly pigmented; south-eastern Australia ..... ***Nousia*** (in part)
[Distribution: SE Qld, NSW, Vic]

## Genus *Atalomicria* Harker 1954

**Diagnosis:** Length of antennae 2-3x width of head. Labrum narrower than clypeus, broadest at base, with moderately deep concavity in anterior margin. Mandibles with outer incisor robust, triangular, with sub-apical denticles. Maxillary palps greatly enlarged. Apical segment of labial palp sub-triangular, with series of stout spines along inner margin. Legs banded, tarsal claws smooth. Postero-lateral spines on abdominal segments 7 or 8-9, or 9 only. Gills double, each lamella long, parallel-sided, ranging from narrow to moderately broad, with a short apical filament.

**Taxonomy:** *Atalomicria* has recently been revised by Campbell and Peters (1993), who recognised seven species and provided a key to the nymphs of five of these. The study was, however, based on limited material, with the four newly described species each being recorded from a single locality, three of them from the same locality. There is clearly a need for a more comprehensive review of the genus. The key below is modified from that given by Campbell and Peters (1993). The voucher species *Atalomicria* sp.AV1 probably includes the described species *A.banjdjalama, A.chessmani* and *A.yugana*, but I am not prepared to split the voucher species further at this time. I have not seen specimens of *A.dalagara*, and it is included in the key on the basis of Campbell and Peters' descriptions.

### Checklist of species included in the key

| | |
|---|---|
| *Atalomicria bifasciata* Campbell & Peters | SE Qld |
| *Atalomicria dalagara* Campbell & Peters | SE Qld |
| *Atalomicria sexfasciata* (Ulmer) | N Qld |
| *Atalomicria* sp.AV1 | SE Qld, NSW, Vic |

### Key to nymphs of Australian species

1 Abdominal segment 8 without postero-lateral spine (Fig 9); gills relatively narrow, lateral tracheae weakly developed (Fig 8); abdominal terga predominantly golden, with restricted brown pigmentation (Fig 7) ..... 2

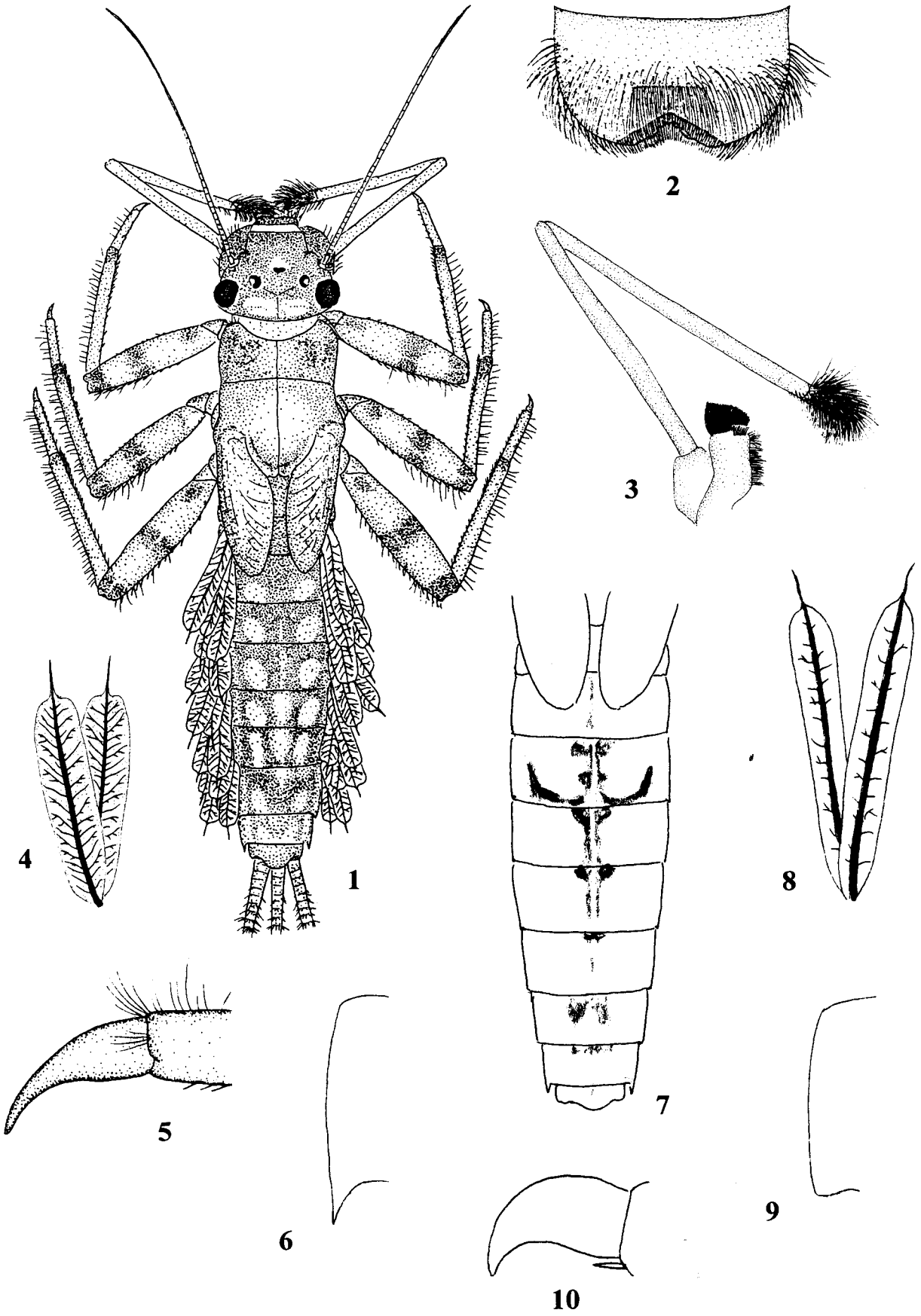
\- Abdominal segment 8 with strongly developed postero-lateral spine (Fig 6); gills moderately broad, with conspicuous lateral tracheae (Fig 4); extensive brown pigmentation on abdominal terga (Fig 1) ..... 3

2(1) North Queensland ..... ***Atalomicria sexfasciata***

\- South-east Queensland ..... ***Atalomicria bifasciata***

3(1) Tarsal claws short and curved (Fig 10) ..... ***Atalomicria dalagara***

\- Tarsal claws long, relatively straight (Fig 5) ..... ***Atalomicria* sp.AV1**




***Atalomicria* sp.AV1**: 1, whole nymph; 2, labrum; 3, maxilla; 4, fourth abdominal gill; 5, fore-tarsal claw. 6, lateral margin of eighth abdominal segment. ***Atalomicria sexfasciata***: 7, dorsum of abdomen; 8, fourth abdominal gill; 9, lateral margin of eighth abdominal segment. ***Atalomicria dalagara***: 10, fore-tarsal claw.

## Genus *Atalophlebia* Eaton 1881

**Diagnosis:** Labrum narrower than clypeus; relatively short, length:width ratio 2.1 to 2.5. Mandibles with outer incisor robust, triangular, with sub-apical denticles. Maxillary palp moderately long. Labium with glossae turned under ventrally; terminal segment of labial palp sub-triangular, with a series of stout spines along the inner margin. Legs usually banded; tarsal claws with ventral series of small denticles, although one species has smooth claws. Postero-lateral spines usually present on abdominal segments 2 to 9, although in a few species these are reduced on the more anterior segments. Gills present on abdominal segments 1 to 7, each gill consisting of an upper and a lower lamella, each lamella with margin divided to form three or more digits.

**Taxonomy:** The genus was erected by Eaton (1881), with *Ephemera australis* Walker from Tasmania the designated type species. The identity of the type species was clarified by Tillyard (1934), who described all stages. *Atalophlebia* has historically been used as a dumping ground for newly described species, and it is obvious that at least some of these species will eventually be accommodated in alternative genera. Many named species have been inadequately described, while some of the voucher species listed below have been associated with undescribed adults, and the genus is clearly in need of revision. Most species in southern Australia are probably included in the key, but the extent of coverage of the Queensland fauna is unknown.

**Checklist of species included in the key**

| | |
|---|---|
| *Atalophlebia australis* (Walker) | NSW, Vic, Tas, Sth Aust |
| *Atalophlebia* sp.AV2 | NSW, Vic |
| *Atalophlebia albiterminata* Tillyard | NSW, Vic, Tas |
| *Atalophlebia* sp.AV4 | SE Qld, NSW, Vic |
| *Atalophlebia* sp.AV5 | Vic |
| *Atalophlebia* sp.AV6 | N Qld, SE Qld, NSW, Vic |
| *Atalophlebia* sp.AV7 | NSW, Vic |
| *Atalophlebia* sp.AV8 | NSW, Vic |
| *Atalophlebia* sp.AV9 | NSW, Vic |
| *Atalophlebia* sp.AV12 | NSW, Vic, Sth Aust |
| *Atalophlebia* sp.AV13 | N Qld, SE Qld, NSW, Vic |
| *Atalophlebia* sp.AV14 | Central Aust |
| *Atalophlebia* sp.AV15 | NSW |
| *Atalophlebia* sp.AV16 | NT |
| *Atalophlebia* sp.AV17 | NW Aust, SW Aust |
| *Atalophlebia* sp.AV18 | SE Qld |
| *Atalophlebia* sp.AV21 | N Qld, SE Qld, NSW |

## Key to nymphs of Australian species

1 Gills with three digits (Figs 27,30,43) ..... 7

- Gills with more than three digits (Figs 13,17,19,20,23,25) ..... 2

2(1) Foretarsus with about 40 ventral spines (Fig 12); gills strongly digitate, outer margins of upper lamellae digitate right to base (Fig 13); well developed postero-lateral spines on abdominal segments 6 or 7 to 9 (Fig 14) ..... ***Atalophlebia* sp.AV12**

- Foretarsus usually with fewer than 20 ventral spines (Figs 16,22), although one species with about 30 spines (Fig 18); gills usually less strongly digitate, outer margins of upper lamellae entire along basal third at least (Figs 17,19,20,23), although one species with gills digitate right to base (Fig 25); well developed postero-lateral spines on abdominal segments 2 to 9 (Fig 24) ..... 3

3(2) Outer margin of fore-femur with spines in apical half relatively long and slender (Fig 15) ..... ***Atalophlebia albiterminata***

- Outer margin of fore-femur with spines in apical half shorter, more robust (Fig 21) ..... 4

4(3) Foretarsus with about 30 ventral spines, tarsal claws long and slender (Fig 18) ..... ***Atalophlebia* sp.AV15**

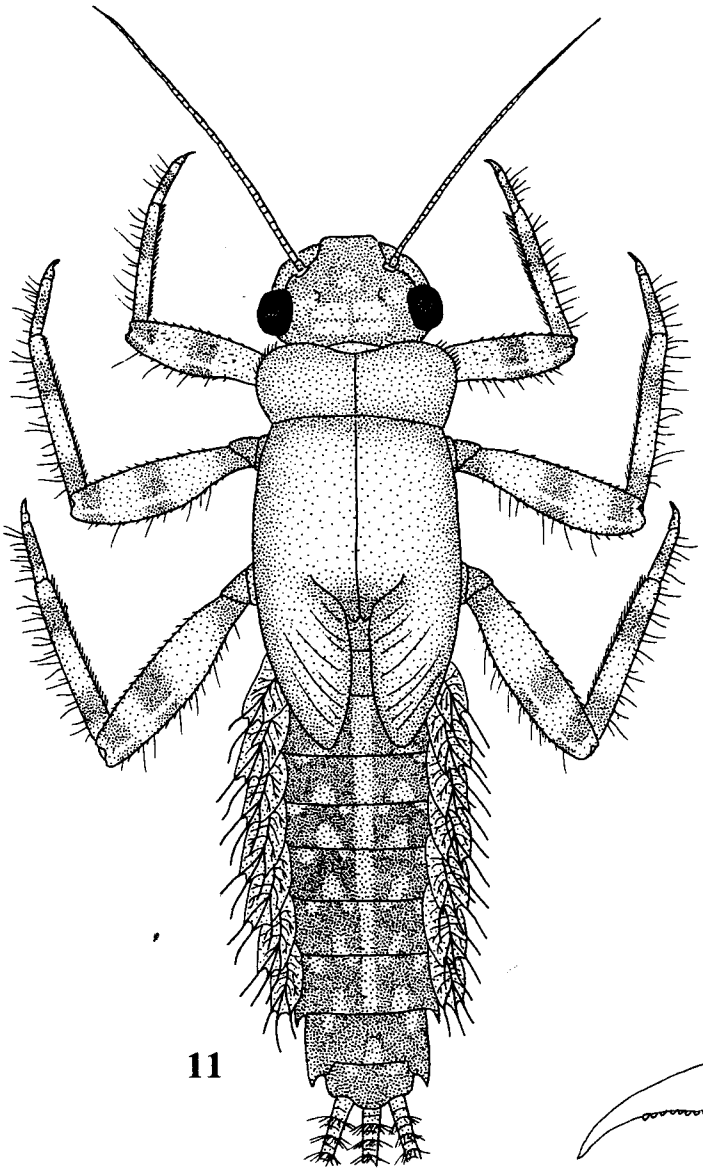
- Foretarsus with fewer than 20 ventral spines, tarsal claws shorter and moderately stout (Fig 22) ..... 5

5(4) Outer margins of upper gill lamellae entire along at least basal three-quarters, only one or two free digits towards apex (Fig 20); foretarsus with fewer than 10 ventral spines ..... ***Atalophlebia* sp.AV2**

- Outer margins of upper gill lamellae entire along basal half or less, usually four or more free digits (Figs 23,25); foretarsus with about 15 ventral spines ..... 6

6(5) Outer margins of upper gill lamellae entire along basal half or a little less (Fig 23) ..... ***Atalophlebia* sp.AV13**

- Outer margins of upper gill lamellae digitate right to base (Fig 25) ..... ***Atalophlebia* sp.AV18**



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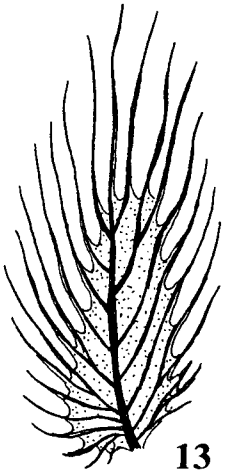

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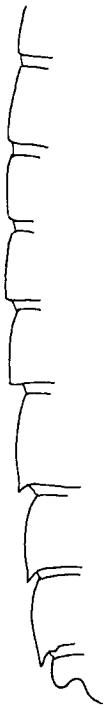

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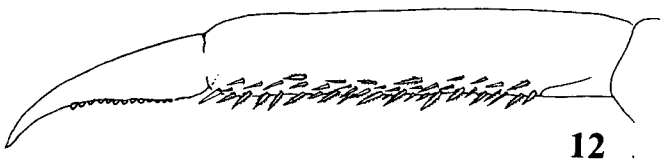

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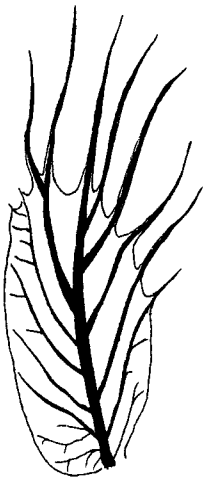

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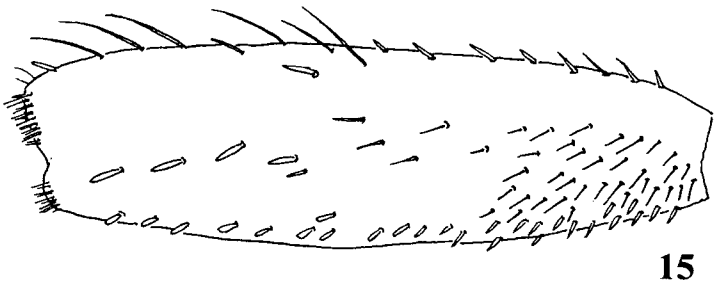

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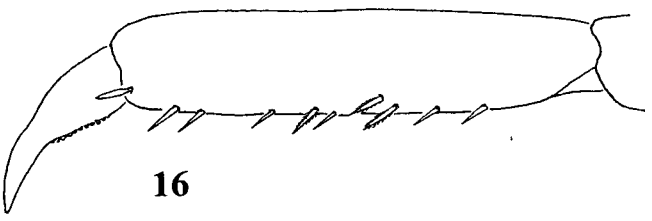

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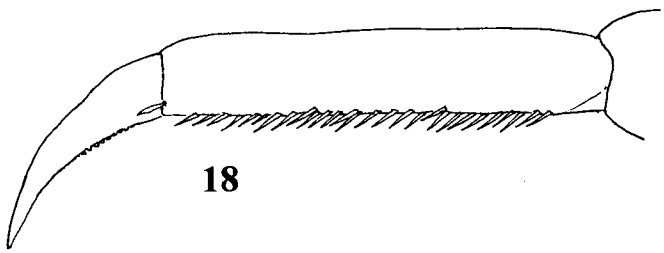

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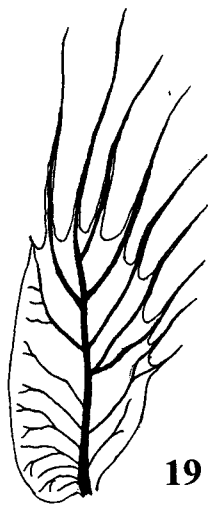

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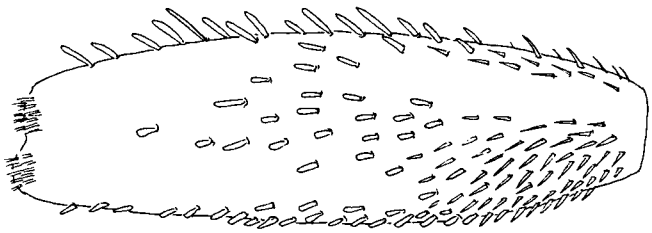

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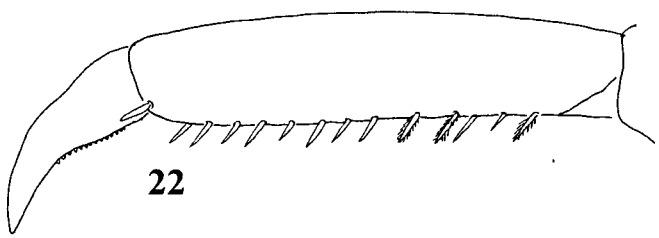

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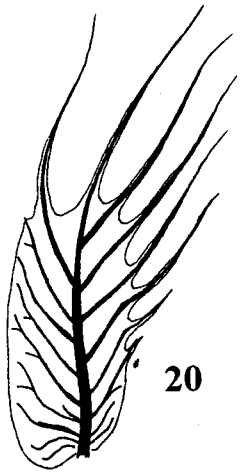

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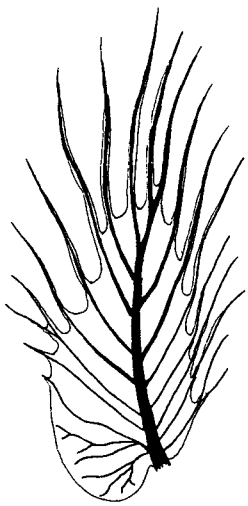

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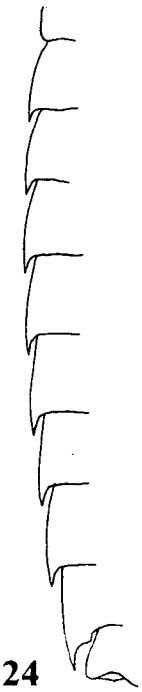

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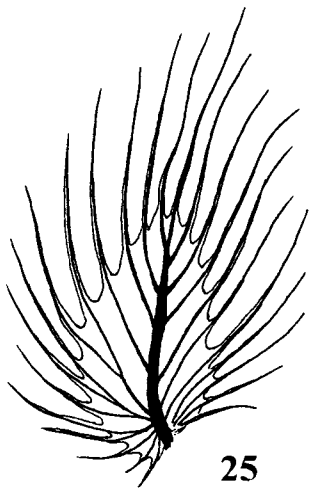

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***Atalophlebia* sp.AV5**: 11, whole nymph. ***Atalophlebia* sp.AV12**: 12, fore-tarsus; 13, fourth abdominal gill, upper lamella; 14, lateral margin of abdominal segments. ***Atalophlebia albiterminata***: 15, fore-femur; 16, fore-tarsus; 17, fourth abdominal gill, upper lamella. ***Atalophlebia* sp.AV15**: 18, fore-tarsus; 19, fourth abdominal gill, upper lamella. ***Atalophlebia* sp.AV2**: 20, fourth abdominal gill, upper lamella. ***Atalophlebia* sp.AV13**: 21, fore-femur; 22, fore-tarsus; 23, fourth abdominal gill, upper lamella; 24, lateral margin of abdominal segments. ***Atalophlebia* sp.AV18**: 25, fourth abdominal gill, upper lamella.

7(1) Postero-lateral spines on abdominal segments 6(or 7) - 9 (Fig 28) ..... 8

- Postero-lateral spines on abdominal segments 2-9 (Figs 31,37,42) .....9

8(7) Nymph extremely setose; foretarsus with 40-50 long ventral spines, tarsal claws smooth (Fig 26) ..... ***Atalophlebia* sp.AV7**

- Nymph not heavily setose; foretarsus with 10 or fewer ventral spines, tarsal claws with series of small ventral denticles (Fig 29) ..... ***Atalophlebia* sp.AV4**

9(7) Foretarsus with about 10 ventral spines; spines short and inconspicuous, length less than about 1/8 diameter of tarsus (Figs 32,34) ..... 10

- Foretarsus with more than 15 ventral spines; spines long and conspicuous, length at least 1/4 diameter of tarsus (Figs 36,38) ..... 12

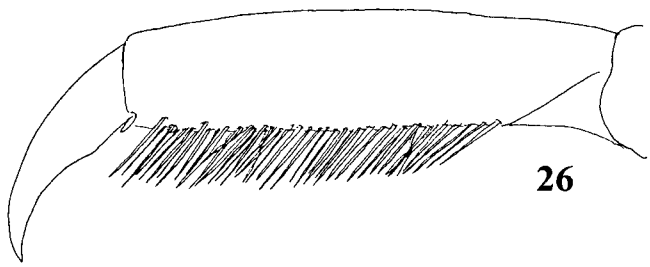
10(9) Venter of abdomen with three well defined longitudinal dark stripes (Fig 31) ..... ..... ***Atalophlebia* sp.AV6**

- Venter of abdomen with pigmentation either more extensive or absent, never forming three longitudinal stripes ..... 11

11(10) Postero-lateral spines on abdominal segments short, those on segment 5 approximately 1/8 length of segment (Fig 33) ..... ***Atalophlebia* sp.AV16**

- Postero-lateral spines on abdominal segments strongly developed, those on segment 5 approximately 1/3 length of segment (Fig 35) ..... ***Atalophlebia* sp.AV21**

***Atalophlebia* sp.AV7**: 26, fore-tarsus; 27, fourth abdominal gill, upper lamella. ***Atalophlebia* sp.AV4**: 28, lateral margins of abdominal segments; 29, fore-tarsus; 30, fourth abdominal gill, upper lamella. ***Atalophlebia* sp.AV6**: 31, venter of abdomen. ***Atalophlebia* sp.AV16**: 32, fore-tarsus; 33, lateral margin of abdominal segment V. ***Atalophlebia* sp.AV21**: 34, fore-tarsus; 35, lateral margin of abdominal segment V.



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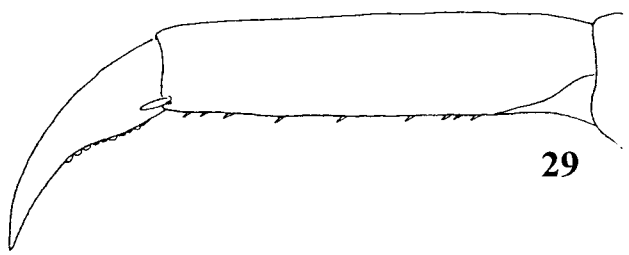

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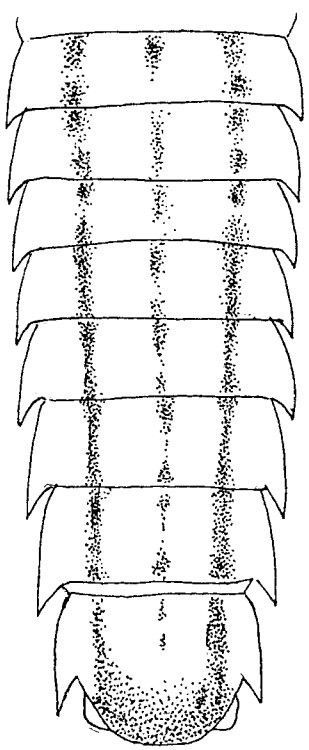

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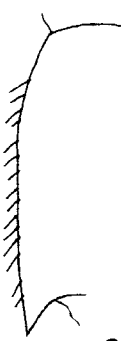

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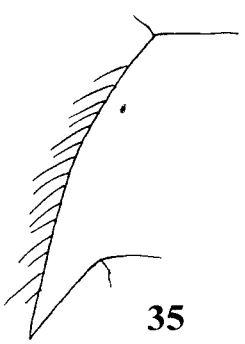

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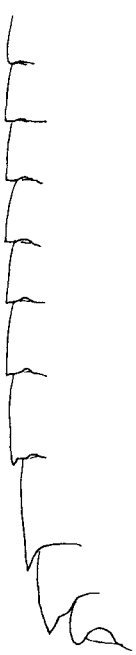

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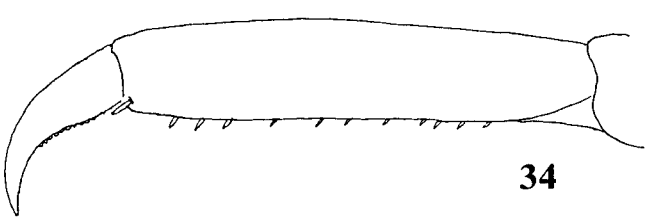

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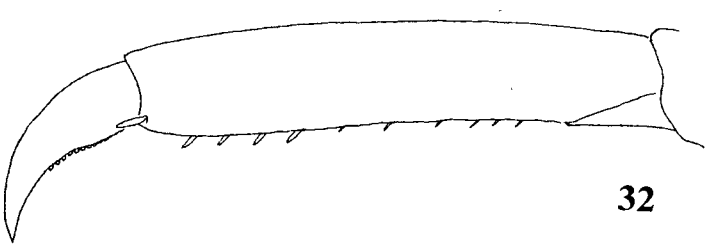

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12(9) Postero-lateral spines on abdominal segments short, those on segment 5 approximately 1/5 (or less) length of segment (Fig 37) ..... 13

- Postero-lateral spines on abdominal segments strongly developed, those on segment 5 approximately 1/3 (or more) length of segment (Fig 42) ..... 14

13(12) Foretarsus with 30-40 ventral spines, length of spines approximately 1/2 diameter of tarsus (Fig 36); dorsum of abdomen with strongly defined broad pale longitudinal band (Fig 46) ..... ***Atalophlebia* sp.AV9**

- Foretarsus with 20-25 ventral spines, length of spines 1/3 or less diameter of tarsus (Fig 38); dorsum of abdomen without broad pale longitudinal band (Fig 45) ..... ***Atalophlebia* sp.AV5**

14(12) Foretarsus with 15-20 ventral spines (Fig 39) ..... 15

- Foretarsus with approximately 30 (or more) ventral spines (Fig 41) ..... 16

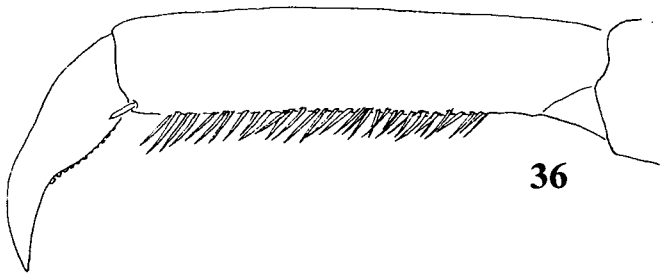
15(14) South-eastern Australia ..... ***Atalophlebia* sp.AV8**

- North-western and south-western Australia ..... ***Atalophlebia* sp.AV17**

16(14) Outer margin of fore femur with relatively sparse series of short, stout spines interspersed with a few long slender spines (Fig 40); mainland south-eastern Australia and Tasmania ..... ***Atalophlebia australis***

- Outer margin of fore femur with dense series of moderate-length robust spines (Fig 44); central Australia ..... ***Atalophlebia* sp.AV14**

***Atalophlebia* sp.AV9**: 36, fore-tarsus; 37, lateral margin of abdominal segment 5. ***Atalophlebia* sp.AV5**: 38, fore-tarsus. ***Atalophlebia* sp.AV8**: 39, fore-tarsus. ***Atalophlebia australis***: 40, fore femur, apical half; 41, fore-tarsus; 42, lateral margins of abdominal segments; 43, fourth abdominal gill, upper lamella. ***Atalophlebia* sp.AV14**: 44, fore femur, apical half.



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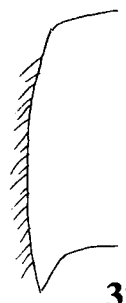

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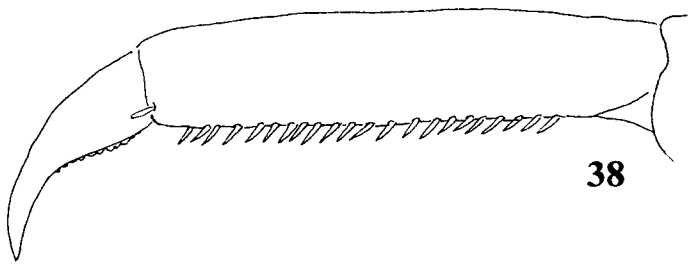

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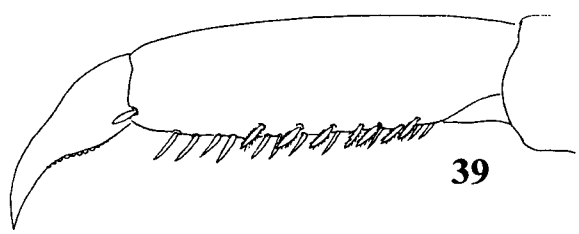

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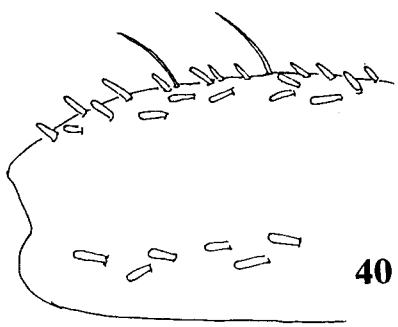

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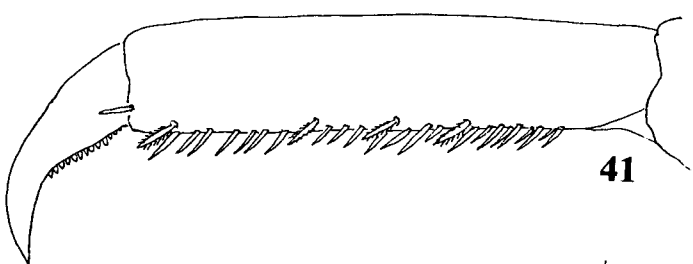

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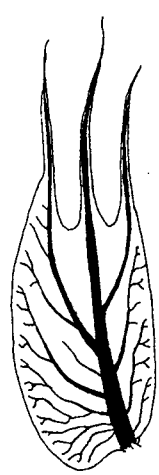

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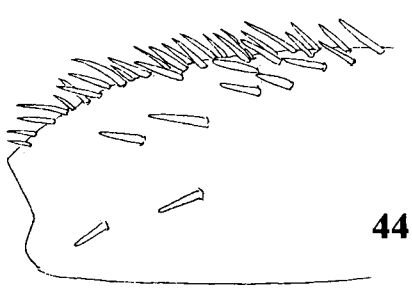

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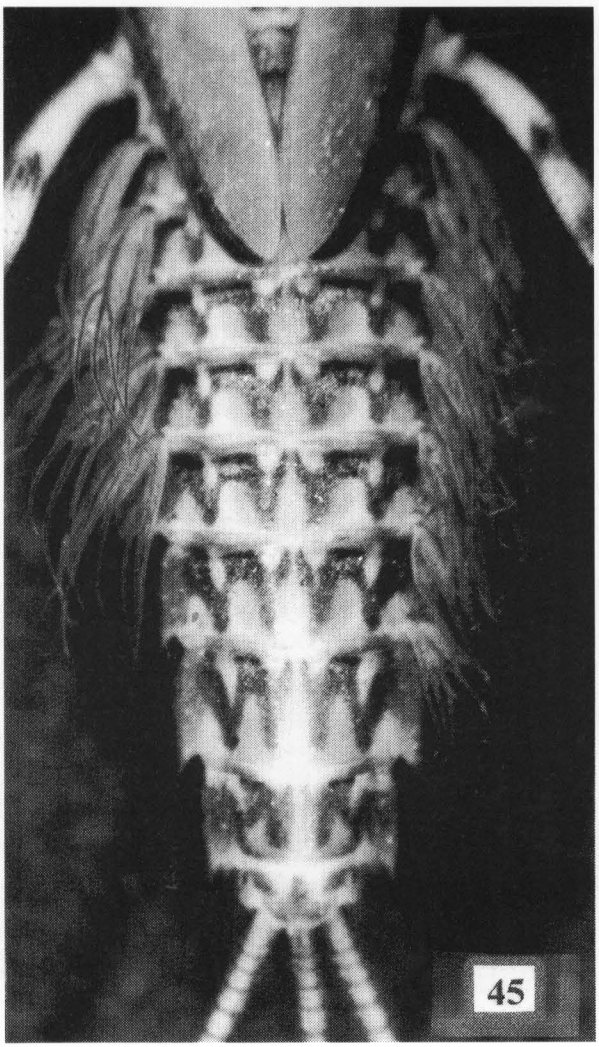
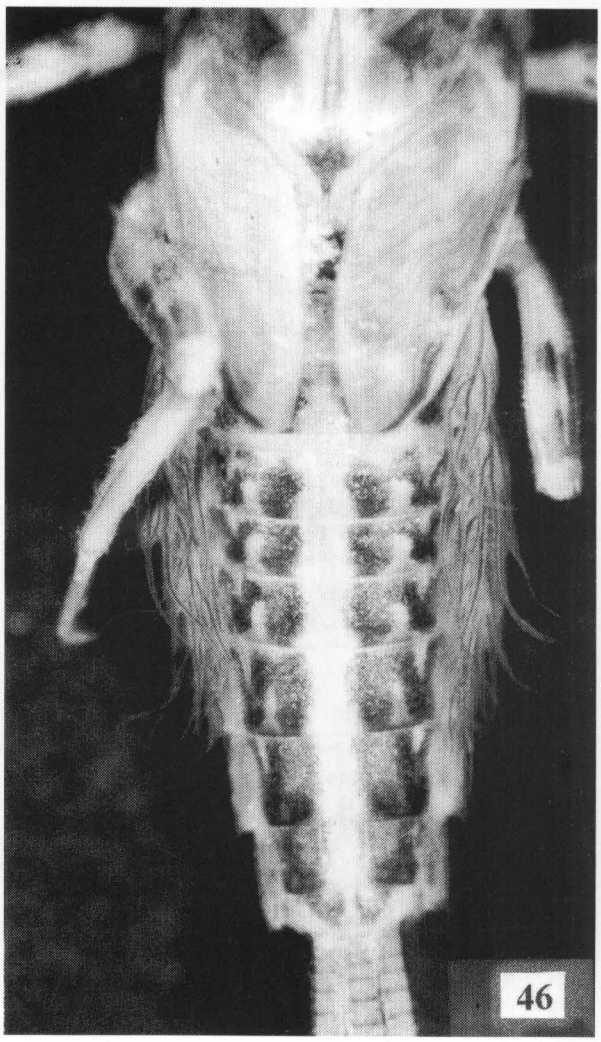
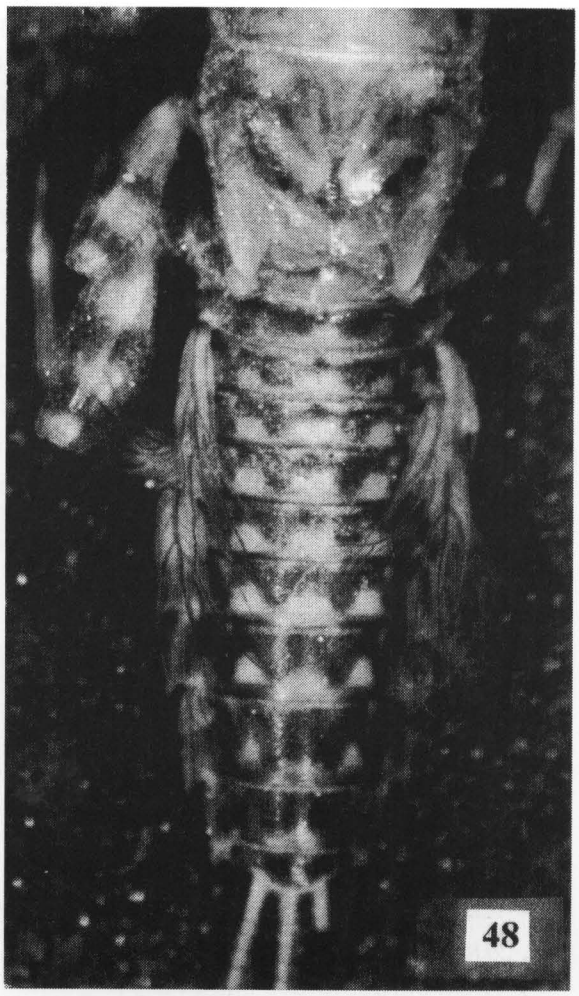



***Atalophlebia* sp.AV5**: 45, abdominal terga. ***Atalophlebia* sp.AV9**: 46, abdominal terga.


***Atalophlebia australis***: 47, abdominal terga. ***Atalophlebia* sp.AV8**: 48, abdominal terga.

## Genus *Austrophlebioides* Campbell & Suter 1988

**Diagnosis:** Head dorso-ventrally flattened; length of antennae about 2x width of head. Labrum considerably broader than clypeus; width of labrum about 3 times length along median line, anterior margin usually with broad central concavity or narrow notch, overhung by hood. Mandibles with incisors slender. Labium with glossae laying in same plane as paraglossae; apical segment of labial palp a little over half width and a little less than half length of middle segment. Legs flattened; tarsi with 1 or 2 elongate ventral spines in apical third, considerably longer than more basal spines; tarsal claws with series of stout ventral teeth. Abdominal segments 2-9 usually with strongly developed postero-lateral spines; lateral margins of abdominal segments usually bearing fringe of fine setae.

**Taxonomy:** The genus *Austrophlebioides* was established by Campbell and Suter (1988) with the type species *A. pusillus* (Harker). At present five species have been formally placed in the genus, but additional species (both described and undescribed) belong here, and the genus is clearly in need of revision. I have examined nymphs from northern New South Wales and Queensland which are probably different to species in the checklist below, but have not included them because of the limited material available.

**Checklist of species included in the key**

| | |
|---|---|
| *Austrophlebioides pusillus* (Harker) | SE Qld, NSW, Vic |
| *Austrophlebioides* sp.AV2 | NSW, Vic |
| *Austrophlebioides marchanti* Parnrong & Campbell | NSW, Vic |
| *Austrophlebioides* sp.AV4 | Tas |
| *Austrophlebioides* sp.AV5 | Tas |
| *Austrophlebioides* sp.AV6 | SE Qld |
| *Austrophlebioides* sp.AV7 | Tas |
| *Austrophlebioides* sp.AV9 | SE Qld, NSW |
| *Austrophlebioides* sp.AV10 | NW Aust, NT |
| *Austrophlebioides* sp.AV11 | SE Qld |
| *Austrophlebioides* sp.AV12 | N Qld |

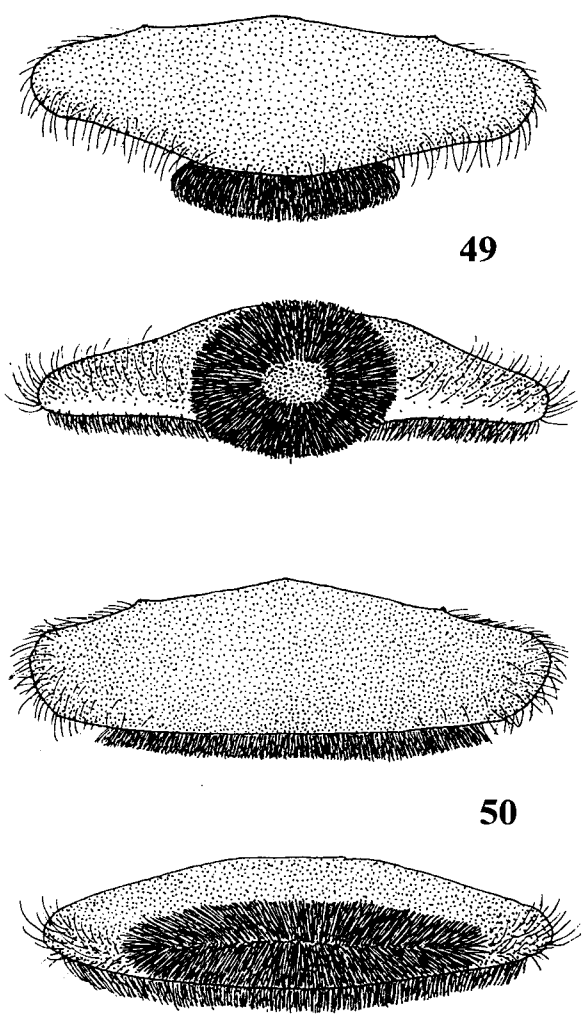
## Key to nymphs of Australian species

1 Setae near frontal margin of labrum dense, arranged to form elliptical or round suction disc (Figs 49,50); Tasmania ..... 2

- Setae near frontal margin of labrum arranged in two straight rows (Figs 52,62); Tasmania and mainland Australia ..... 3

2(1) Suction disc round, protruding well beyond frontal margin of labrum (Fig 49) ..... ***Austrophlebioides* sp.AV7**

- Suction disc elliptical, not protruding far beyond frontal margin of labrum (Fig 50) ..... ***Austrophlebioides* sp.AV5**



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**50**

***Austrophlebioides* sp.AV7**: 49, labrum, dorsal and frontal views. ***Austrophlebioides* sp.AV5**: 50, labrum, dorsal and frontal views.

3(1) Postero-lateral spines on abdominal segments 2 (or 3) to 9 (Fig 56) ..... 4

- Postero-lateral spines on abdominal segments 7 to 9 only (Fig 58) ..... ***Austrophlebioides*** **sp.AV10**

4(3) Abdominal segments with lateral fringe of fine setae (Fig 56); gill lamellae pale, generally white, grey or yellow ..... 5

- Abdominal segments without fringe of setae; gill lamellae heavily pigmented, dark purple ..... ***Austrophlebioides*** **sp.AV9**

5(4) Fore tibia with spines along ventral margin coarsely bipectinate (Fig 53); middle and hind femora with an area lacking pigmentation on upper surface, which takes the form of an elongate streak extending from the base of the femur to about midlength (Fig 55) ..... 6

- Fore tibia with spines along ventral margin finely bipectinate (Fig 64); middle and hind femora with area lacking pigmentation variable, usually restricted to a small patch near the base of the femur (Fig 65), but can take the form of an elongate streak or be completely absent ..... 8

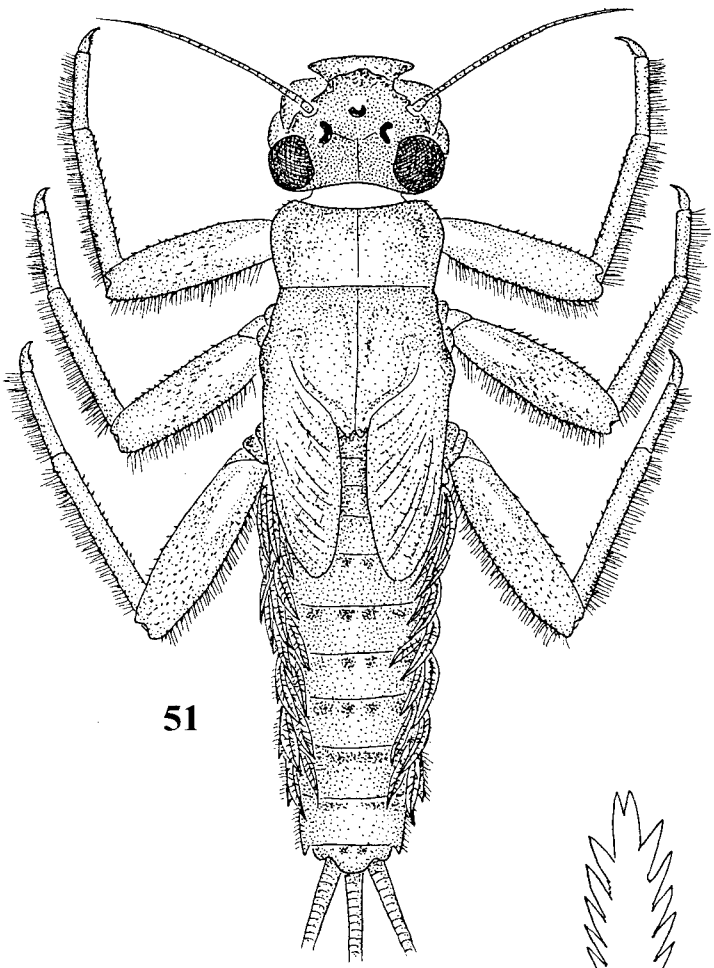
6(5) Tasmania ..... ***Austrophlebioides*** **sp.AV4**

- Mainland Australia ..... 7

7(6) Femora with broad band of dark brown pigmentation adjacent to the ventral margin (Fig 59) ..... ***Austrophlebioides*** **sp.AV2**

- Femora without dark band of pigmentation adjacent to the ventral margin (Fig 55) ..... ***Austrophlebioides marchanti***

***Austrophlebioides marchanti***: 51, whole nymph; 52, labrum, dorsal view; 53, ventral spine, fore tibia; 54, fore tarsus; 55, hind femur; 56, lateral margins of abdominal segments; 57, fourth abdominal gill. ***Austrophlebioides*** **sp.AV10**: 58, lateral margins of abdominal segments. ***Austrophlebioides*** **sp.AV2**: 59, fore femur.



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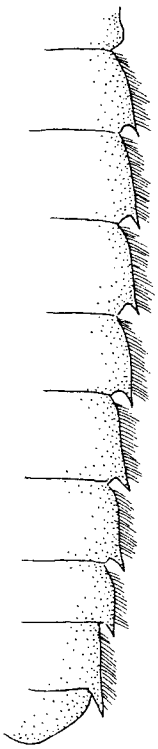

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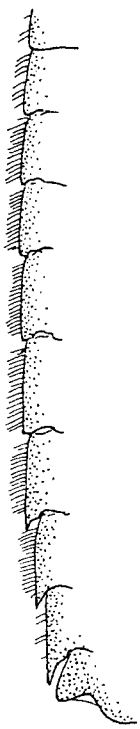

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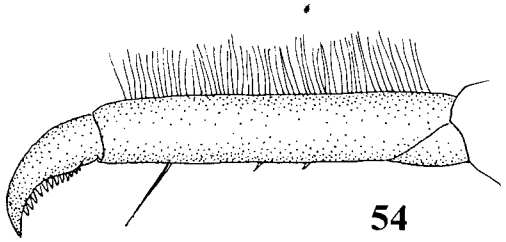

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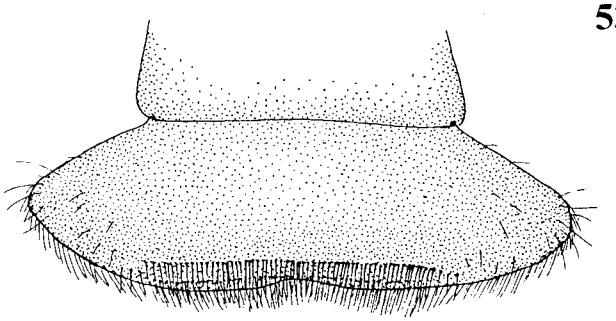

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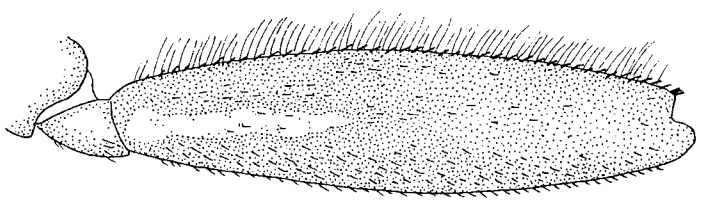

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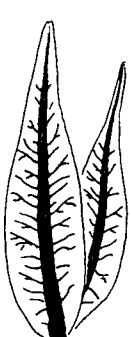

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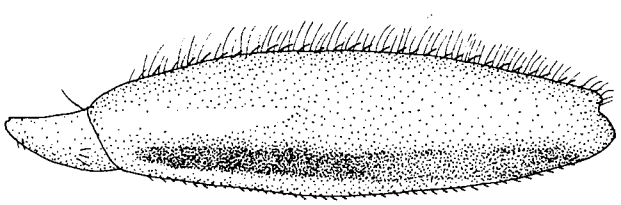


59

8(5) Gills with lateral tracheae well developed (Figs 68,71); outer margin of mandibles with sparse row of setae distal to the medial tuft (Fig 63) ..... 9

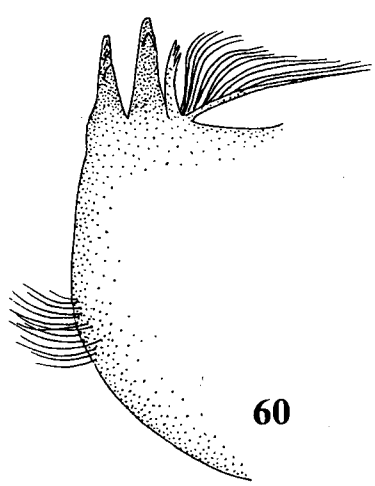
- Gills with lateral tracheae often reduced or absent (Fig 61); outer margin of mandibles without setae distal to the medial tuft (Fig 60) ..... ***Austrophlebioides* sp.AV12**

9(8) Middle and hind femora without an area lacking pigmentation in basal third; postero-lateral spines on abdominal segment V short, about 1/10 length of segment (Fig 69) ..... ***Austrophlebioides* sp.AV6**

- Middle and hind femora with small unpigmented patch near base (Fig 65); postero-lateral spines on segment V longer, at least 1/6 length of segment (Fig 67) ..... 10

10(9) Gill lamellae with lateral tracheae strongly developed, membrane yellow (Fig 71); femora with dense series of spines along outer margin (Fig 70) ..... ***Austrophlebioides* sp.AV11**

- Gill lamellae with lateral tracheae moderately developed, membrane grey/white (Fig 68); femora with sparse series of spines along outer margin (Fig 66) ..... ***Austrophlebioides pusillus***



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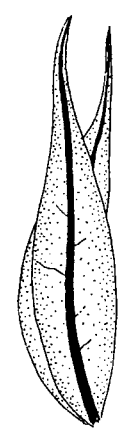

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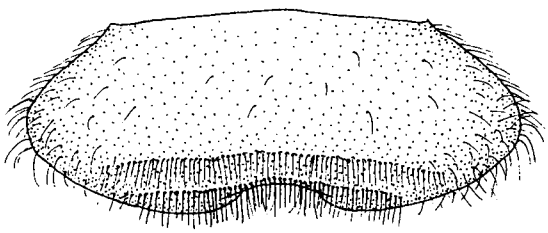
***Austrophlebioides* sp.AV12**: 60, left mandible, outer margin; 61, fourth abdominal gill. ***Austrophlebioides pusillus***: 62, labrum, dorsal and frontal views; 63, left mandible, outer margin; 64, ventral spine, fore tibia; 65, hind femur; 66, apex of hind femur; 67, lateral margin, abdominal segment V; 68, fourth abdominal gill. ***Austrophlebioides* sp.AV6**: 69, lateral margin, abdominal segment V. ***Austrophlebioides* sp.AV11**: 70, apex of hind femur; 71, fourth abdominal gill.



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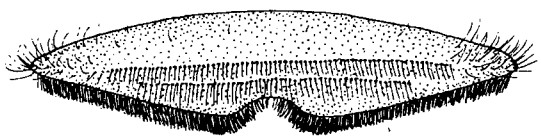

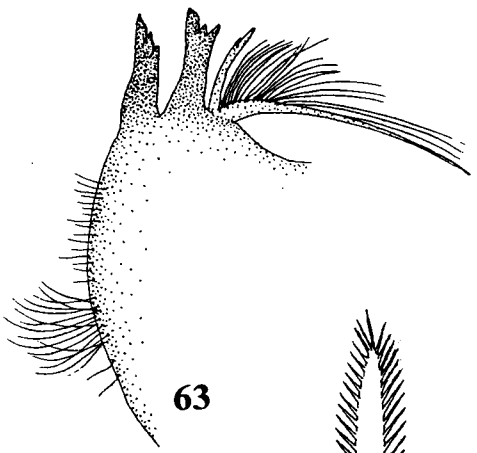

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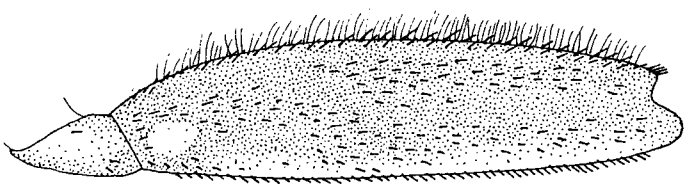

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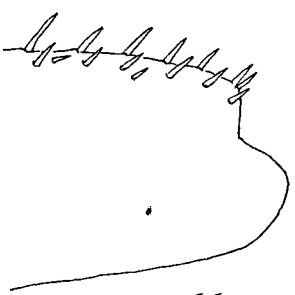

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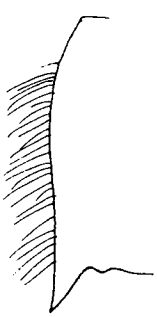

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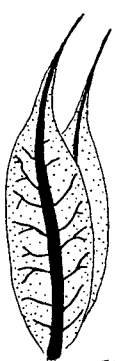

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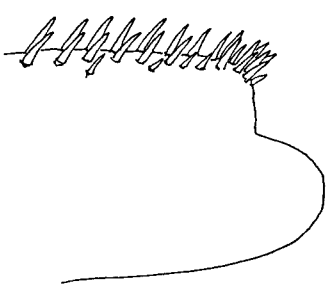

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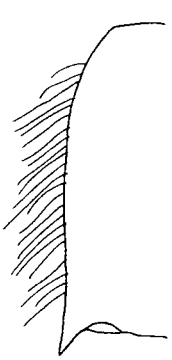

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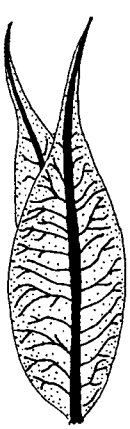


71

## Genus *Bibulmena* Dean 1987

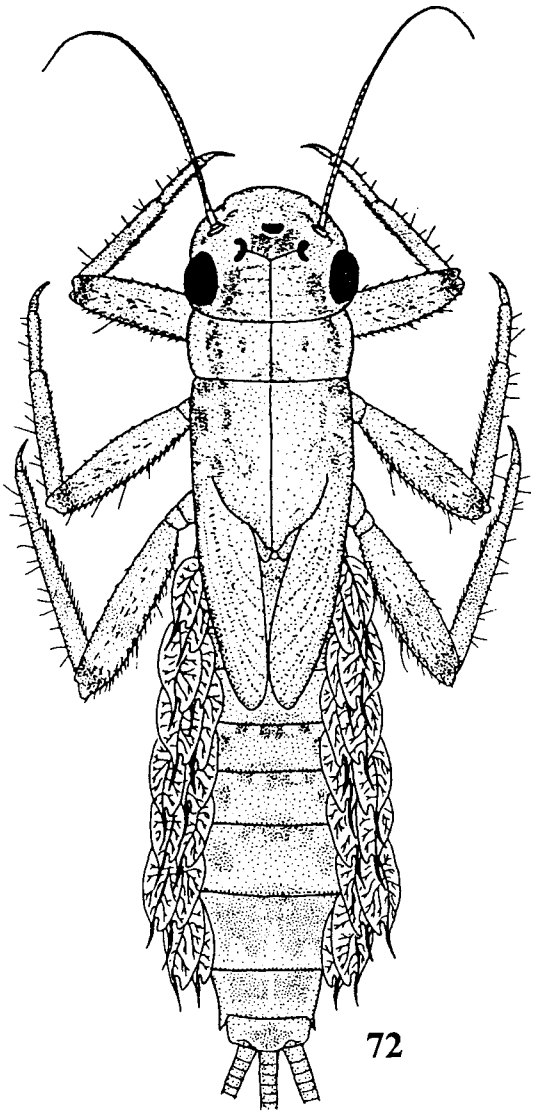
**Diagnosis:** Length of antenna about 2x width of head. Labrum slightly wider than frontal margin of clypeus, width 1.8 to 1.9 length along median line. Mandible with incisors slender. Labium with glossae turned under ventrally; apical segment of labial palp with series of small denticles along inner margin. 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 and terminating in a single filament; inner margin with small recess at base of filament; lateral tracheae well developed.

**Taxonomy:** The genus was established by Dean (1987) for the species *B. kadjina* from south-western Australia, which remains the only described species. Suter (1992) referred two undescribed species from Kakadu in northern Australia to *Bibulmena*, but these have been designated 'Genus P' in the present work.

**Checklist of recognised species**

| | |
|---|---|
| *Bibulmena kadjina* Dean | SW Aust |

***Bibulmena kadjina***: 72, whole nymph; 73, labrum; 74, apical segment of labial palp; 75, foreleg; 76, fourth abdominal gill.



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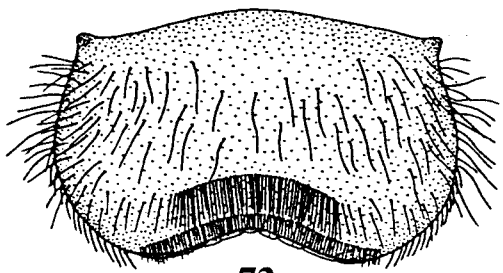

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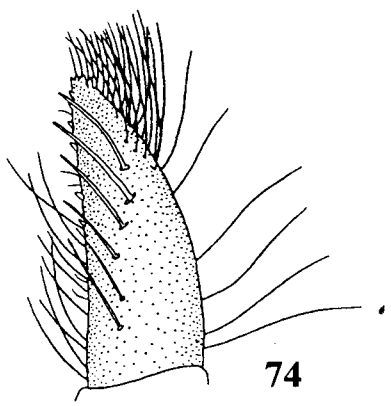

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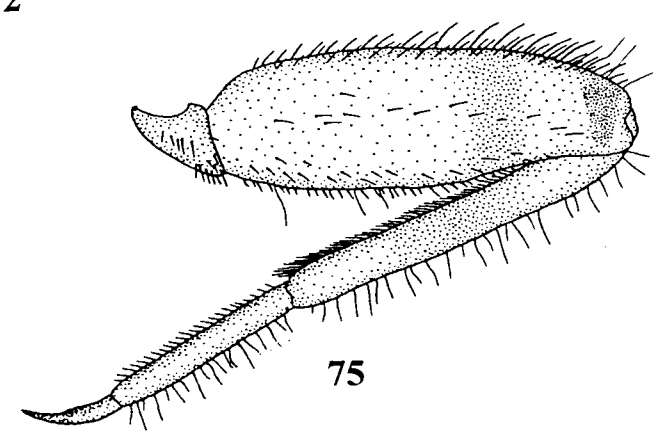

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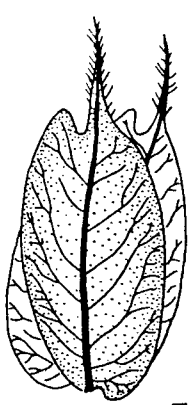


76

# Genus *Garinjuga* Campbell & Suter 1988

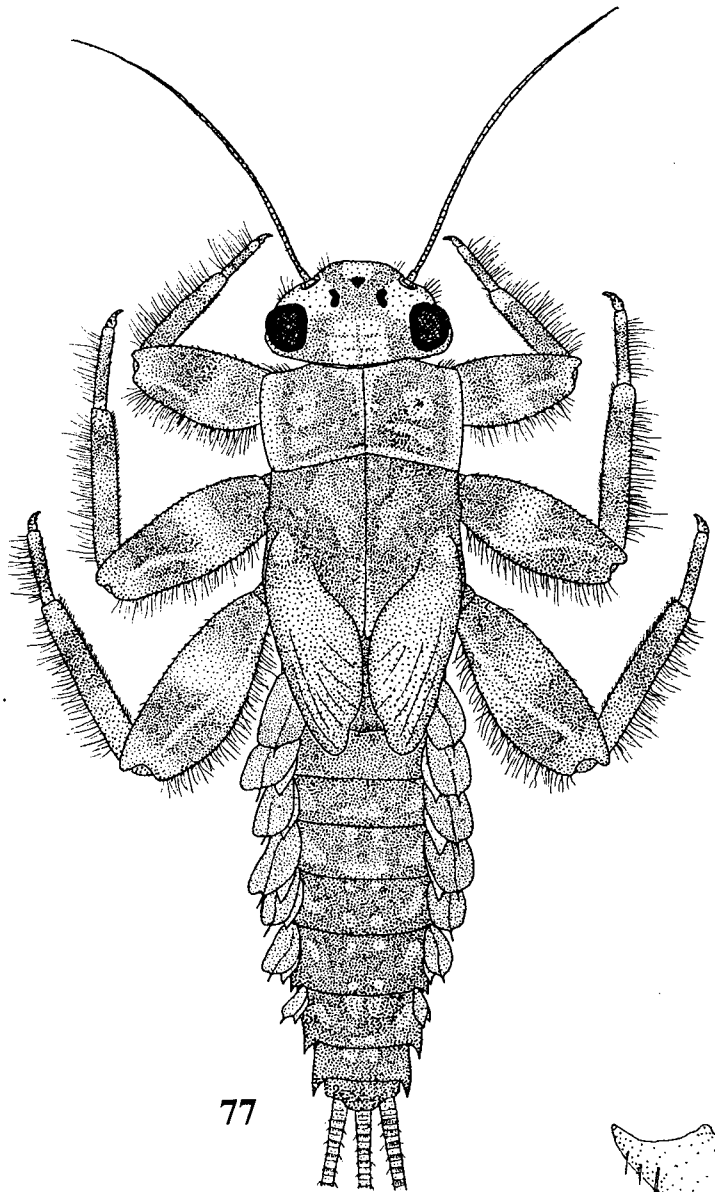
**Diagnosis:** Antenna length about 2x width of head. Labrum slightly wider than clypeus, width 1.7-1.8 x length along median line; anterior margin shallowly concave with five strongly developed denticles. Mandibles with outer margin bearing a series of long setae basal to medial tuft; outer incisors slender. Maxilla with subapical row of about 20 pectinate spines; maxillary palp short. Labium with glossae lying in same plane as paraglossae; apical segment of labial palp slightly shorter and narrower than middle segment, length 2.5x width or a little more. Legs robust, all segments with well developed fringe of setae along outer margin; femur broad with longitudinal ridge along upper surface; tarsus with about 5 ventral spines, increasing in size apically; tarsal claws with series of stout ventral teeth. Abdominal segments 7-9 with postero-lateral spines. Gills with upper lamella broad, dark with short apical filament, lower lamella smaller, paler, broadly lanceolate; gills on abdominal segments 6 and 7 considerably smaller than on more anterior segments.

**Taxonomy:** The genus was established by Campbell and Suter (1988) to accommodate *G. maryannae* from the Thredbo River in New South Wales, and is at the present time monotypic. It is probable that at least several species occur in south-eastern Australia, and characters such as gill colour, shape and arrangement of spines on the femora, abdominal colour pattern and structure of the mouthparts show potential for species discrimination. A large amount of material has been examined, and although potential voucher species were initially established, it proved difficult to confidently assign many specimens to these voucher species. For the present, therefore, all material has been lumped as *Garinjuga* sp.AV1. Clarification of the situation will require formal taxonomic study of adults and extensive association of nymphs by rearing out.

**Checklist of recognised species**

| | |
|---|---|
| *Garinjuga* sp.AV1 | NSW, Vic, Tas |

***Garinjuga* sp.AV1**: 77, whole nymph; 78, labrum; 79, foreleg; 80, foretarsal claw; 81, fourth and seventh abdominal gills.



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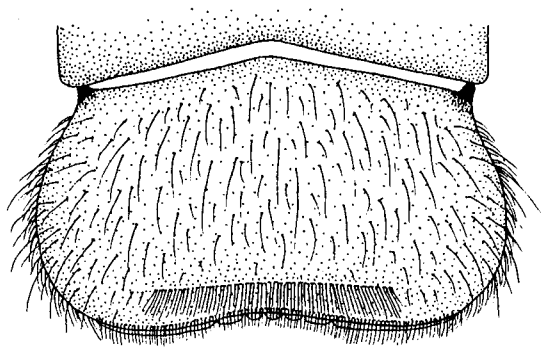

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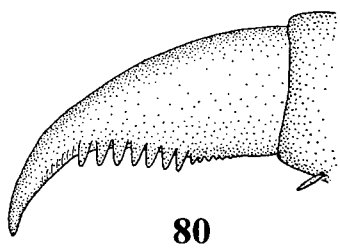

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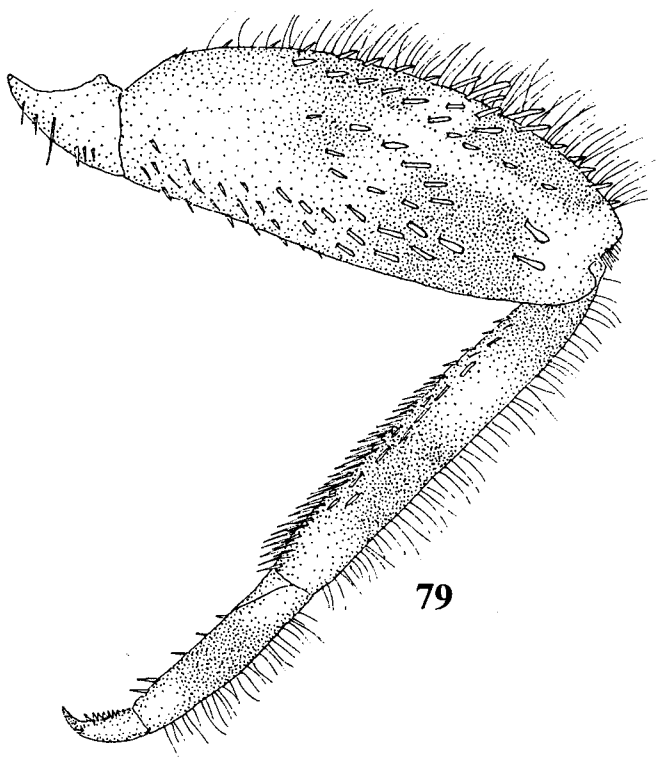

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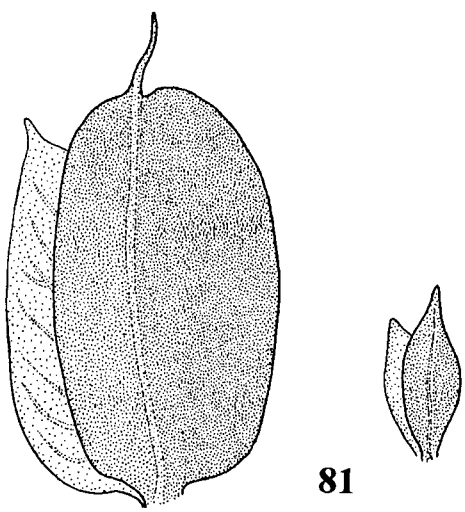


81

## Genus *Jappa* Harker 1954

**Diagnosis:** Head capsule with large frontal horns; antennae heavily setose. Labrum narrower than clypeus, broadest at base, anterior margin with conspicuously projecting medial tooth. Maxillary palp with terminal segment short, subtriangular. Mandibles with outer incisors robust, triangular. Pronotum with long setae along lateral margins. Legs heavily setose; tarsal claws with small ventral denticles. Abdominal segments with dense fringe of setae along lateral margins; abdominal terga bearing numerous long, fine setae. Gills on abdominal segments 1 to 7, each gill with upper and lower lamella, each lamella broad with a single apical filament, apical half densely clothed with fine setae. Terminal filaments densely setose.

**Taxonomy:** The genus *Jappa* was established by Harker (1954), who described the type species *J. kutera* from northern New South Wales, and included a second species from Tasmania. The Tasmanian species does not belong in *Jappa*, and when the holotype can be examined will probably be transferred to the genus *Tillyardophlebia* Dean. The only other authors to ascribe species to the genus *Jappa* were Skedros and Polhemus (1986), who described *J. edmundsi* and *J. serrata* from the Daintree area of North Queensland. Three additional described species which probably belong in *Jappa* are *furcifera* Eaton, *strigata* Eaton and *bicornis* Ulmer, all of which reside at the present time in the genus *Deleatidium* Eaton. *Deleatidium* is, however, endemic to New Zealand, and it has long been recognised that such a placement is inappropriate (Campbell, 1988). The status of the three species is uncertain, and a critical revision may reveal one or more synonomies. In the present study nymphs of seven species have been recognised, three of which are formally identified.

**Checklist of species included in the key**

| | |
|---|---|
| *Jappa* sp.AV1 | NW Aust, NT |
| *Jappa* sp.AV2 | N Qld, SE Qld |
| *Jappa* sp.AV3 | SE NSW, Vic |
| *Jappa* sp.AV4 | SE Qld, NSW, E Vic |
| *Jappa kutera* Harker | NT, N Qld, SE Qld, NSW |
| *Jappa edmundsi* Skedros & Polhemus | N Qld |
| *Jappa serrata* Skedros & Polhemus | N Qld |

## Key to nymphs of Australian species

1 Frontal horns with strongly developed spines and/or small teeth in addition to dorsal protuberance near base (Figs 88,89,90,91) ..... 2

- Frontal horns smooth, without spines and/or teeth apart from dorsal protuberance near base (Figs 83,86,87) ..... 5

2(1) Frontal horns with very small teeth and pointed processes only (Fig 88) ..... ***Jappa* sp.AV4**

- Frontal horns with strongly developed spines (Figs 89,90,91) ..... 3

3(2) Frontal horns with a single large dorsal spine just beyond midlength (Fig 89) ..... ***Jappa edmundsi***

- Frontal horns with numerous spines and teeth (Figs 90,91) ..... 4

4(3) Frontal horns with spines and teeth on dorsal surface only (Fig 90); abdominal terga with darker pigmentation overlaying midline (Fig 92); north Queensland ..... ***Jappa serrata***

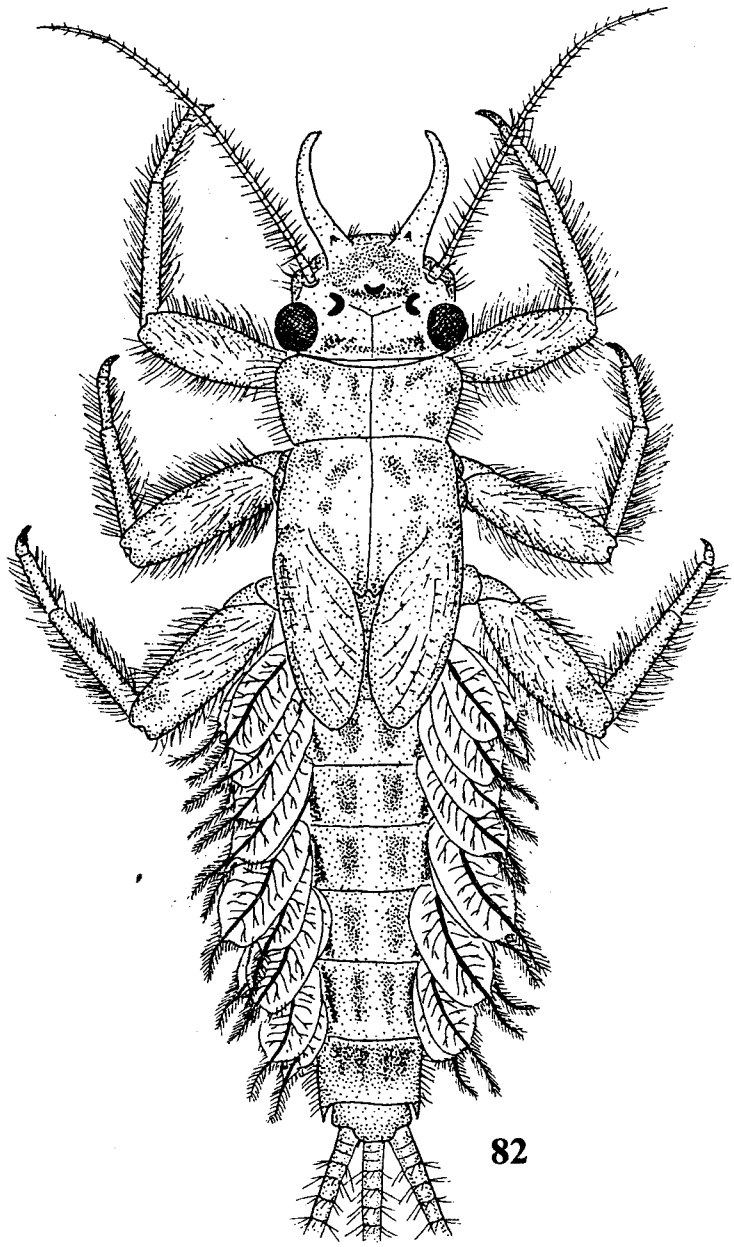
- Frontal horns with spines and teeth on outer surface as well as dorsal surface (Fig 91); abdominal terga with midline paler, darker pigmentation in form of four sub-parallel stripes (Fig 93); NW Australia, Northern Territory ..... ***Jappa* sp.AV1**

5(1) Frontal horns long, slender, curvature slight (Fig 87) ..... ***Jappa* sp.AV3**

- Frontal horns shorter, stouter, curvature greater (Figs 83,86) ..... 6

6(5) Abdominal terga with four widely spaced and sub-parallel dark stripes (Figs 82,94); abdominal sterna with very conspicuous thin dark stripe along midline (Fig 95); upper lamellae of gills with conspicuous lateral tracheae (Fig 85) ..... ***Jappa kutera***

- Abdominal terga with a pair of triangular dark maculae, one either side of the midline, and also with dark pigmentation on midline adjacent to the anterior margin of each segment (Fig 96); abdominal sterna with darker pigmentation more dispersed, not restricted to thin stripe along midline (Fig 97); gills with lateral tracheae absent or inconspicuous ..... ***Jappa* sp.AV2**



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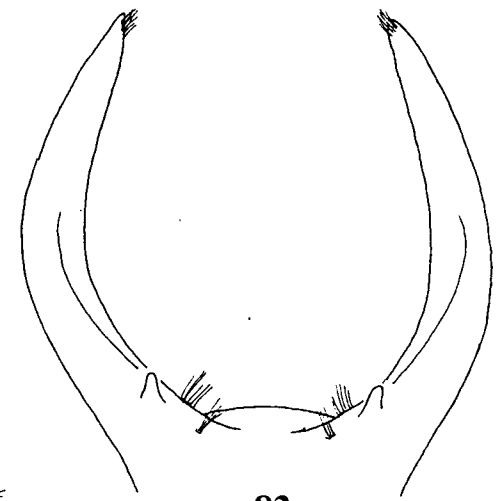

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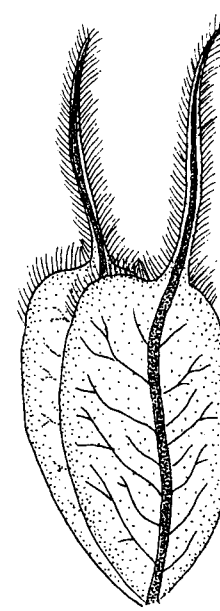

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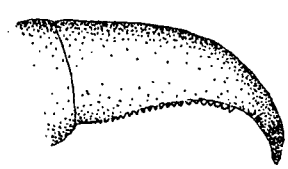

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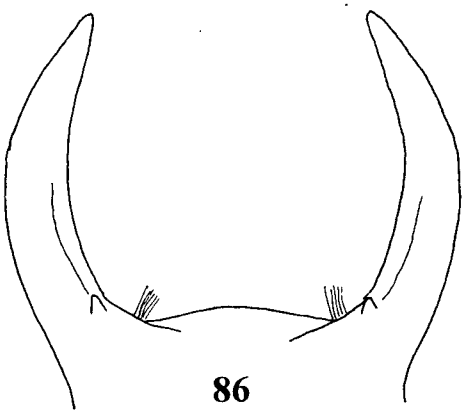
***Jappa kutera***: 82, whole nymph; 83, frontal horns; 84, fore tarsal claw; 85, fourth abdominal gill. ***Jappa* sp.AV2**: 86, frontal horns. ***Jappa* sp.AV3**: 87, frontal horns. ***Jappa* sp.AV4**: 88, frontal horns. ***Jappa edmundsi***: 89, frontal horns. ***Jappa serrata***: 90, frontal horns. ***Jappa* sp.AV1**: 91, frontal horns.



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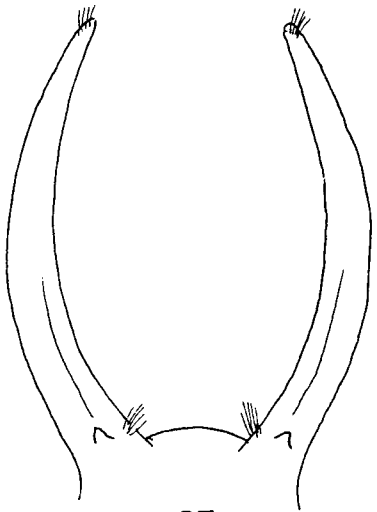

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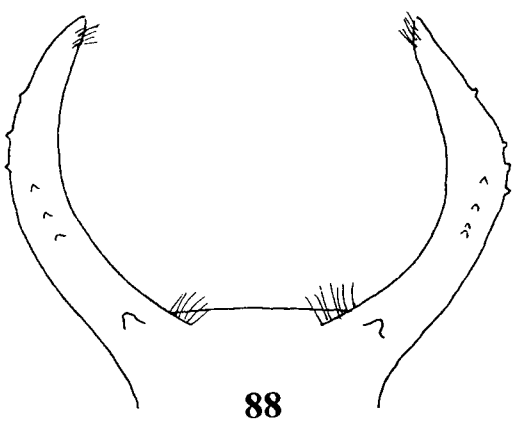

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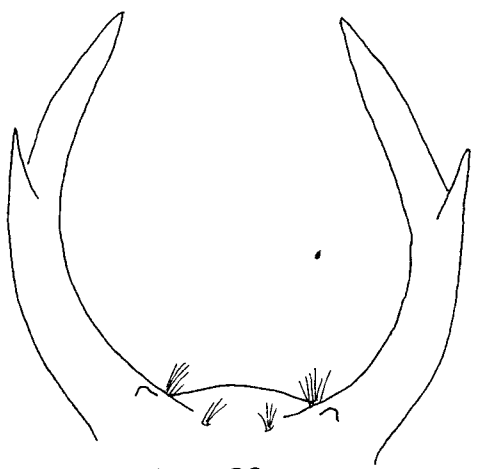

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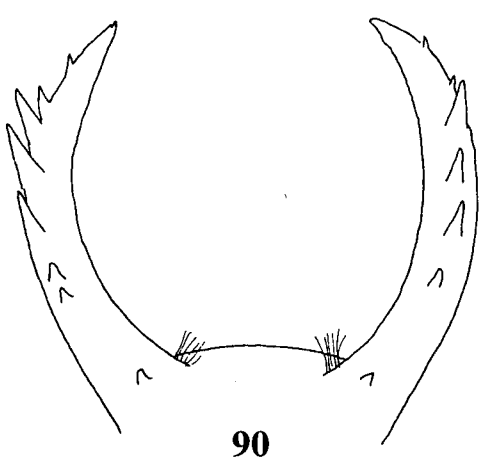

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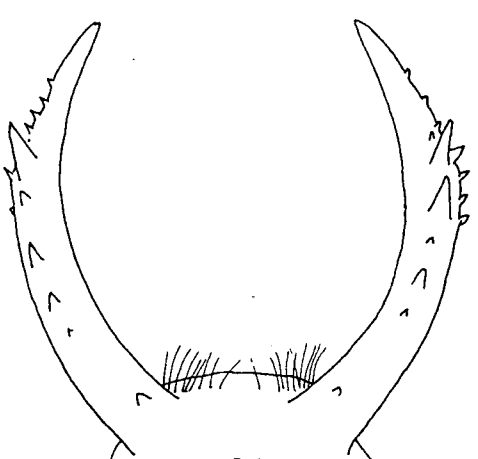

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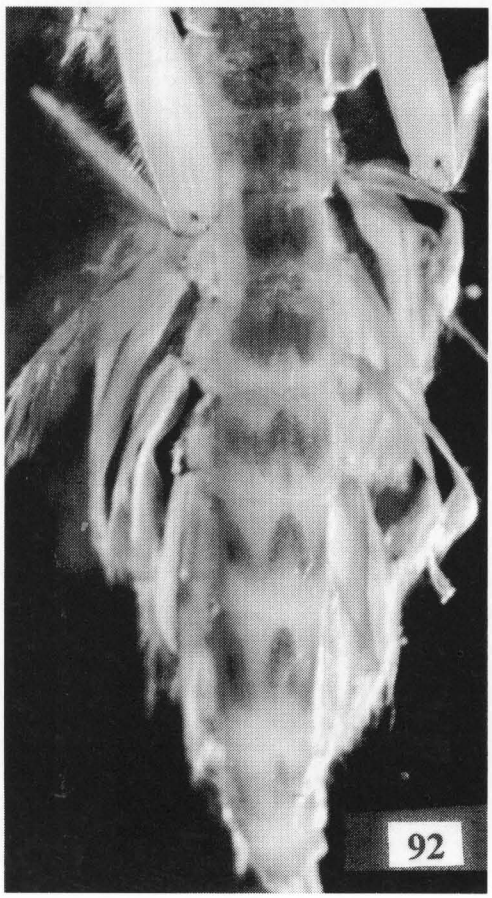
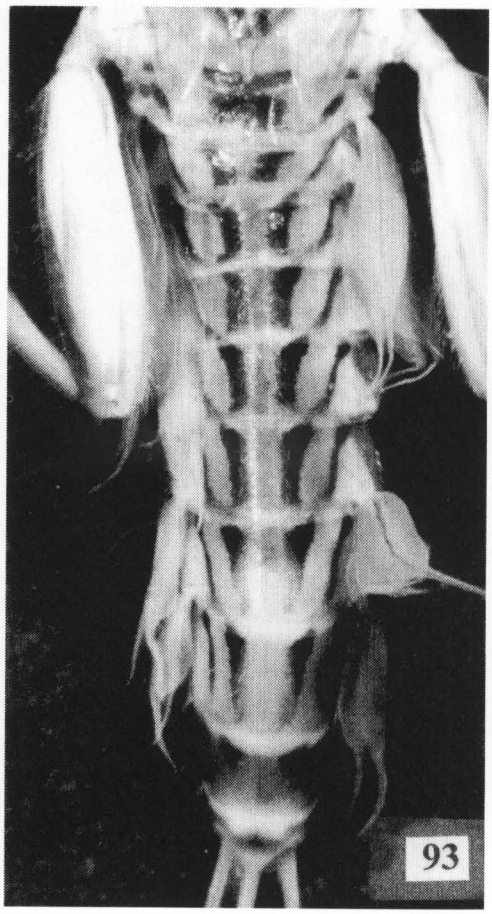
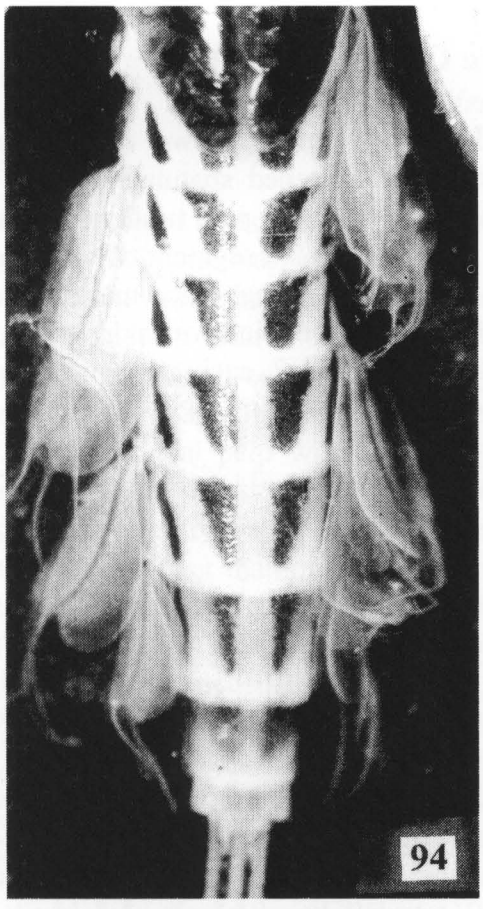



***Jappa serrata***: 92, abdominal terga. ***Jappa*** **sp.AV1**: 93, abdominal terga. ***Jappa kutera***: 94, abdominal terga; 95, abdominal sterna. ***Jappa*** **sp.AV2**: 96, abdominal terga; 97, abdominal sterna.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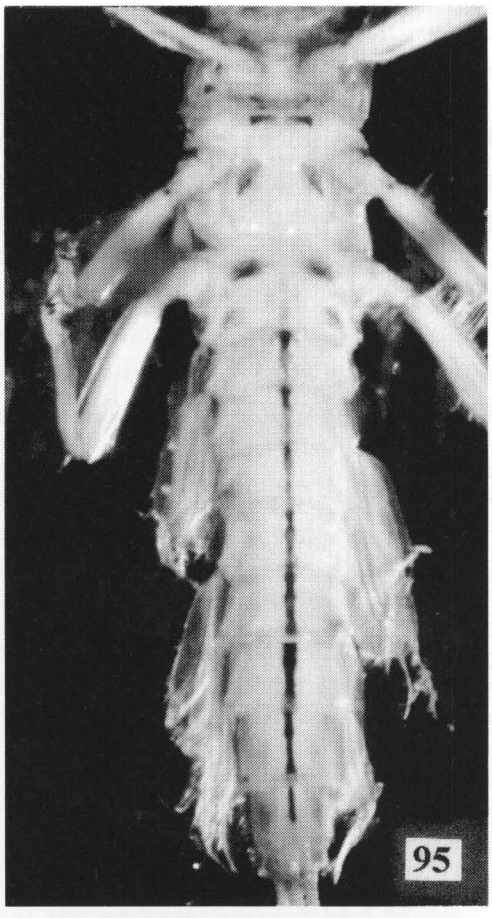
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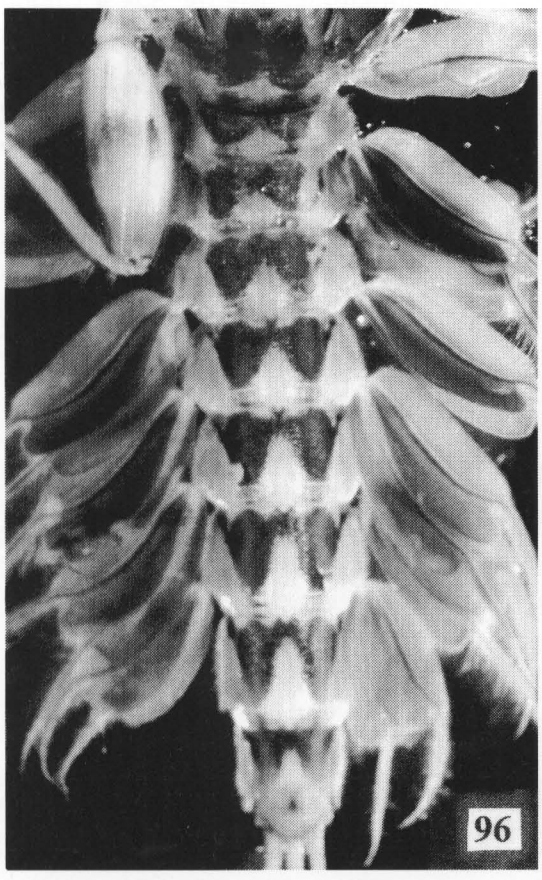
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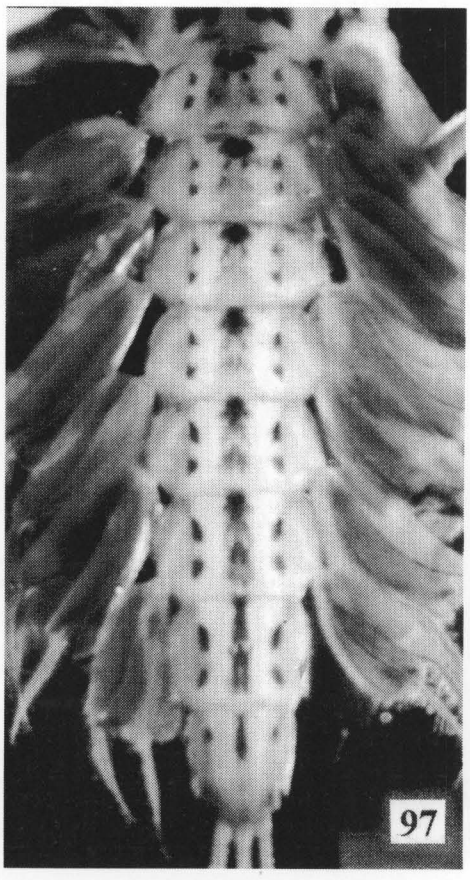

97

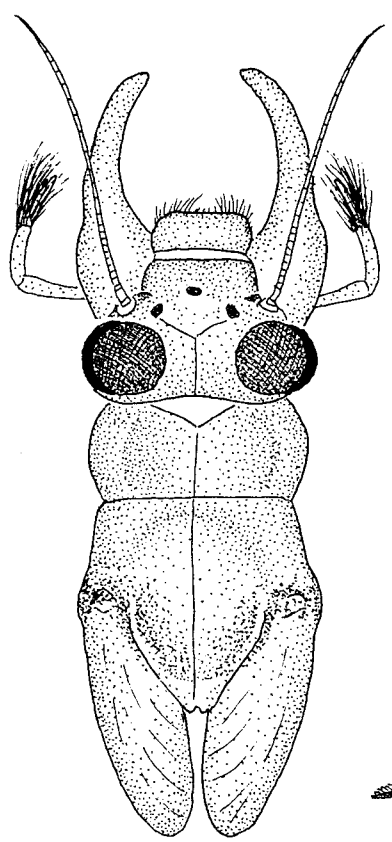
## Genus *Kalbaybaria* Campbell 1993

**Diagnosis:** Antennae about 2x head width. Labrum slightly narrower than clypeus, anterior margin straight. Mandibles with very long flattened spatulate process on outer margin; outer incisors robust, subtriangular. Maxillary palp moderately long. Labium with glossae turned under ventrally; labial palps with segment two short and segment three elongate, both segments heavily setose 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 1-7, each gill consisting of an upper and lower lamella, both tridigitate.

**Taxonomy:** The genus was described by Campbell (1993), and is monotypic.

### Checklist of recognised species

*Kalbaybaria doantrangae* Campbell — Nth Q'ld



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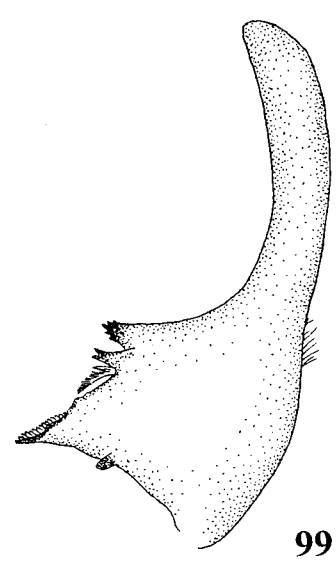

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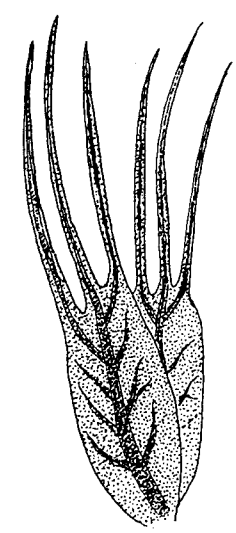


100

***Kalbaybaria doantrangae***: 98, nymph, head and thorax; 99, right mandible; 100, fourth abdominal gill.

# Genus *Kirrara* Harker 1954

**Diagnosis:** Head dorso-ventrally flattened, length of antennae about equal to head width. Clypeus with lateral margins strongly diverging to anterior. Labrum considerably broader than clypeus, width about 4x length along median line; frontal setae dense, unmodified or modified to form round suction disc. Mandibles with outer margin angular. Maxillary palps short; terminal segment triangular, ventral surface with dense brush of setae running along the entire length of the segment. Labium with glossae lying in same plane as paraglossae; labial palp with apical segment about 1/3 length of middle segment and about 1/2 width. Legs with femora broad and flat; outer margins of femora, tibiae and tarsi bearing dense fringes of setae; tarsi with 1-3 elongate ventral spines in apical third, considerably longer than more basal spines; tarsal claws with strongly developed ventral teeth. Abdominal terga 1-9 either with or without a small median projection near posterior margin. Gills present on abdominal segments 1-7; upper lamella large, ovate, with well developed lateral tracheae, lower lamella greatly reduced in size; gills downturned to form a suction disc.

**Taxonomy:** *Kirrara* was established by Harker (1954) to accommodate two species, *K. procera* (the designated type species) and *K. amenia.* A third species, *K. algona*, was later described from New South Wales (Harker, 1957). Subsequently the genus was redefined by Campbell and Peters (1986), and the species *amenia* and *algona* were excluded because both appeared to belong to a different phyletic line, a conclusion with which I agree. After examination of adults and nymphs of an undescribed species from north Queensland, Christidis (in press) concluded that the species probably belonged in *Kirrara*. The nymph has previously been placed in an undescribed genus, 'Genus T', by Dean & Suter (1996), and transfer to the genus *Kirrara* is accepted in the present work.

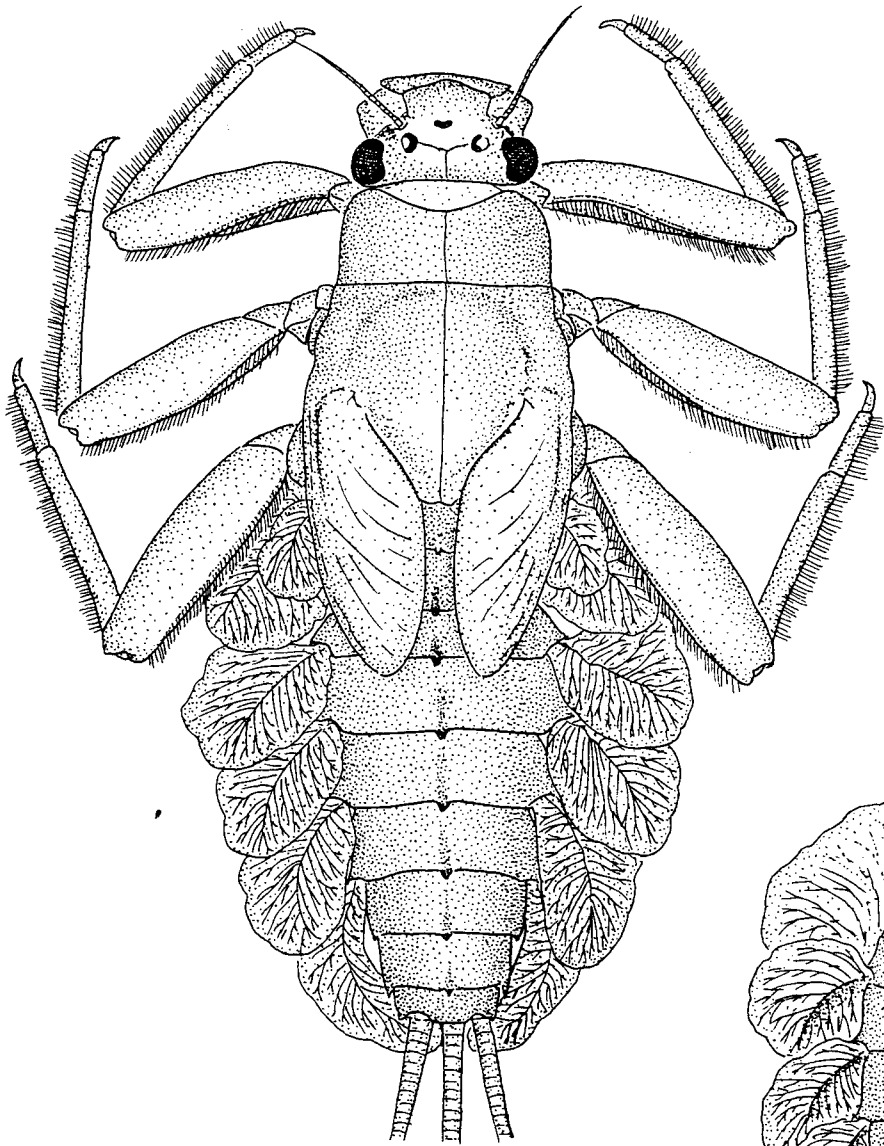
## Checklist of species included in the key

| | |
|---|---|
| *Kirrara procera* Harker | NSW, Vic |
| *Kirrara* sp.AV1 | Nth Qld |

## Key to nymphs of Australian species

1 Labrum with frontal setae modified to form round suction disc (Fig 103); abdominal terga without medial projections ..... ***Kirrara* sp.AV1**

\- Labrum with frontal setae not modified to form suction disc; abdominal terga with medial projections near posterior margin (Fig 101) ..... ***Kirrara procera***



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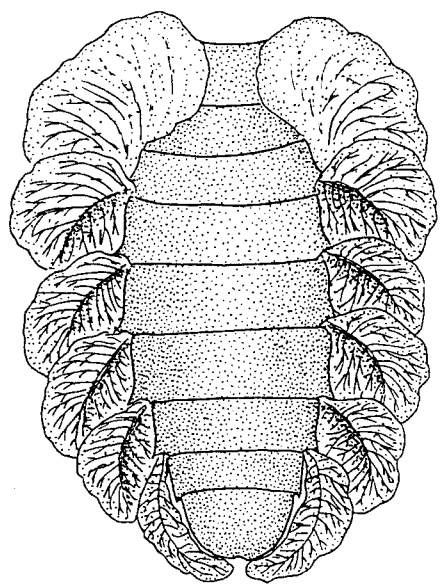
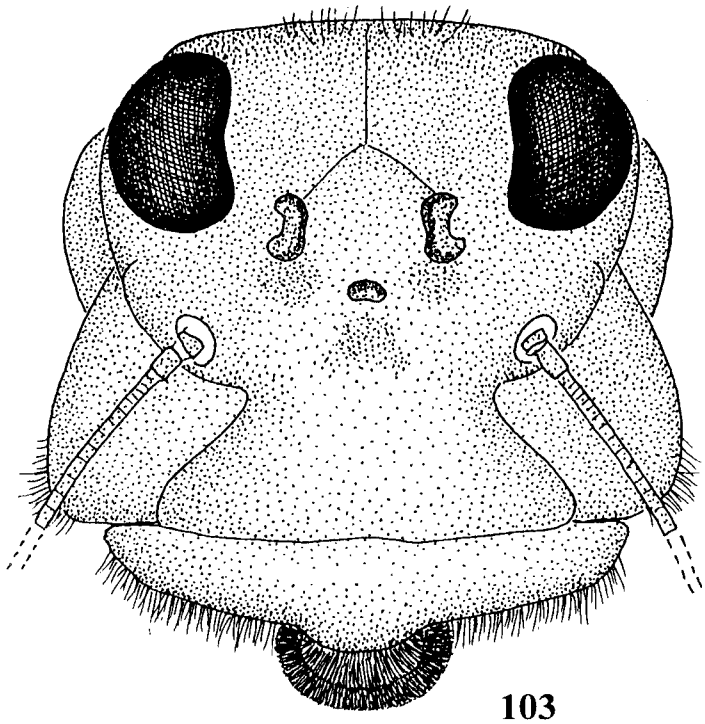


**102**

***Kirrara procera***: 101, whole nymph, dorsal; 102, abdomen, ventral. ***Kirrara* sp.AV1**: 103, head, dorsal, and ventral view of suction disc; 104, hind tarsus; 105, third abdominal gill.



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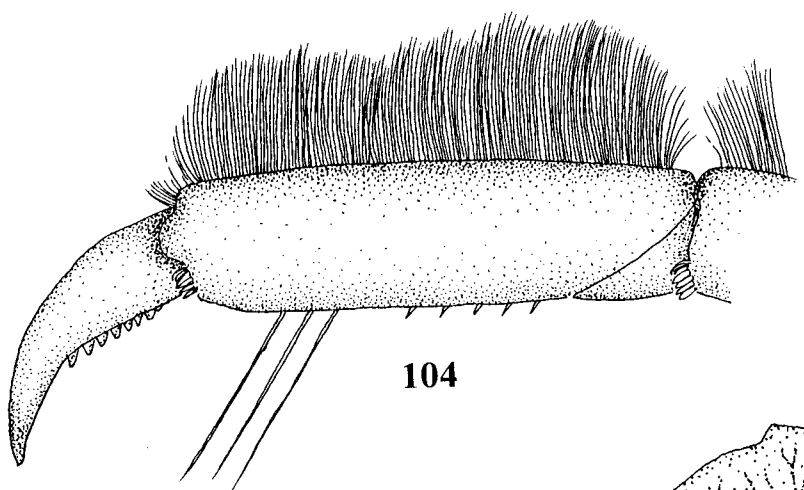

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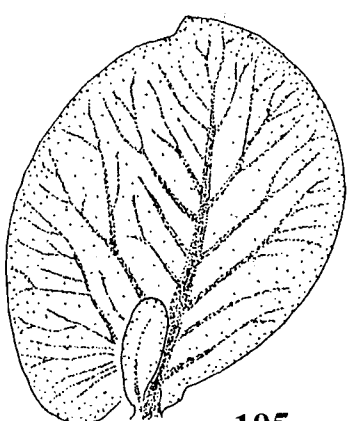


**105**

## Genus *Koorrnonga* Campbell & Suter 1988

**Diagnosis:** Length of antennae 2-3x width of head capsule. Labrum a little broader than clypeus, maximum width 1.7-2.1x length along median line; sub-apical setal fringe located close to anterior margin and projecting beyond the margin as a conspicuous tuft; width of sub-apical setal fringe usually less than about 0.2 maximum width of labrum. Mandibles with outer incisors slender. Maxillary palp moderately short. Labium with glossae not turned under ventrally; labial palp with apical segment almost as long as middle segment. Legs usually with dark banding on all segments; tarsal claws with series of stout ventral teeth, increasing in size apically. Postero-lateral spines on abdominal segments 3 or 4 - 9. Gills double, on abdominal segments 1-7; lamellae lanceolate, sometimes broadly so, narrowing at about 2/3 length.

**Taxonomy:** When establishing the genus, Campbell and Suter (1988) listed six species to be included. I believe that the species *fusca* Ulmer 1919 should be removed from *Koorrnonga*, while the species *lucida* Ulmer 1919 should be added. Figures of genitalia and hindwings provided with the original descriptions by Ulmer (1919) suggest that *fusca* belongs in the genus *Nousia* and that *lucida* belongs in the genus here called *Koorrnonga*. However, *Atalophlebia lucida* Ulmer has previously been designated the type species for the genus *Thraulophlebia* (Demoulin, 1955), and if it is congeneric with the species here placed in *Koorrnonga,* then *Koorrnonga* becomes a junior synonom of *Thraulophlebia.* A revision of the genus should be undertaken before any final decision is made on synonomy. As stated previously, a conservative approach has been adopted in the recognition of voucher species, and within *Koorrnonga* several of the taxa listed below display variations which may indicate the presence of additional species. I am not comfortable with current arrangements, but a shortage of both time and additional material has prevented further investigation.

**Checklist of species included in the key**

| | |
|---|---|
| *Koorrnonga* sp.AV1 | SE Qld, NSW, Vic, Tas |
| *Koorrnonga* sp.AV2 | Nth Qld, SE Qld, NSW, Vic |
| *Koorrnonga* sp.AV3 | W Vic |
| *Koorrnonga* sp.AV4 | Nth Qld |
| *Koorrnonga* sp.AV5 | SE Qld, NSW, Vic |
| *Koorrnonga* sp.AV6 | Nth Qld |

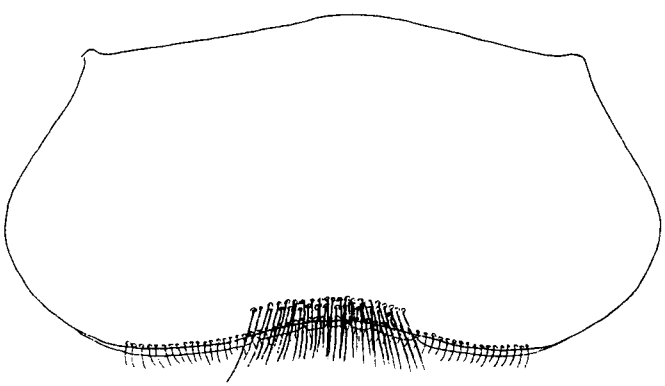
## Key to nymphs of Australian species

1 Gills narrowing at about 2/3 length, upper lamella then broadening in apical third; inner margin of upper lamella with small recess near base of broadened apical third (Figs 107,109) ..... 2

- Gills narrowing at about 2/3 length, both lamellae slender in apical third (Figs 112,117) ..... 3

2(1) Labrum broadest in apical half; sub-apical fringe with about 40 setae (Fig 106) ..... ***Koorrnonga* sp.AV2**

- Labrum broadest at about midlength; sub-apical fringe with 10-15 setae (Fig 108) ..... ***Koorrnonga* sp.AV6**



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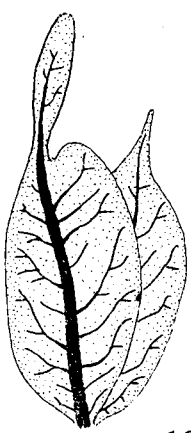

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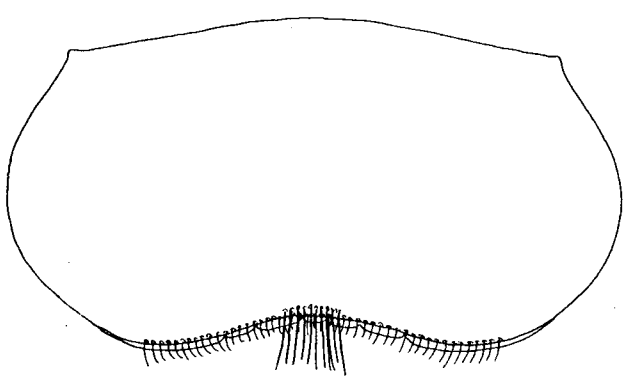

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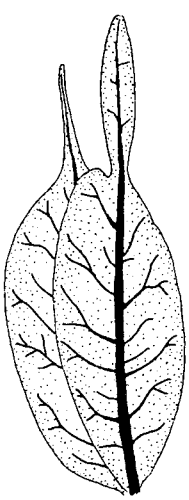


**109**

***Koorrnonga* sp.AV2**: 106, labrum; 107, fourth abdominal gill. ***Koorrnonga* sp.AV6**: 108, labrum; 109, fourth abdominal gill.

3(1) Labrum with relatively deeper concavity on anterior margin (Fig 110), width of denticles about equal to width of sub-apical setal fringe (Fig 110); foretarsus with 15-20 ventral spines, length of spines about 1/2 diameter of tarsus (Fig 111) ..... ***Koorrnonga* sp.AV5**

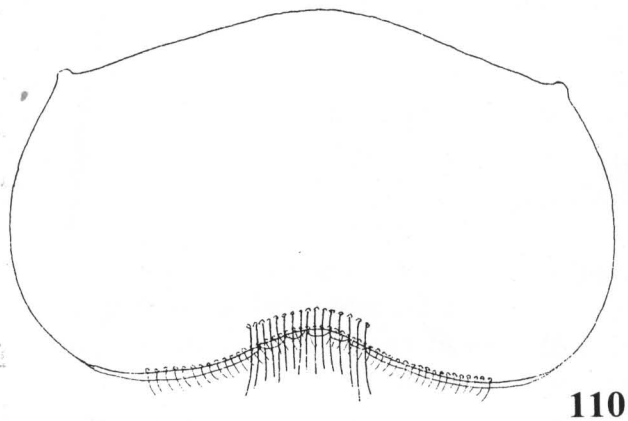
- Labrum with relatively shallower concavity on anterior margin (Figs 113,115); width of denticles clearly greater than width of sub-apical setal fringe (Figs 113,115); foretarsus with number and length of ventral spines variable ..... 4

4(3) Abdominal terga predominantly dark brown (Fig 114); south-eastern Australia ..... 5

- Abdominal terga golden, darker markings inconspicuous; north Queensland ..... ***Koorrnonga* sp.AV4**

5(4) Foretarsus with about 7-12 ventral spines, length of spines 1/3 or less the diameter of the tarsus (Fig 116); banding on legs conspicuous (Fig 114) ..... ***Koorrnonga* sp.AV1**

- Foretarsus with 15-20 ventral spines, length of spines about 1/2 diameter of tarsus; banding on legs inconspicuous or absent ..... ***Koorrnonga* sp.AV3**



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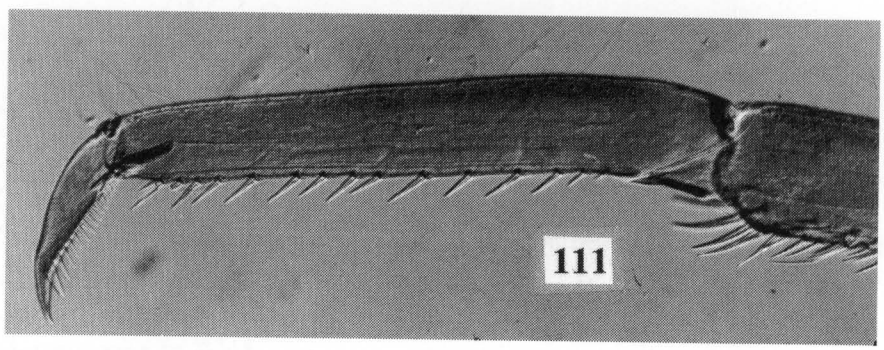
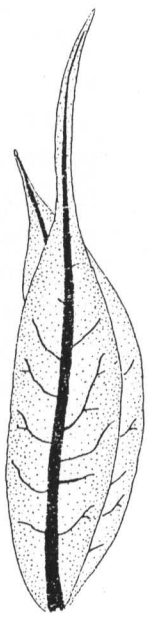
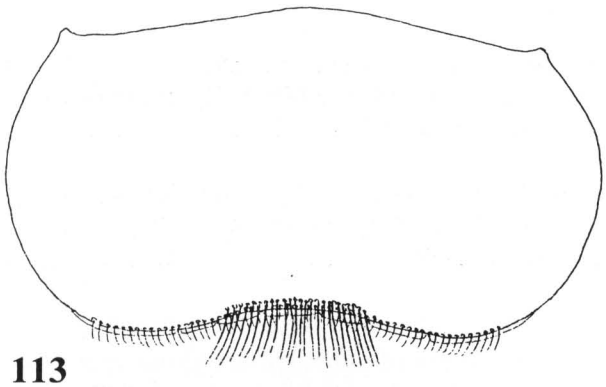


**111**



**112**

***Koorrnonga* sp.AV5**: 110, labrum; 111, foretarsus; 112, fourth abdominal gill. ***Koorrnonga* sp.AV4**: 113, labrum. ***Koorrnonga* sp.AV1**: 114, whole nymph; 115, labrum; 116, foretarsus; 117, fourth abdominal gill.



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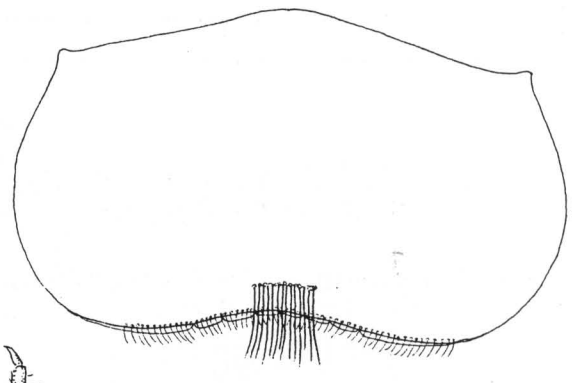

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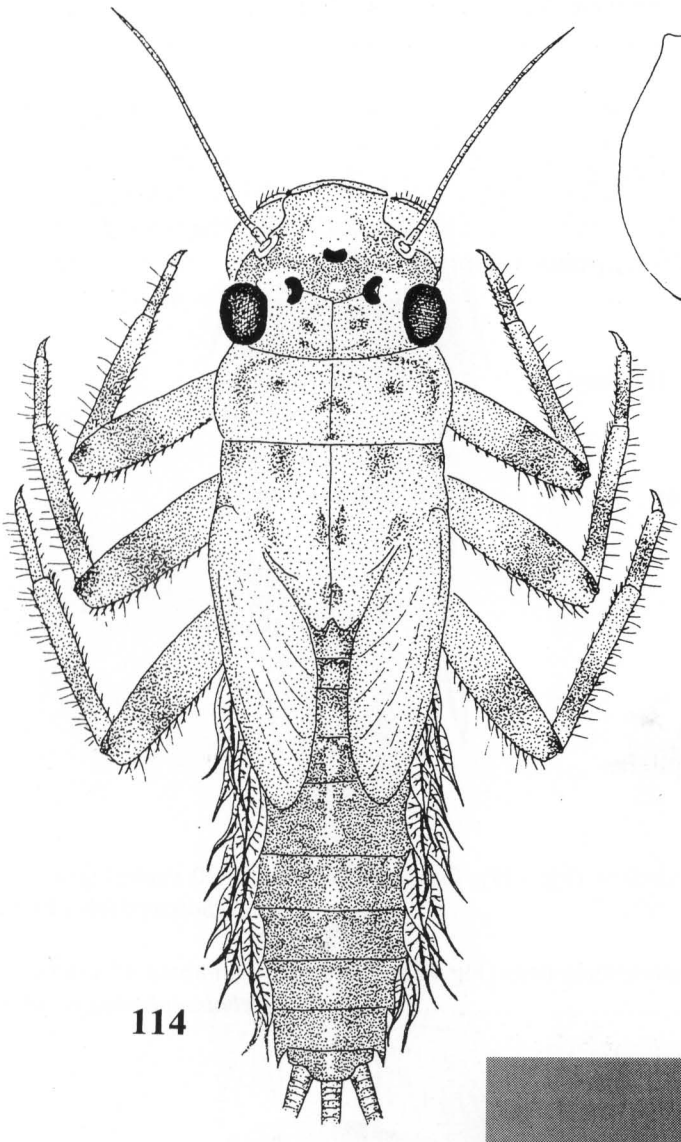

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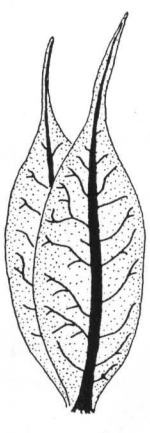

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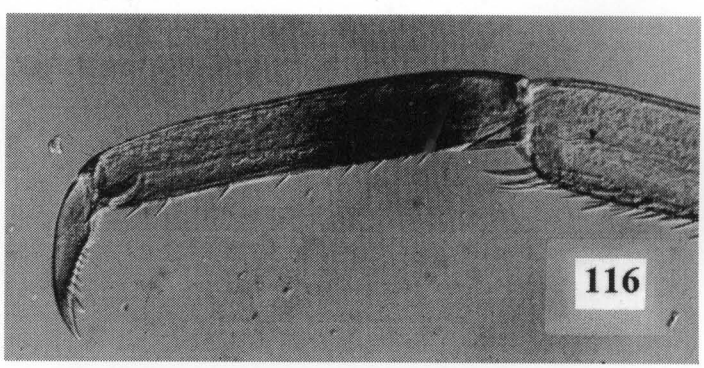


116

# Genus *Neboissophlebia* Dean 1988

**Diagnosis:** Antennae 1.5-2x width of head. Labrum slightly wider than clypeus, width 2.3-2.5x length along median line; sub-apical setal fringe located a little forward of midlength. Mandibles with outer incisors slender. Labium with glossae turned under ventrally, not lying in same plane as paraglossae; terminal segment of labial palp sub-triangular, series of short spines along inner margin. Legs moderately stout, tarsal claws smooth. Abdomen with postero-lateral spines on segments 5-9. Gills on abdominal segments 1-7; each gill with both upper and lower lamella linear, tracheae without lateral branches.

**Taxonomy:** The genus was described by Dean (1988) to accommodate two species, one from south-eastern Australia and the other from south-western Australia. Nymphs are also known from north Queensland, and it seems likely that the genus occurs right up the east coast. A decision on whether the northern nymphs represent a distinct species has been hampered by inadequate material.

## Checklist of species included in the key

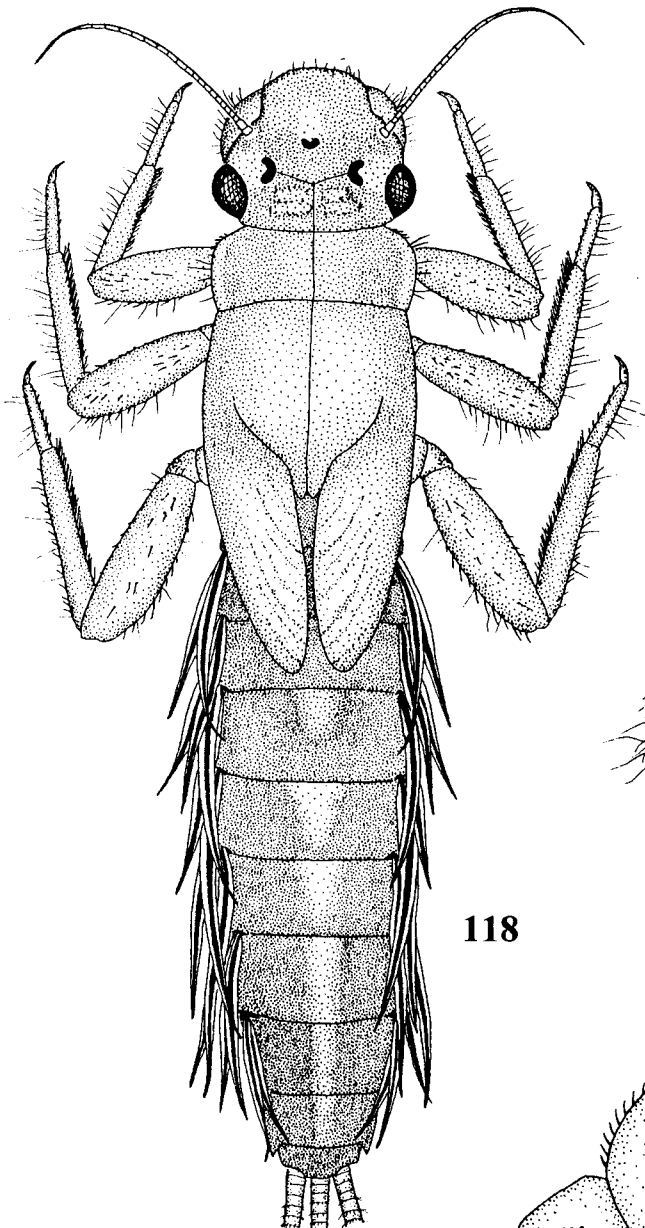
| | |
|---|---|
| *Neboissophlebia hamulata* Dean | NSW, Vic |
| *Neboissophlebia occidentalis* Dean | SW Aust |

## Key to nymphs of Australian species

1 Labrum with frontal concavity shallow (Fig 119); foretarsus with about 20 ventral spines; south-eastern Australia ..... ***Neboissophlebia hamulata***

\- Labrum with frontal concavity moderately deep (Fig 122); foretarsus with about 40 ventral spines; south-western Australia ..... ***Neboissophlebia occidentalis***

***Neboissophlebia hamulata***: 118, whole nymph; 119, labrum; 120, foreleg; 121, fourth abdominal gill.
***Neboissophlebia occidentalis***: 122, labrum.



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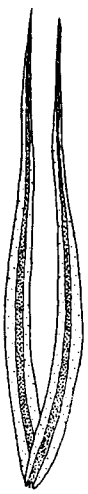

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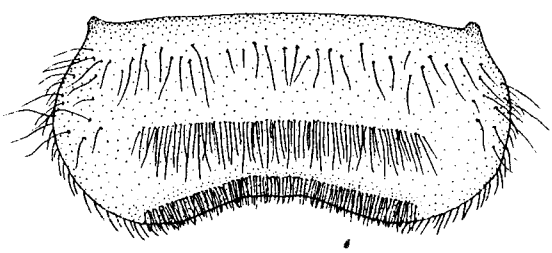

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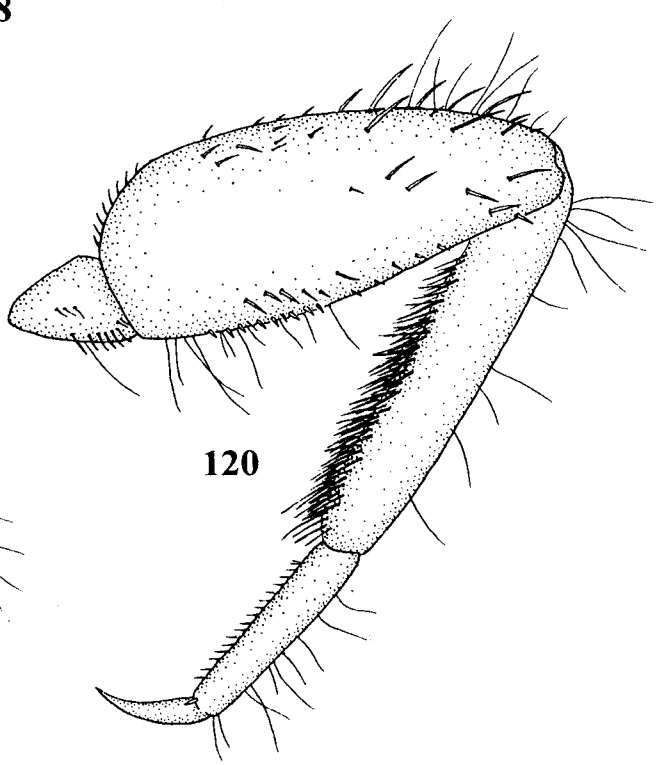

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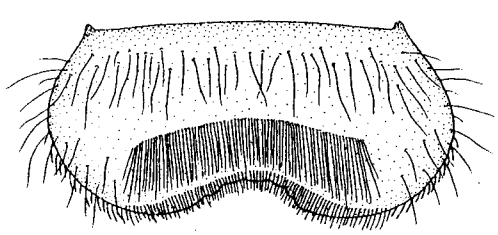


122

# Genus *Nousia* Navás 1918

**Diagnosis:** Labrum sub-equal or slightly wider than clypeus; width 1.7-2.4x length along median line; sub-apical setal fringe about 0.5x width of labrum; frontal setae either arranged as a narrow band or in a single row. Mandibles with incisors slender. Labium with glossae lying in same plane as paraglossae; labial palp with apical segment 0.7 (or more) x length of the middle segment. Legs moderately robust; tarsal claws with series of ventral teeth, progressively larger apically. Postero-lateral spines on abdominal segments 4, 5, or 6 to 9, the spines on more anterior segments small. Gills lanceolate, sometimes linear; lateral tracheae absent to moderately developed.

**Taxonomy:** The genus *Nousia* has been recorded from Australia and South America, and is the only cool temperate genus of Leptophlebiidae in Australia which is not endemic. The type species, *Nousia delicata* from South America, was redescribed by Pescador and Peters (1985), who also redefined the genus and revised the known South American species. Campbell and Suter (1988) established the subgenus *Australonousia* to accommodate several Australian species, but retained them in the genus *Nousia*. After examination of nymphs and adults of species recognised in this study, I agree with the retention of Australian species in the genus *Nousia*, but have doubts about the validity of some characters used by Campbell and Suter to justify subgeneric separation. *Nousia* is clearly an ancient and morphologically conservative genus, although the Australian species in this regard are more diverse than the South American species described by Pescador & Peters (1985).

Sixteen species have been recognised, but it is probable that some are actually species complexes. In particular, the voucher species *Nousia* sp.AV1 is a variable and widespread taxa which requires further investigation. The single species previously referred to Genus R (Dean & Suter, 1996) has now been transferred to the genus *Nousia*, and is listed below as *Nousia* sp.AV16.

**Checklist of species included in the key**

| | |
|---|---|
| *Nousia* sp.AV1 | SE Qld, NSW, Vic, Tas, Sth Aust |
| *Nousia* sp.AV2 | SE Qld, NSW, Vic |
| *Nousia* sp.AV3 | NSW, Vic |
| *Nousia* sp.AV4 | NSW, Vic |
| *Nousia* sp.AV5 | Tas |
| *Nousia* sp.AV6 | Tas |
| *Nousia* sp.AV7 | Tas |
| *Nousia* sp.AV8 | Tas |
| *Nousia* sp.AV9 | Tas |
| *Nousia* sp.AV10 | Tas |
| *Nousia* sp.AV11 | NSW, Vic |
| *Nousia* sp.AV12 | Vic |
| *Nousia* sp.AV13 | Tas |
| *Nousia* sp.AV15 | Vic |
| *Nousia* sp.AV16 | SW Aust |
| *Nousia* sp.AV17 | Vic |

## Key to nymphs of Australian species

1 Labrum with anterior margin relatively straight or shallowly concave (Figs 123,131,138, 145); mainland Australia and Tasmania ..... 2

- Labrum with deep mesal notch in anterior margin (Figs 153,156,158); Tasmania ..... 14

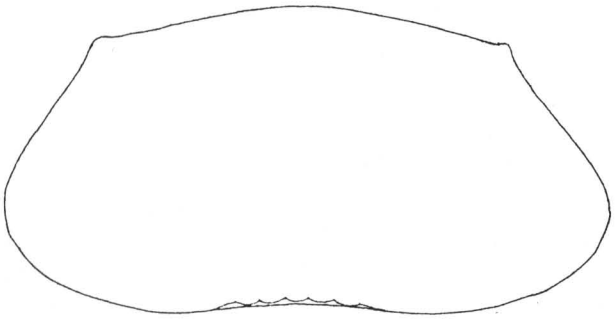
2(1) Abdominal terga predominantly golden, some paler whitish markings but darker pigmentation completely absent (Fig 163); Tasmania ..... 3

- Abdominal terga with at least some dark brown pigmentation, often extensive (Figs 160,162,164,168); mainland Australia and Tasmania ..... 4

3(2) Labrum broadest in apical half, maximum width 1.9-2.0x length along midline (Fig 123), frontal setae arranged in single row (Fig 124); gill lamellae narrow (Fig 125) ..... ..... ***Nousia* sp.AV6**

- Labrum broadest a little beyond midlength, maximum width 2.0-2.2x length along midline (Fig 126), frontal setae arranged as narrow band (Fig 127); gill lamellae moderately broad (Fig 128) ..... ***Nousia* sp.AV5**

***Nousia* sp.AV6**: 123, labrum; 124, frontal setae of labrum; 125, fourth abdominal gill. ***Nousia* sp.AV5**: 126, labrum; 127, frontal setae of labrum; 128, fourth abdominal gill.



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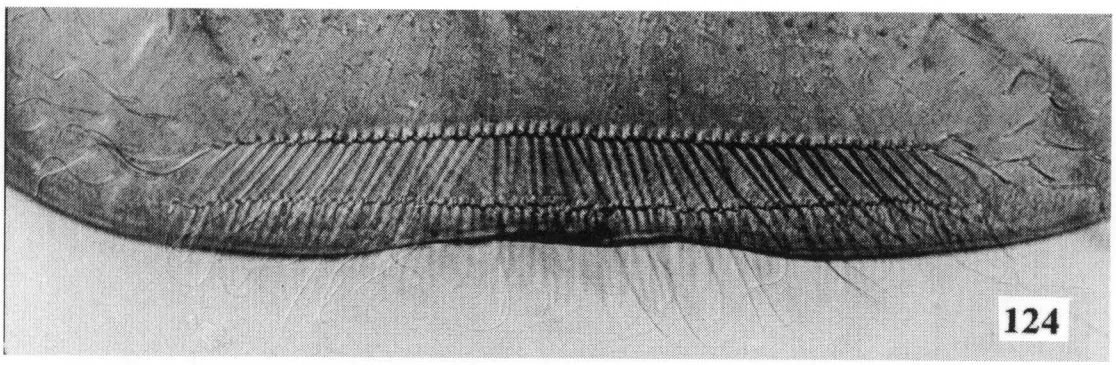

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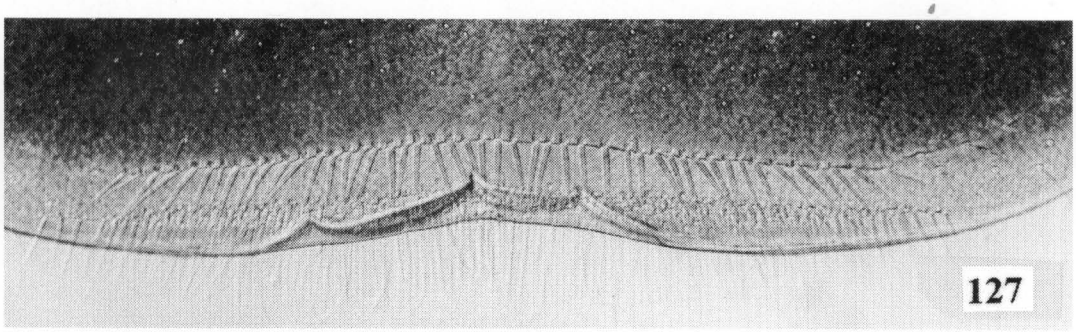

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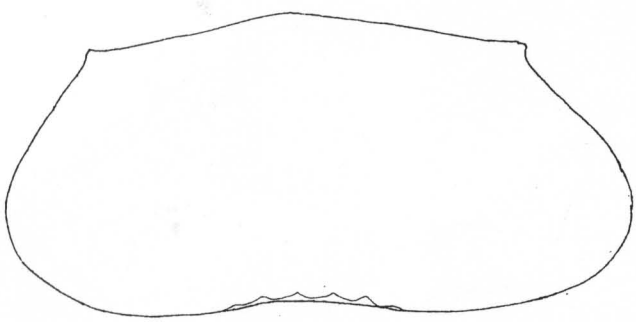


126

128

4(2) Labrum with frontal setae arranged as single row (Figs 132,135) ..... 5

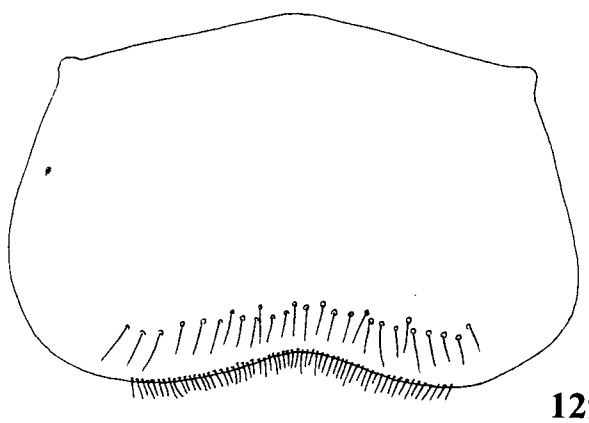
- Labrum with frontal setae arranged as narrow band (Figs 142,148,150) ..... 7

5(4) Labrum relatively narrow, maximum width approximately 1.7x length along median line (Fig 129); foretarsus with 15-20 ventral spines; gills narrow, lateral tracheae absent (Fig 130); south-western Australia ..... ***Nousia* sp.AV16**

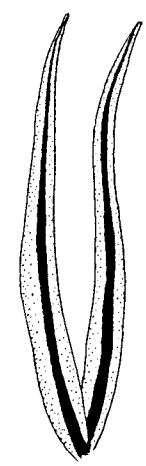
- Labrum slightly broader, maximum width 1.7-1.9x length along median line (Figs 131,134); foretarsus with 10 or fewer ventral spines; gills variable, narrow without lateral tracheae or moderately broad with lateral tracheae (Figs 133,137); eastern Australia ..... 6

6(5) Gill lamellae moderately broad, lateral tracheae present, membrane pale (Fig 133); Tasmania ..... ***Nousia* sp.AV7**

- Gill lamellae narrow, lateral tracheae absent, membrane purple (Fig 137); mainland Australia ..... ***Nousia* sp.AV15**



**129**



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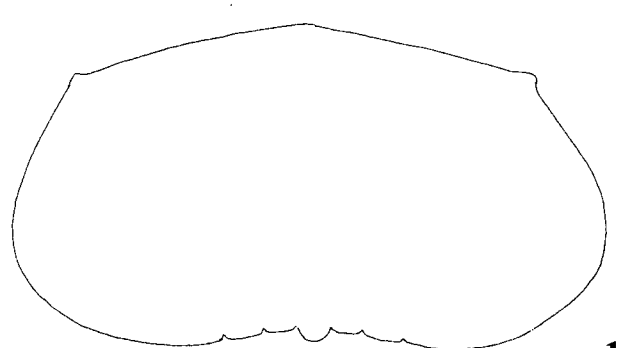
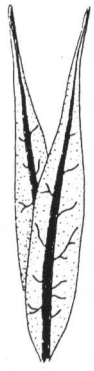
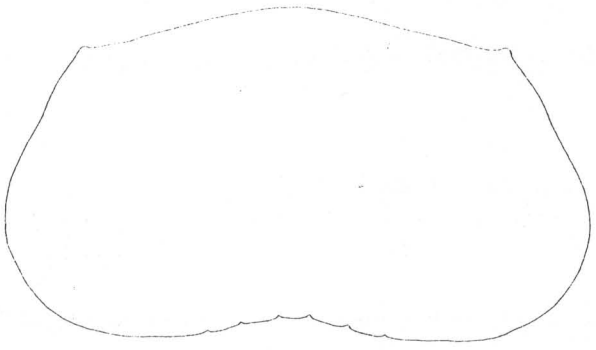


**131**

***Nousia* sp.AV16**: 129, labrum; 130, fourth abdominal gill. ***Nousia* sp.AV7**: 131, labrum; 132, frontal setae of labrum; 133, fourth abdominal gill. ***Nousia* sp.AV15**: 134, labrum; 135, frontal setae of labrum; 136, foreleg; 137, fourth abdominal gill.



133



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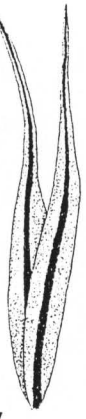

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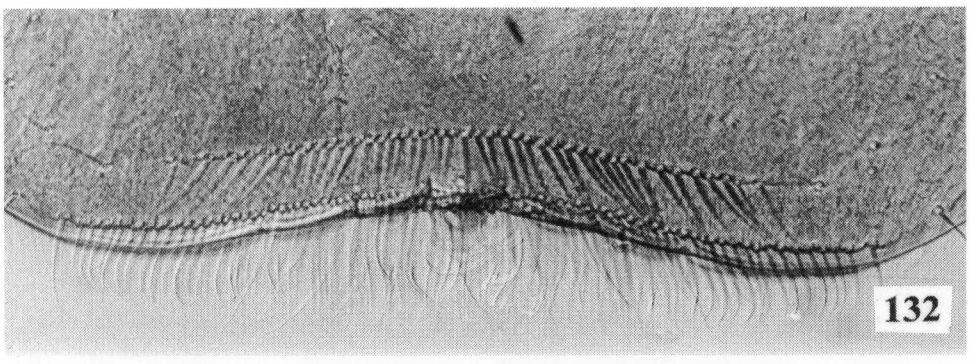

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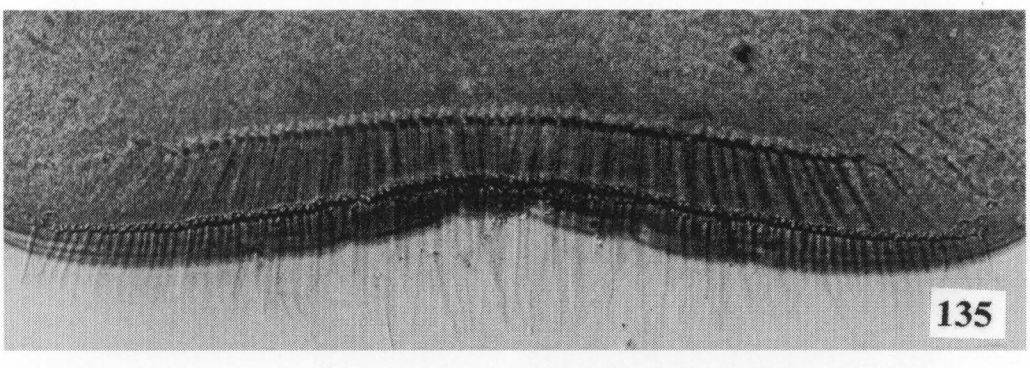

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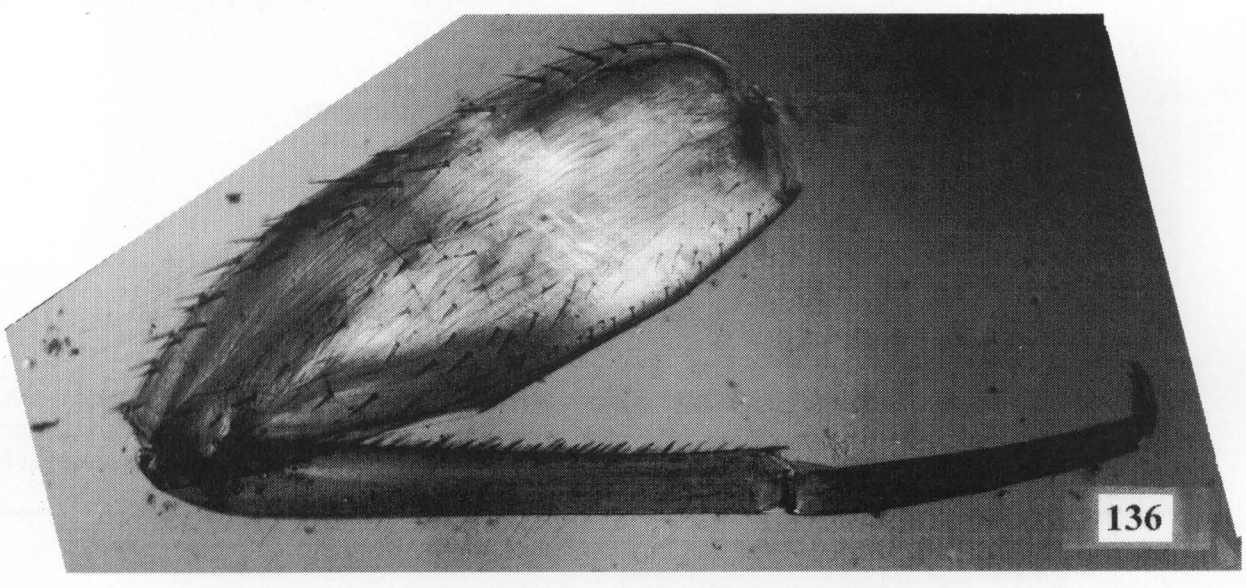


136

7(4) Gills with lamellae unpigmented or lightly pigmented, membrane usually off-white or grey, but occassionally yellow or pale pink ..... 8

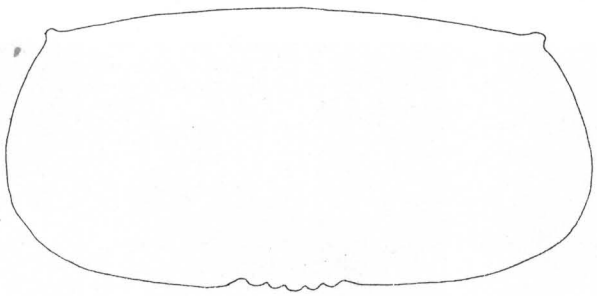
- Gills with lamellae darkly pigmented, ranging from mauve to dark purple or black ..... 10

8(7) Gill lamellae very broad, lateral tracheae strongly developed (Fig 140); abdominal terga with continuous row of moderately large spines along posterior margin (Fig 139) ..... ***Nousia* sp.AV4**

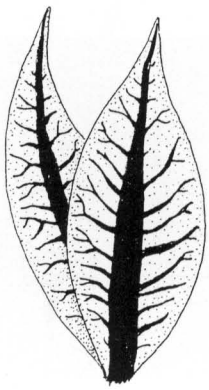
- Gill lamellae narrow to moderately broad; abdominal terga with minute spines along posterior margin, discontinuous and clustered in groups of 2 to 5 spines (Fig 146) ..... 9

9(8) Smaller species, body length less than 10 mm; maximum width of labrum 1.8-2.0x length along median line (Fig 141); denticles along anterior margin of labrum not extending across more than about 0.3x the maximum width of the labrum (Figs 141, 143) ..... ***Nousia* sp.AV1**

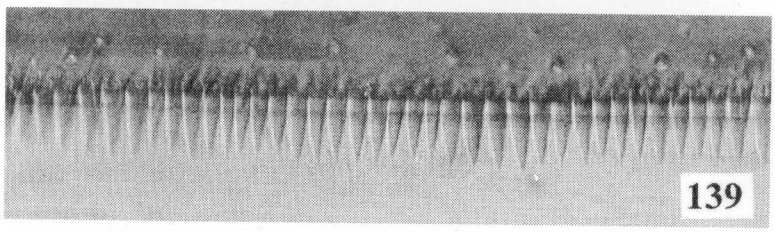
- Larger species, body length more than about 14 mm; maximum width of labrum 2.0-2.2x length along median line (Fig 145); denticles along anterior margin of labrum extending across 0.4-0.5x the maximum width of the labrum (Fig 145) ..... ***Nousia* sp.AV3**



**138**

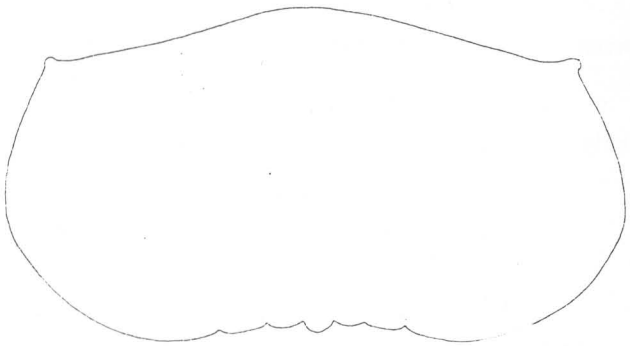


**140**



**139**

***Nousia* sp.AV4**: 138, labrum; 139, spines on posterior margin of abdominal tergum IV; 140, fourth abdominal gill. ***Nousia* sp.AV1**: 141, labrum; 142, frontal setae of labrum; 143, denticles on anterior margin of labrum, variant; 144, foreleg. ***Nousia* sp.AV3**: 145, labrum; 146, spines on posterior margin of abdominal tergum IV.



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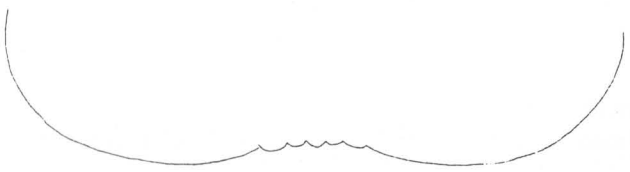
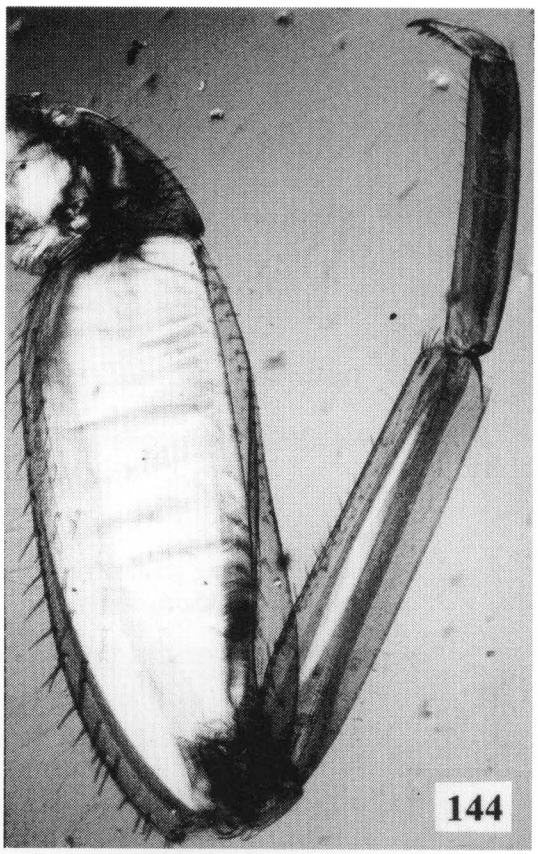
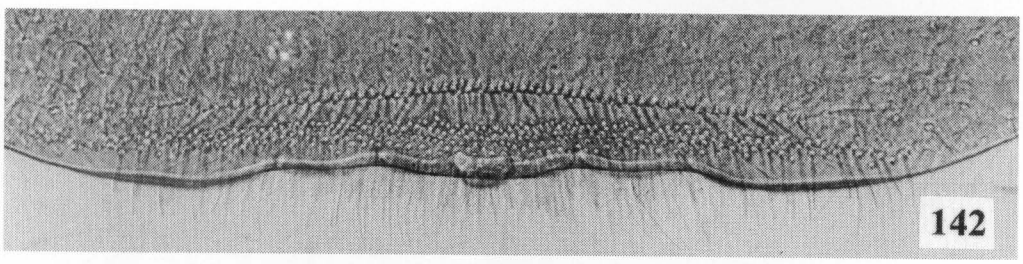


143



144



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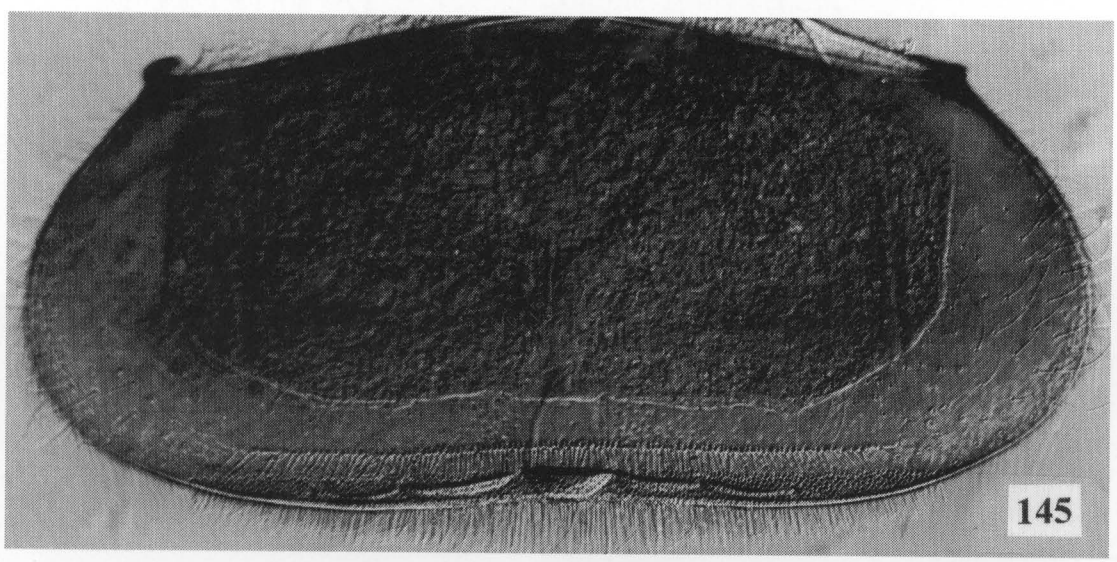

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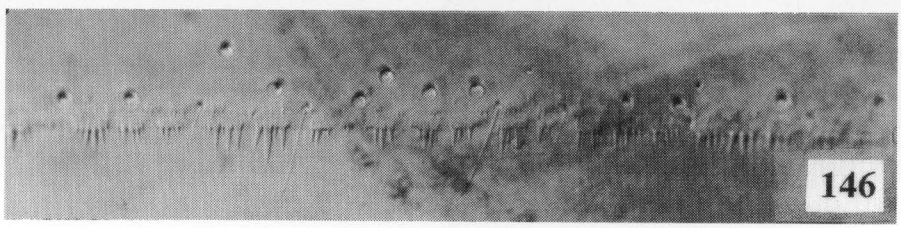


146

10(7) Labrum without clear separation between band of frontal setae and the sub-apical row of setae (Fig 148) ..... ***Nousia* sp.AV2**

- Labrum with band of frontal setae clearly separated from sub-apical row of setae (Fig 150) ..... 11

11(10) Tasmania ..... ***Nousia* sp.AV13**

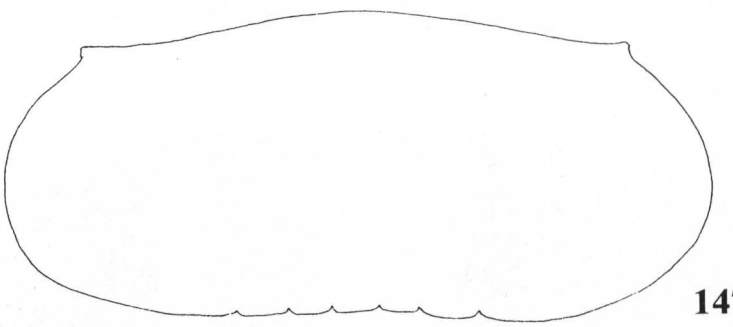
- Mainland south-eastern Australia ..... 12

12(11) Gills narrowing gradually towards apex (Fig 151); abdominal terga with contrasting pale and dark colour pattern, darkly pigmented along midline (Fig 167) ..... ***Nousia* sp.AV11**

- Gills narrowing slightly more abruptly, terminating in a short apical filament (Fig 152); abdominal terga uniform medium brown or, if with contrasting colour pattern, pale along midline (Fig 168) ..... 13

13(12) Abdominal terga uniform medium brown ..... ***Nousia* sp.AV12**

- Abdominal terga with contrasting pale and dark colour pattern (Fig 168) ..... ***Nousia* sp.AV17**



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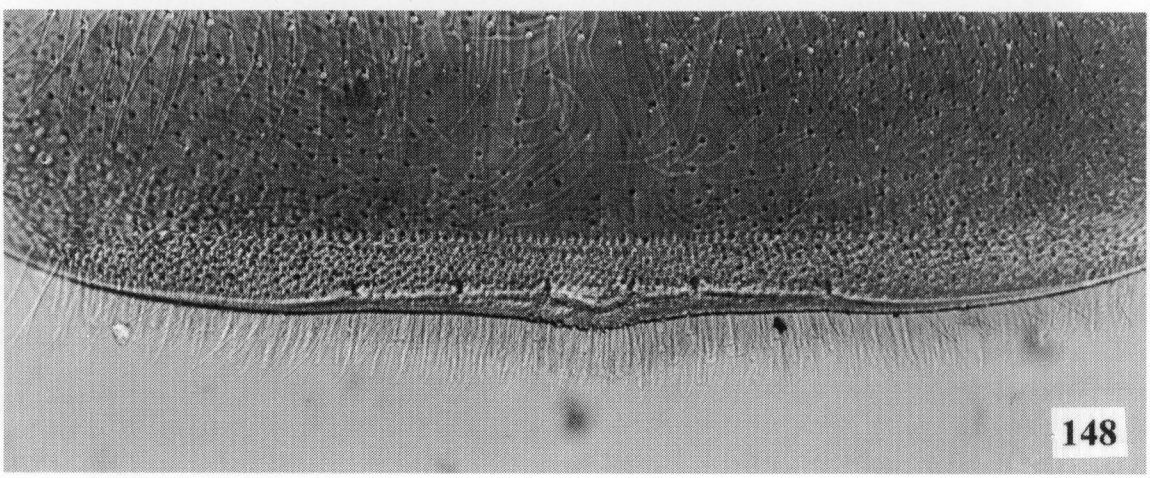

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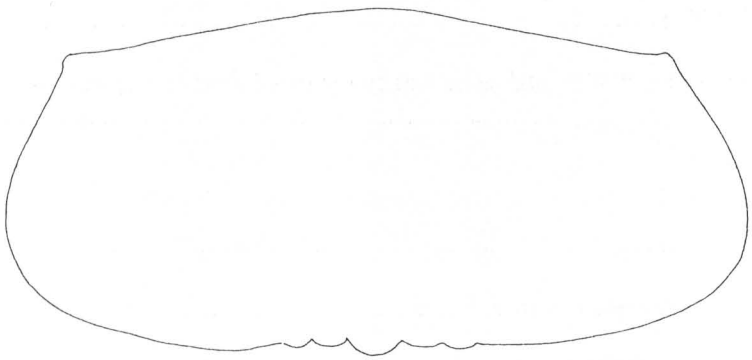

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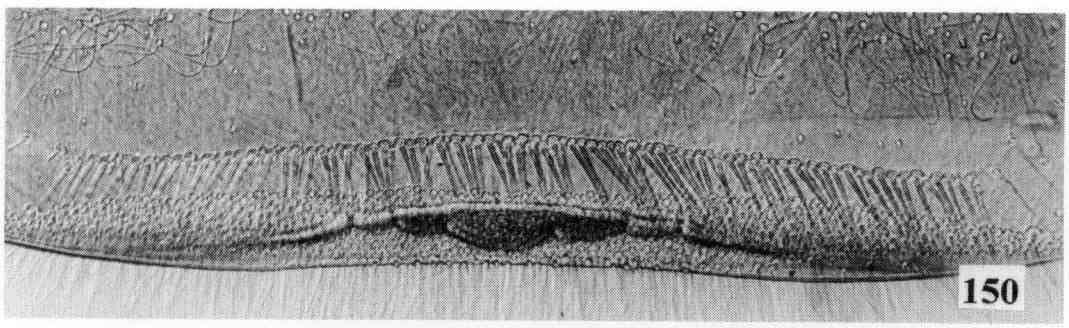

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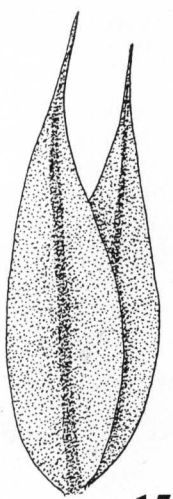

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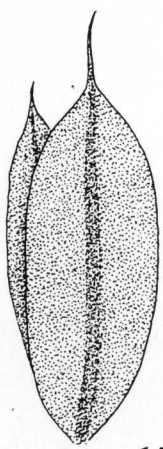


152

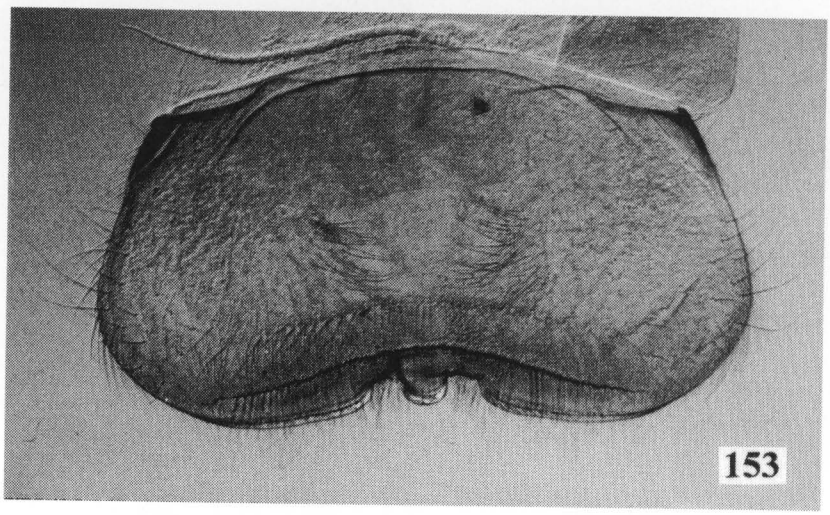
*Nousia* **sp.AV2**: 147, labrum; 148, frontal setae of labrum. *Nousia* **sp.AV11**: 149, labrum; 150, frontal setae of labrum; 151, fourth abdominal gill. *Nousia* **sp.AV12**: 152, fourth abdominal gill.

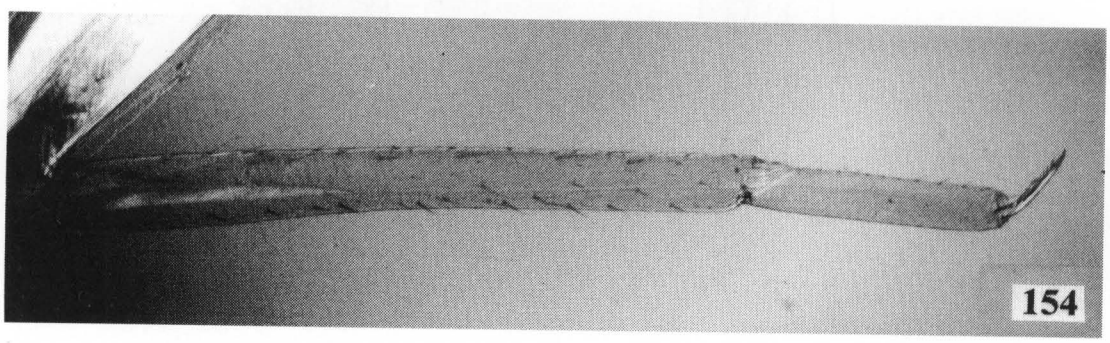
14(1) Anterior margin of labrum with middle denticle large, projecting almost to the mouth of the frontal notch (Fig 153); hind tibia slender (Fig 154); abdominal terga with minute spines along posterior margin, discontinuous and clustered in groups of 2-5 spines (Fig 155) ..... ***Nousia* sp.AV10**

- Anterior margin of labrum with middle denticle smaller, projecting half or less the depth of the frontal notch (Figs 156,158); hind tibia robust (Fig 157); abdominal terga with continuous row of moderately large spines along posterior margin (Fig 159) ..... 15

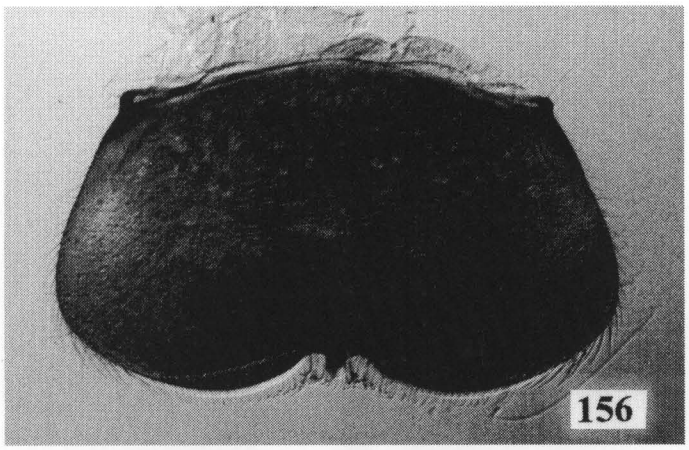
14(13) Anterior margin of labrum with middle denticle projecting about half the depth of the frontal notch, lateral margins moderately diverging to anterior (Fig 156); abdominal terga predominantly pale with dark markings (Fig 165) ..... ***Nousia* sp.AV8**

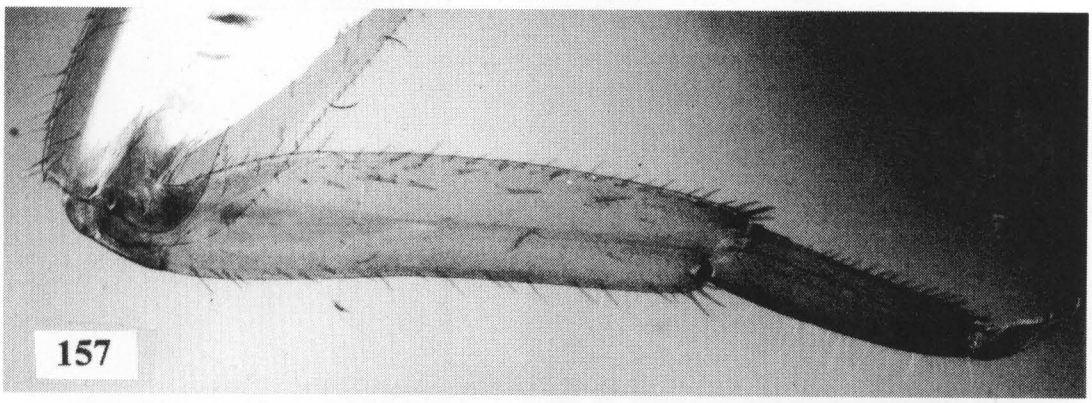
- Anterior margin of labrum with middle denticle projecting less than half the depth of the frontal notch, lateral margins weakly diverging to anterior (Fig 158); abdominal terga usually predominantly dark (Fig 166) ..... ***Nousia* sp.AV9**

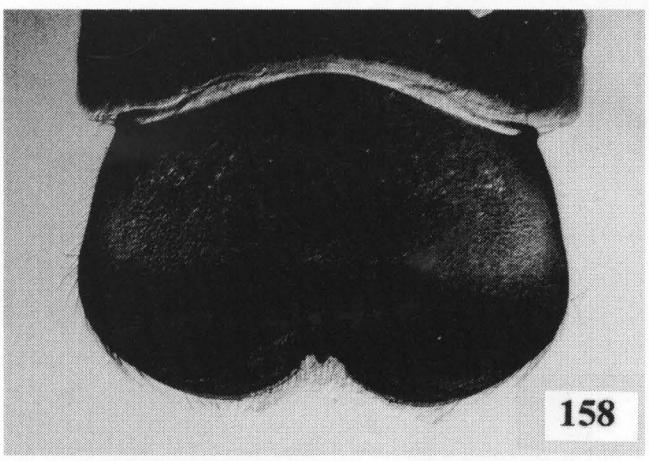



**155**

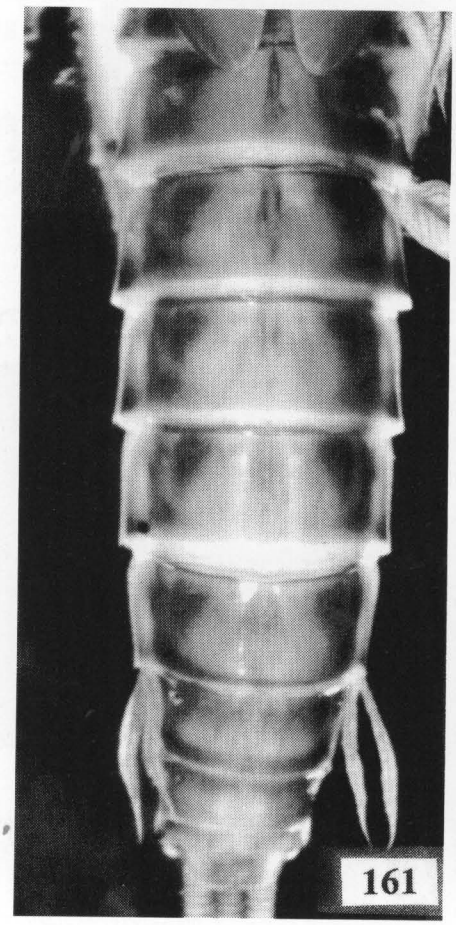


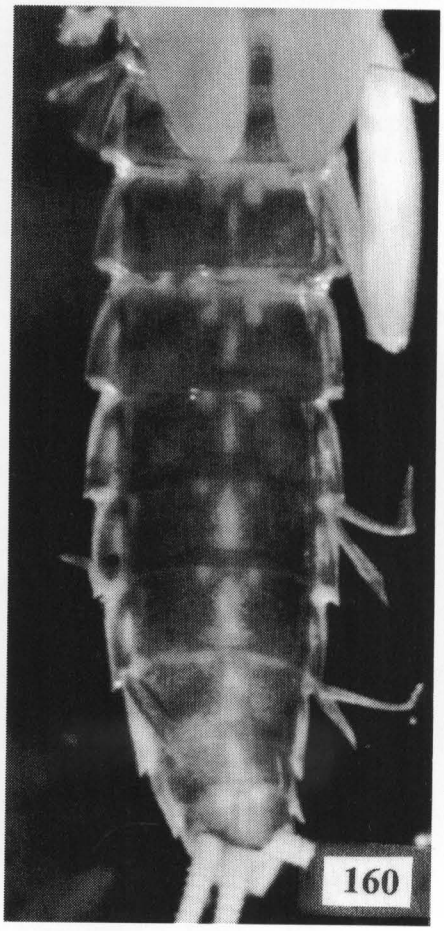



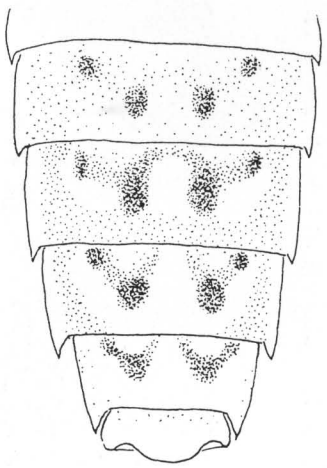




159

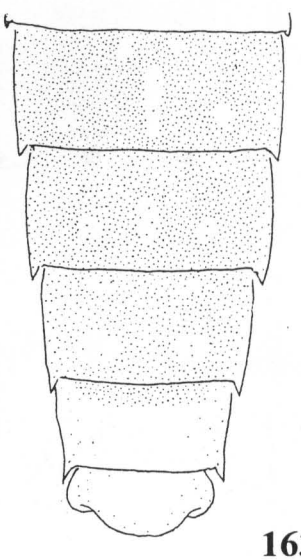
*Nousia* **sp.AV10**: 153, labrum; 154, hindleg; 155, spines on posterior margin of abdominal tergum IV. *Nousia* **sp.AV8**: 156, labrum; 157, hindleg. *Nousia* **sp.AV9**: 158, labrum; 159, spines on posterior margin of abdominal tergum IV.



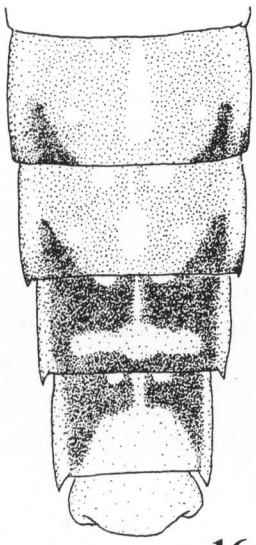



162



163

Abdominal terga. 160, ***Nousia*** **sp.AV1**; 161, ***Nousia*** **sp.AV3**; 162, ***Nousia*** **sp.AV4**; 163, ***Nousia*** **sp.AV6**;



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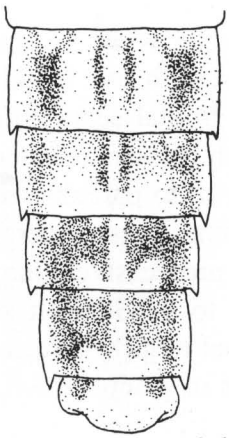
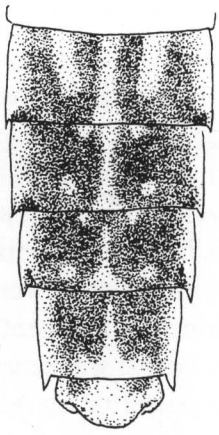


165



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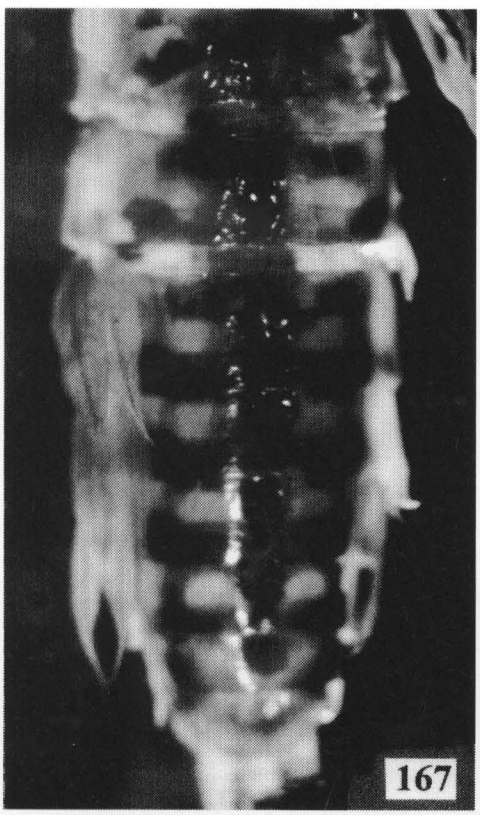

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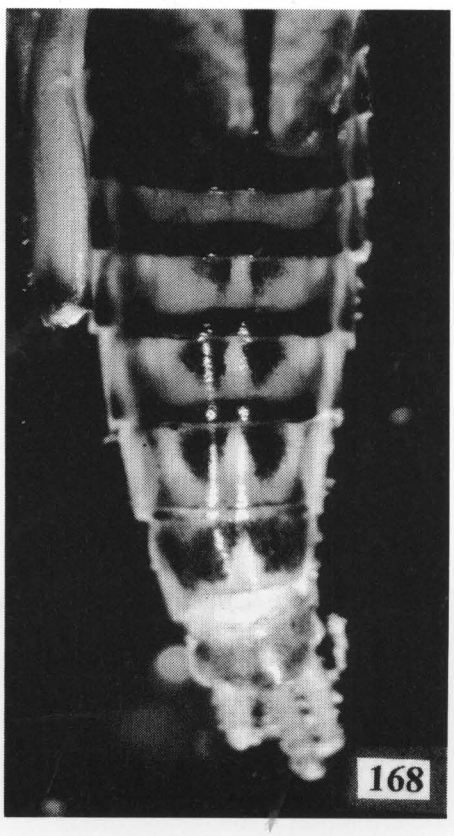


168

Abdominal terga. 164, ***Nousia*** **sp.AV7**; 165, ***Nousia*** **sp.AV8**; 166, ***Nousia*** **sp.AV9**; 167, ***Nousia*** **sp.AV11**; 168, ***Nousia*** **sp.AV17**.

# Genus *Nyungara* Dean 1987

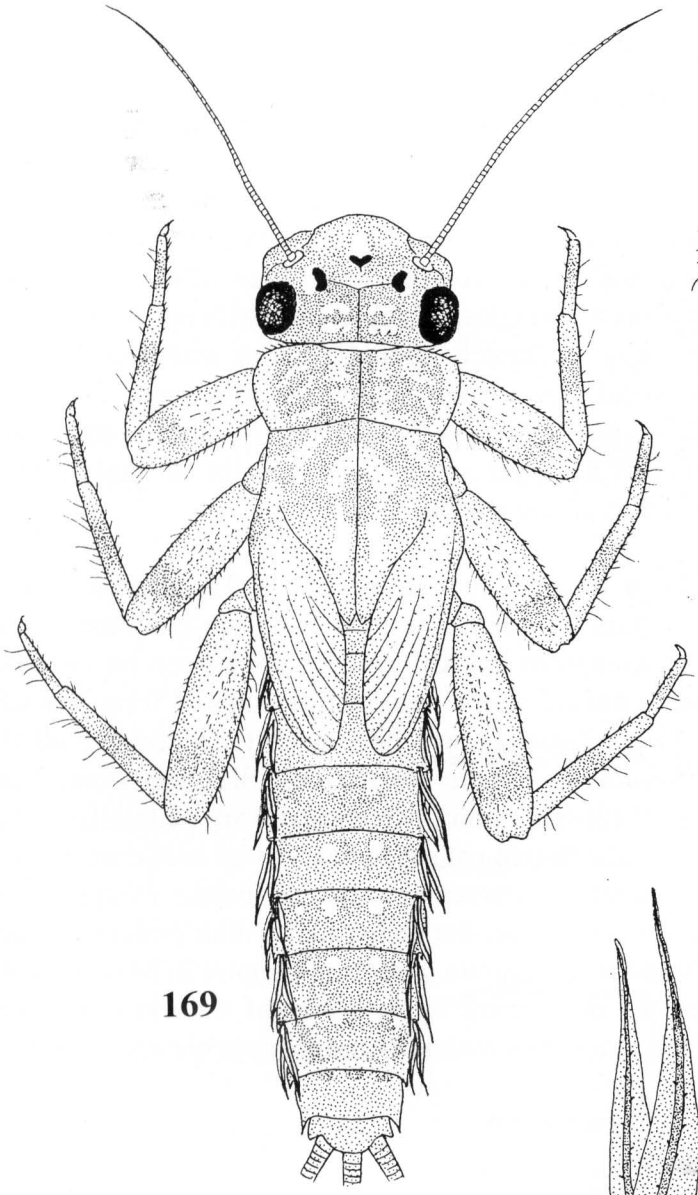
**Diagnosis:** Antenna length about 2x width of head. Labrum width about 2x length along median line; anterior margin with five broad denticles, extending over at least half maximum width of labrum; frontal setae arranged as narrow band, sub-apical setal fringe absent. Mandibles with incisors slender. Labium with glossae not turned under ventrally, lying slightly dorsal to paraglossae; terminal segment of labial palp about 0.7x length of middle segment. Legs moderately robust, weakly banded; tarsal claws with series of ventral teeth, progressively larger apically. Postero-lateral spines on abdominal segments 5(small) to 9. Gills on segments 1-7, lamellae lanceolate without lateral tracheae. Abdominal terga with discontinuous series of minute spines close to posterior margin, arranged in groups of 3-5 spines.

**Taxonomy:** The genus was erected by Dean (1987) to accommodate two small species from south-western Australia, and these remain the only known species. The nymph of the type species (*N.bunni*) has been described, but the nymph of the second species is unknown.

**Checklist of recognised species**

| | |
|---|---|
| *Nyungara bunni* | SW Aust |

***Nyungara bunni*:** 169, whole nymph; 170, labrum; 171, frontal setae of labrum; 172, foreleg; 173, foretarsal claw; 174, fourth abdominal gill; 175, spines on posterior margin of abdominal tergum IV.



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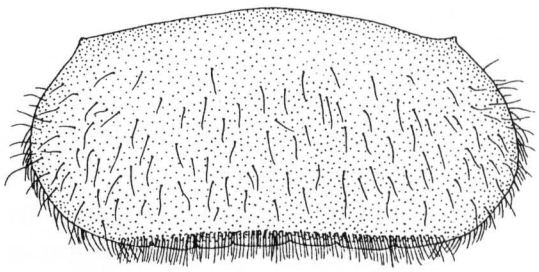

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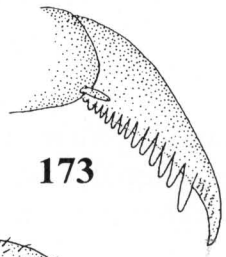

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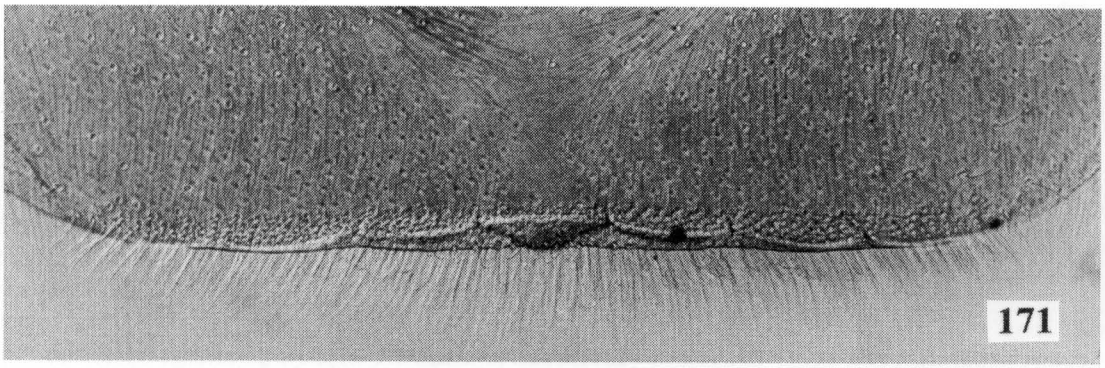


171

## Genus *Thraulus* Eaton 1881

**Diagnosis:** Antenna length 2-3x width of head capsule. Labrum sub-equal or slightly wider than clypeus; width about 2.1-2.2x length along median line; anterior margin shallowly concave; upper surface delicately reticulate; sub-apical setal fringe sparse, located at about 0.7 of labrum length; frontal setae arranged as a single row. Mandibles with incisors slender; outer margin with dense row of long setae along apical half. Labium with glossae lying in same plane as paraglossae; labial palp with apical segment a little longer than middle segment. Legs moderately robust, femora with row of long, slender spines along outer margin; tarsal claws either smooth or with series of ventral teeth. Postero-lateral spines on abdominal segments 7 or 8 to 9. Gills on abdominal segments 1 to 7, each gill consisting of an upper and a lower lamella, all multidigitate except upper lamella of first gill, which is a long slender filament.

**Taxonomy:** While it has long been recognised that the genus *Thraulus* occurs in northern Australia, no species have thus far been described from the continent. Suter (1992) recognised nymphs of two species from the Alligator Rivers Region on the basis of abdominal colour pattern. I have examined a small amount of material from Kakadu, and all darker nymphs which key to his *Thraulus* sp.2 have been female, while all the paler nymphs which key to his *Thraulus* sp.1 have been males. Similarly, males and females of a species from Cape York Peninsula in north Queensland are quite different in abdominal colour patterns. The female abdominal pattern appears to be conservative, and I have been unable to find a satisfactory character to separate female nymphs from different regions in northern Australia. Therefore, the abdominal colour pattern of male nymphs has had to be used as a character to separate species at couplet 2. Male nymphs can be recognised by the presence of developing upper lobes of the eyes. The key presented below is based on a limited amount of material, and there is clearly a need for examination of additional specimens.

### Checklist of species included in the key

| | |
|---|---|
| *Thraulus* sp.AV1 | NW Aust, NT |
| *Thraulus* sp.AV2 | N Qld |
| *Thraulus* sp.AV3 | N Qld |

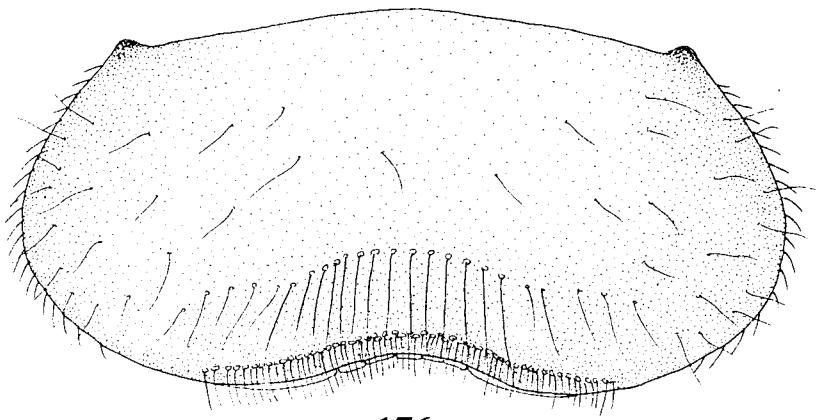
### Key to nymphs of Australian species

1 Tarsal claws smooth (Fig 182) ..... ***Thraulus* sp.AV3**

\- Tarsal claws with ventral teeth (Fig 179) ..... 2

2(1) Male nymphs with abdominal terga predominantly pale, posterior margin of each segment dark brown (Fig 180); north-west Australia, Northern Territory ..... ***Thraulus* sp.AV1**

\- Male nymphs with abdominal terga pale, each segment with longitudinal dark bands (Fig 181); North Queensland ..... ***Thraulus* sp.AV2**



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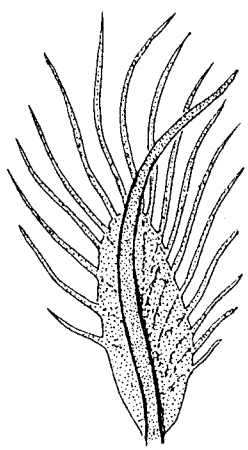

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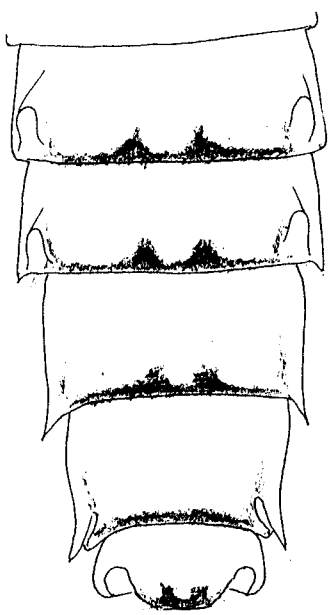

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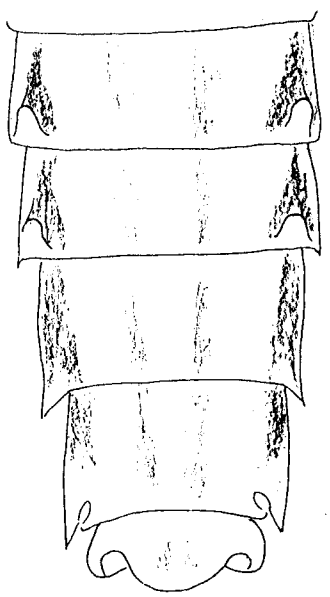

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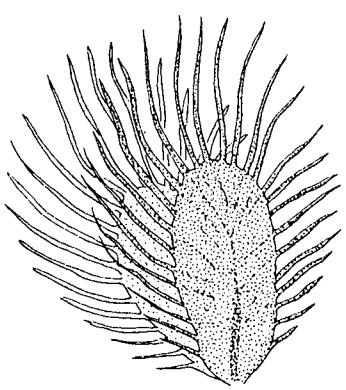

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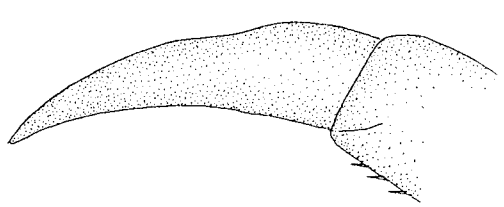

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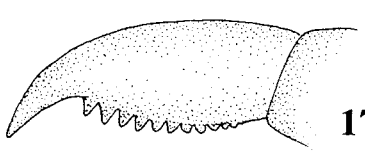


179

***Thraulus* sp.AV1**: 176, labrum; 177, first abdominal gill; 178, third abdominal gill; 179, fore tarsal claw; 180, abdominal terga, male nymph. ***Thraulus* sp.AV2**: 181, abdominal terga, male nymph. ***Thraulus* sp.AV3**: 182, fore tarsal claw.

## Genus *Tillyardophlebia* Dean 1997

**Diagnosis:** Antenna length about 2x width of head capsule. Labrum a little broader than clypeus; maximum width 1.8-2.2x maximum length; anterior margin with central notch, usually overhung by canopy. Maxillae with subapical row of 25-30 pectinate setae on ventral surface. Mandibles with incisors slender. Labium with glossae lying in same plane as paraglossae; labial palp with terminal segment less than half length of middle segment. Legs relatively large, all segments with fringe of setae along outer margin; tibiae long and slender; tarsi with ventral spines relatively uniform in length, without elongate spine in apical third; tarsal claws with ventral teeth. Abdominal segments without setae on lateral margins; strongly developed postero-lateral spines on segments 2-9. Gills lanceolate, lateral tracheae either well developed or inconspicuous.

**Taxonomy:** The genus was erected by Dean (1997) to accommodate two species from mainland south-eastern Australia which had previously been designated 'Genus D' (Dean & Suter, 1996). A single species is widespread in Tasmania, and although referred to here as *Tillyardophlebia* sp.AV2, on the basis of reared adults probably represents the species described by Harker (1954) as *Jappa tristis*. Nymphs of an additional two undescribed species are known from mainland south-eastern Australia, and nymphs of three undescribed species are known from northern Australia. The nymphs from northern Australia are included in *Tillyardophlebia* on morphological grounds, however, the male genitalia of reared specimens of *Tillyardophlebia* sp.AV8 and genitalia dissected from ripe nymphs of the two Queensland species are quite different from the very characteristic genitalia of southern species. On the basis of a preliminary cladistis analysis, Christidis (In press) has suggested that *Tillyardophlebia* sp.AV7 (= WT species 1) should perhaps be placed in a new genus.

**Checklist of species included in the key**

| | |
|---|---|
| *Tillyardophlebia alpina* Dean | NSW, Vic |
| *Tillyardophlebia rufosa* Dean | NSW, Vic |
| *Tillyardophlebia* sp. AV2 | Tas |
| *Tillyardophlebia* sp. AV3 | Vic |
| *Tillyardophlebia* sp. AV5 | NSW |
| *Tillyardophlebia* sp. AV6 | SE Qld |
| *Tillyardophlebia* sp. AV7 | N Qld |
| *Tillyardophlebia* sp. AV8 | NW Aust, NT |

## Key to nymphs of Australian species

1 Foretibiae with ventral spines sparse in apical third; length of spines usually 1/3 (or less) the width of the tibiae (Figs 186,192) ..... 2

- Foretibiae with ventral spines relatively dense in apical third; length of spines about 1/2 width of tibiae (Fig 195,198,201) ..... 5

2(1) Gills with membranes darkly pigmented, purple ..... ***Tillyardophlebia alpina***

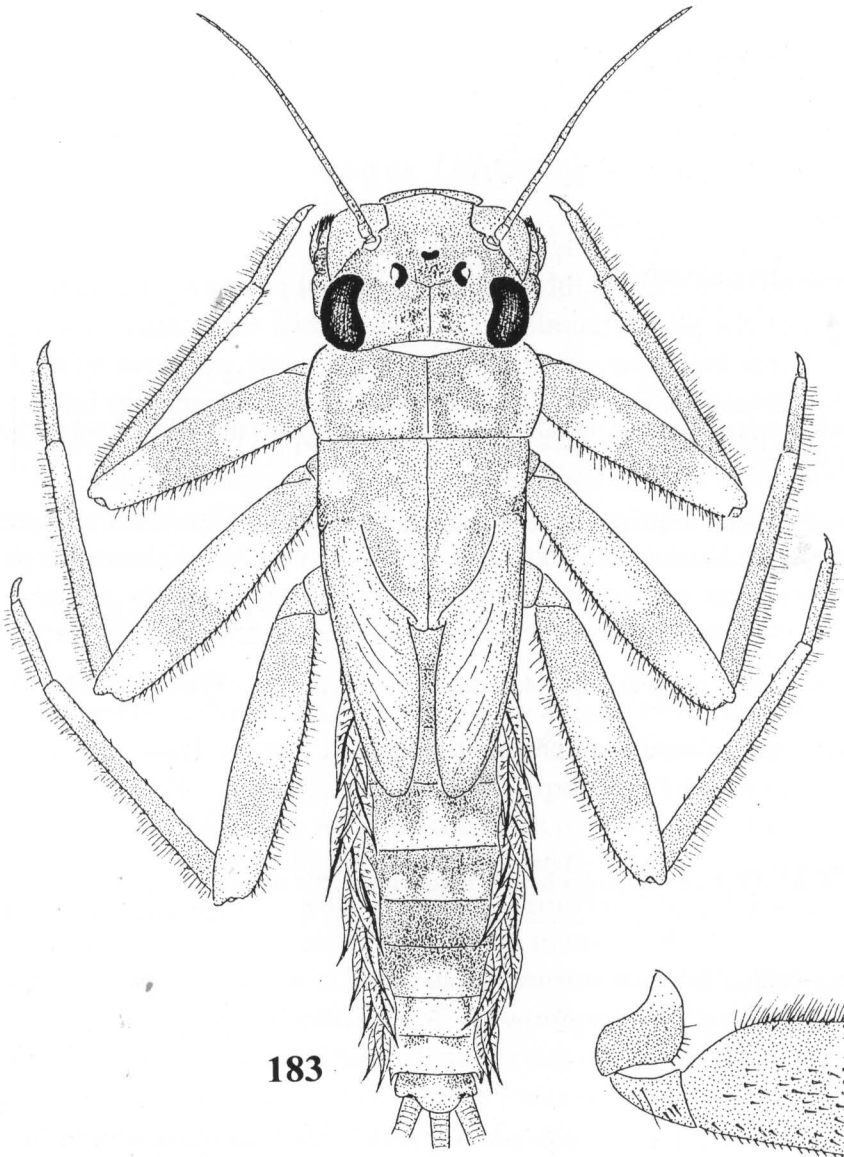
- Gills with membranes unpigmented, white or grey ..... 3

3(2) Labrum broader, width 2.0-2.1x maximum length; notch in anterior margin broad (Fig 188) ..... ***Tillyardophlebia rufosa***

- Labrum narrower, width 1.8-1.9x maximum length; notch in anterior margin narrow (Figs 191,193) ..... 4

4(3) Labrum with frontal setae arranged as a single row (Fig 191) ..... ***Tillyardophlebia* sp.AV3**

- Labrum with frontal setae arranged as a narrow band (Fig 193) ..... ***Tillyardophlebia* sp.AV5**



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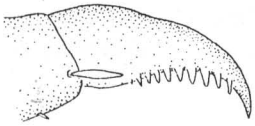
187



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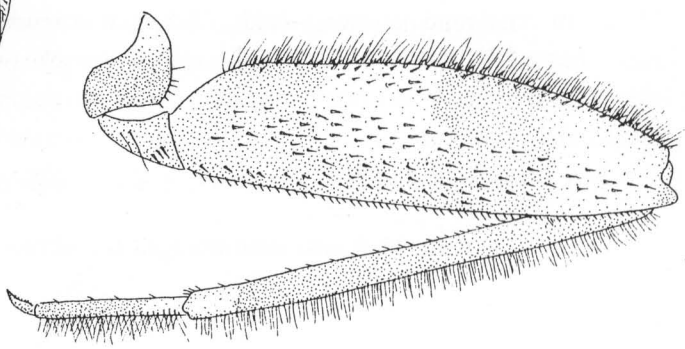

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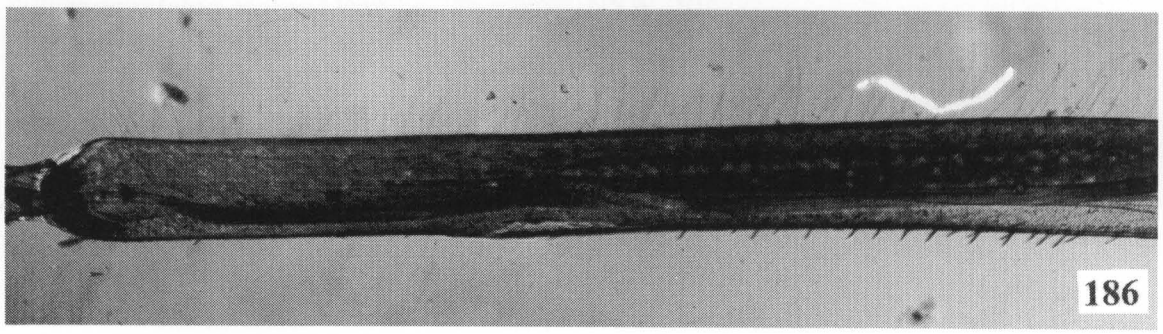
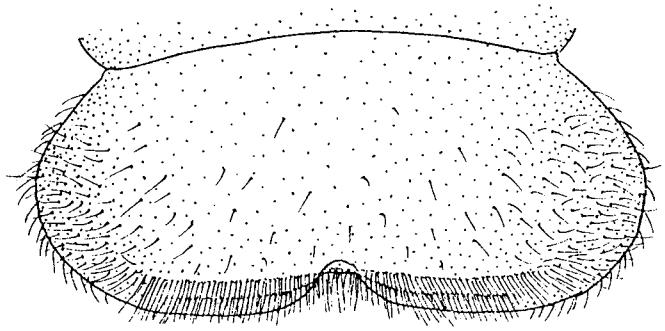


186

***Tillyardophlebia rufosa***: 183, whole nymph; 184, foreleg; 185, fore tarsal claw; 186, foretibia; 187, fourth abdominal gill.



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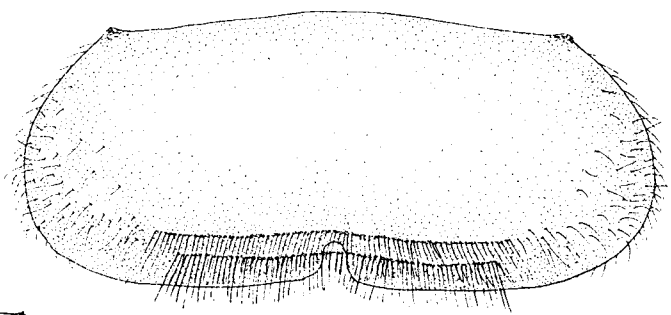

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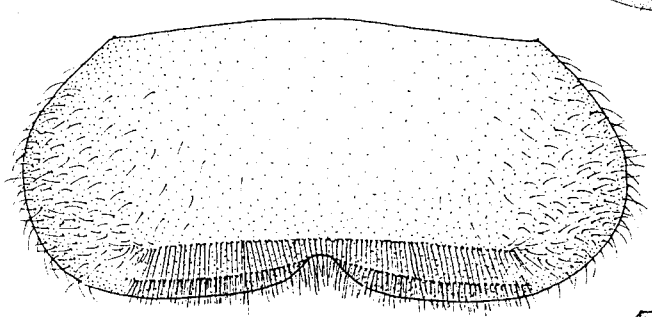

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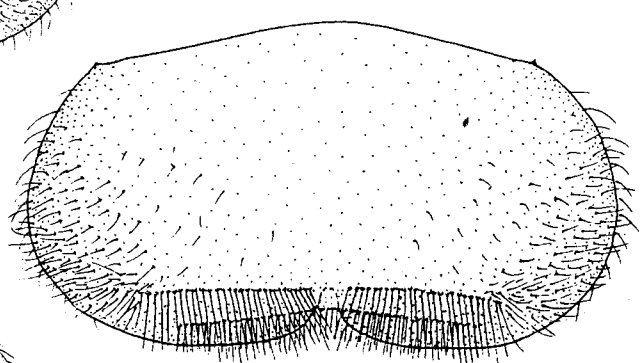

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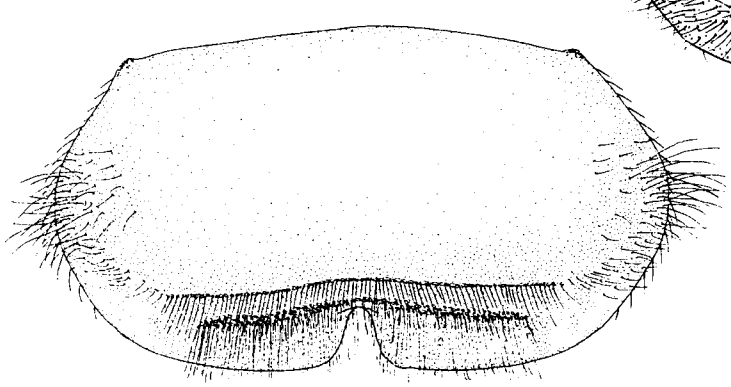

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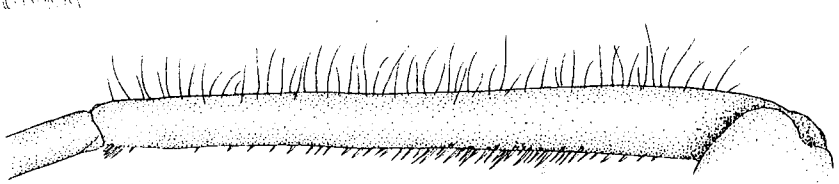


192

***Tillyardophlebia rufosa:*** 188, labrum. ***Tillyardophlebia alpina***: 189, labrum. ***Tillyardophlebia* sp.AV2**: 190, labrum. ***Tillyardophlebia* sp.AV3**: 191, labrum; 192, foretibia. ***Tillyardophlebia* sp.AV5**: 193, labrum.

5(1) Tasmania ..... ***Tillyardophlebia* sp.AV2**

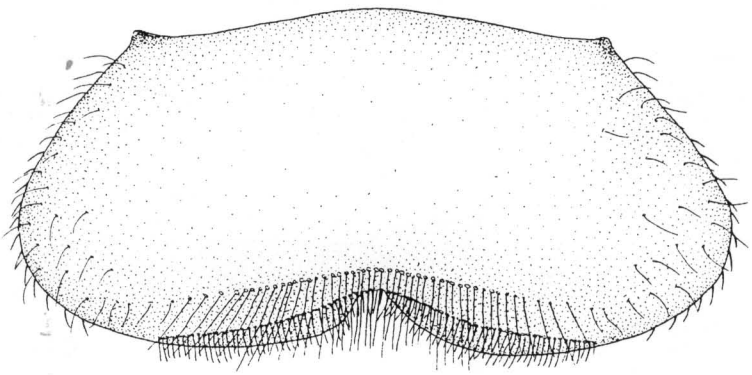
- Mainland Australia, predominantly northern ..... 6

6(5) Gill lamellae narrow, lateral tracheae absent (Fig 196); labrum with frontal setal fringe extending over about 0.65x maximum width of labrum (Fig 194); north-western Australia and Northern Territory ..... ***Tillyardophlebia* sp.AV8**

- Gill lamellae moderately to broadly lanceolate, lateral tracheae strongly developed (Figs 199,202); labrum with frontal setal fringe extending over about 0.55x maximum width of labrum (Figs 198,201); eastern Australia ..... 7

7(6) Gill lamellae broad (Fig 199); legs heavily banded (Fig 198); south-eastern Queensland ..... ***Tillyardophlebia* sp.AV6**

- Gill lamellae less broad (Fig 202); legs with restricted pigmentation (Fig 201); north Queensland ..... ***Tillyardophlebia* sp.AV7**



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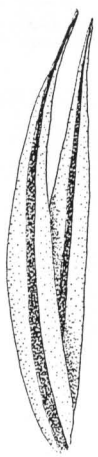
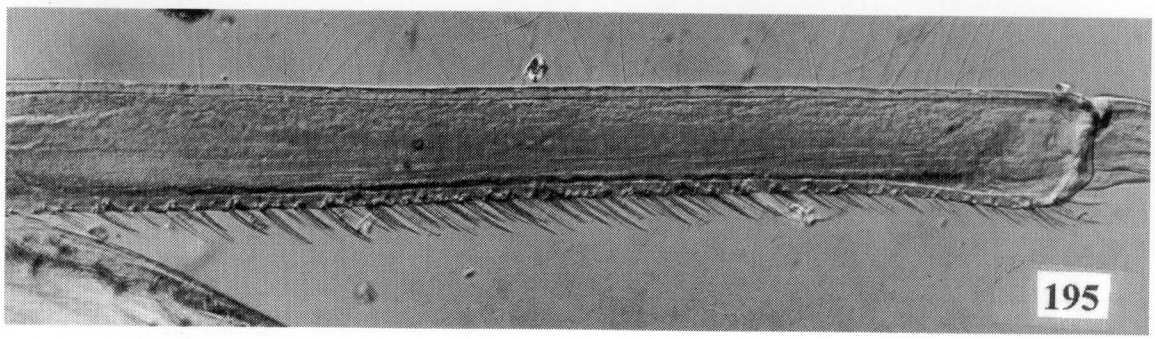
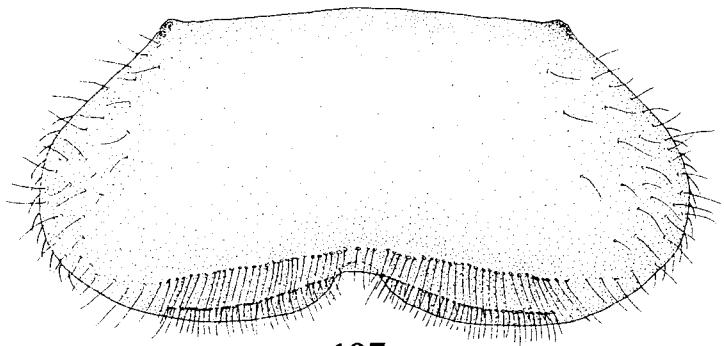


**196**





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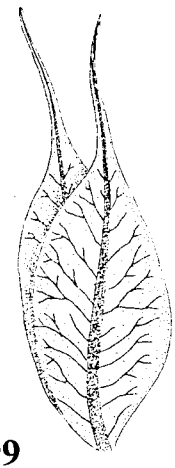

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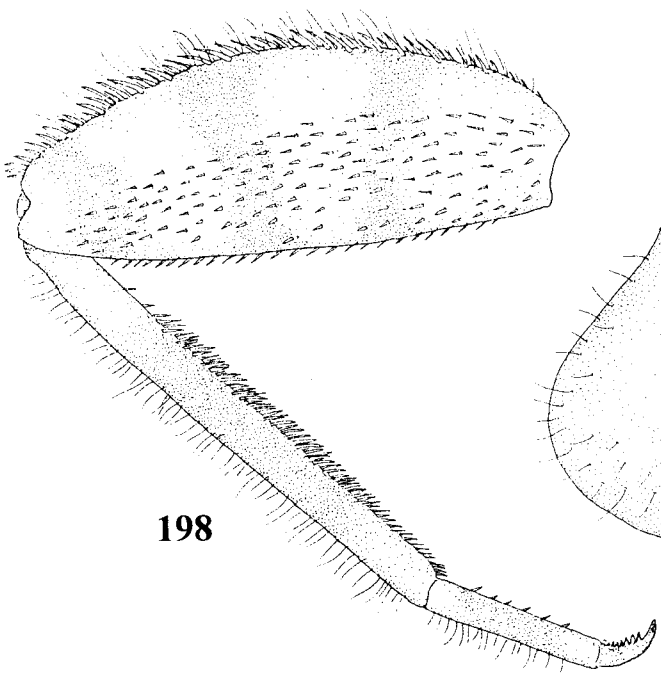

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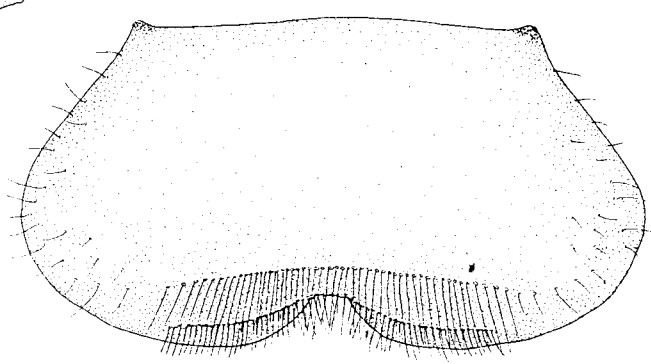

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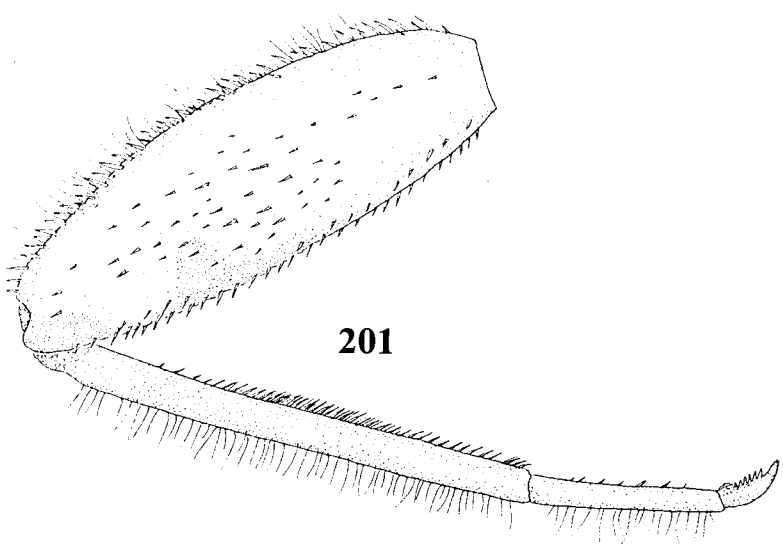

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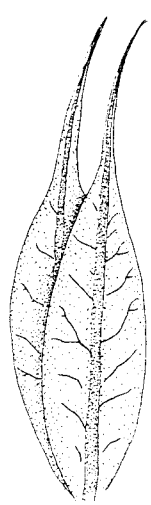


202

*Tillyardophlebia* **sp.AV8**: 194, labrum; 195, foretibia; 196, fourth abdominal gill. *Tillyardophlebia* **sp.AV6**: 197, labrum; 198, foreleg; 199, fourth abdominal gill. *Tillyardophlebia* **sp.AV7**: 200, labrum; 201, foreleg; 202, fourth abdominal gill.

## Genus *Ulmerophlebia* Demoulin 1955

**Diagnosis:** Head capsule without frontal horns; antennae heavily setose. Labrum narrower than clypeus, broadest at base, anterior margin with conspicuously projecting medial tooth; maxillary palp with terminal segment short, subtriangular; mandibles with outer incisors robust. Pronotum with long setae along lateral margins. Legs heavily setose; tarsal claws with small ventral denticles. Abdominal segments with dense fringe of setae along lateral margins; abdominal terga bearing numerous long, fine setae. Gills on abdominal segments 1-7, each gill with both upper and lower lamella broad with a single apical filament; gill lamellae densely clothed with fine setae in apical half. Terminal filaments densely setose.

**Taxonomy:** The genus *Ulmerophlebia* was established by Demoulin (1955) with the designated type species *Euphyurus mjobergi* Ulmer 1916 from Queensland. The only other species to be formally placed in the genus is *U.pipinna* (Suter, 1986), although it is clear from published descriptions (Harker, 1950) that *Deleatidium annulatum* Harker and probably also *Atopopus spadix* Harker belong here. Adults and nymphs of *Ulmerophlebia* are very similar to those of *Jappa*, the only major difference being that nymphs of *Jappa* possess frontal horns. The two genera were apparently considered synonomous by Riek (1970), who ignored *Ulmerophlebia* and included species both with and without frontal horns in the genus *Jappa*. Suter (1986) also questioned the validity of *Ulmerophlebia*, however, a consideration of this issue is beyond the scope of the present work. Adult material which has been examined indicates that the genus is quite speciose, and there are probably several species in addition to the nymphal voucher species recognised below. *Ulmerophlebia* sp.AV2, in particular, is thought to be a complex of species, and further taxonomic studies are required.

### Checklist of species included in the key

| | |
|---|---|
| *Ulmerophlebia* sp.AV1 | NSW, Vic |
| *Ulmerophlebia* sp.AV2 | SE Qld, NSW, Vic |
| *Ulmerophlebia* sp.AV3 | NQ, SE Qld |
| *Ulmerophlebia* sp.AV6 | NQ, NSW |

### Key to nymphs of Australian species

1 Gills with lateral tracheae well developed, conspicuous and darker than gill membrane (Fig 207) ..... ***Ulmerophlebia* sp.AV6**

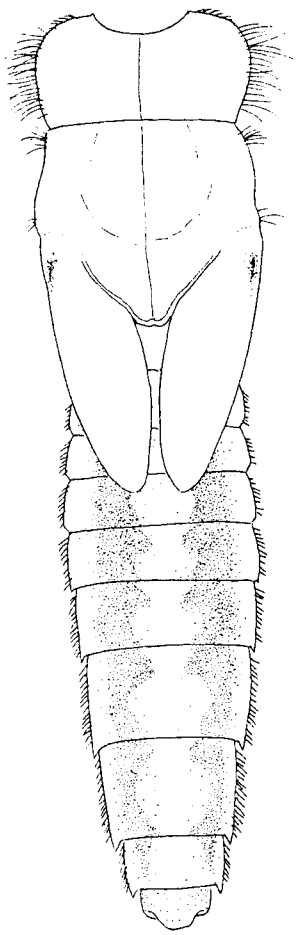
\- Gills with lateral tracheae inconspicuous or absent, if present then paler than gill membrane (Figs 204) ..... 2

2(1) Wingpads with black pigment spots at about midlength (Fig 205) ..... 3

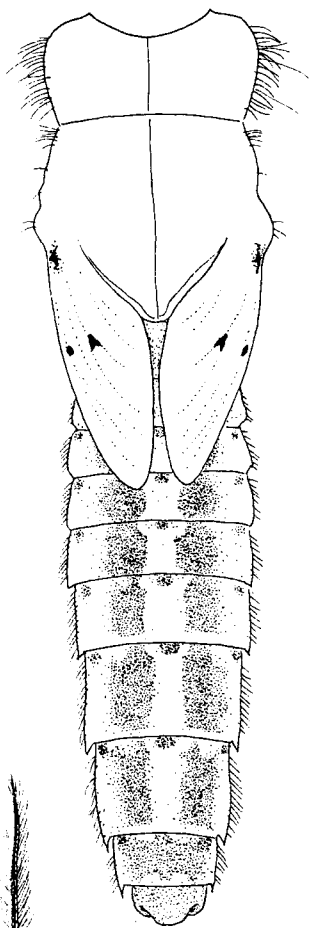
\- Wingpads without pigment spots (Fig 203) ..... ***Ulmerophlebia* sp.AV1**

3(2) Abdomen golden, darker pigmentation present along mid-dorsal line (Fig 206) ..... ..... ***Ulmerophlebia* sp.AV3**

- Abdomen yellowish, darker pigmentation either side of midline; mid-dorsal line pale except for small dark blotch adjacent to anterior margin (Fig 205) ..... ***Ulmerophlebia* sp.AV2**



**203**



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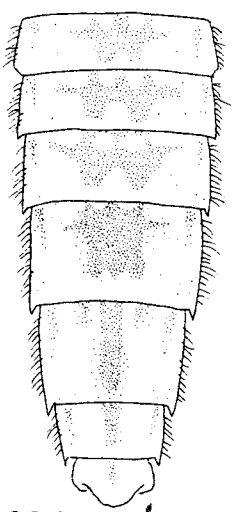

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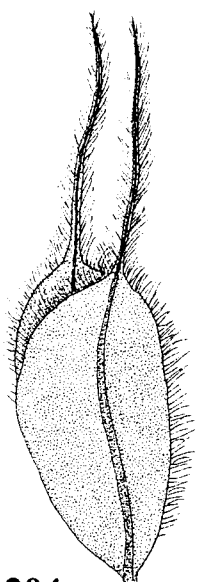

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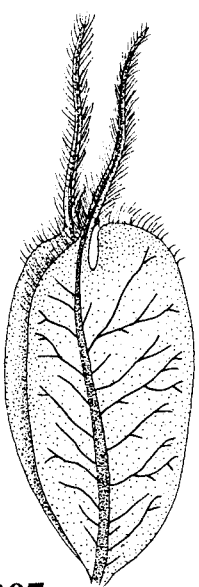


**207**

***Ulmerophlebia* sp.AV1**: 203, thorax and abdomen; 204, fourth abdominal gill. ***Ulmerophlebia* sp.AV2**: 205, thorax and abdomen. ***Ulmerophlebia* sp.AV3**: 206, abdominal terga. ***Ulmerophlebia* sp.AV6**: 207, fourth abdominal gill.

Loamaggalangta
Dean et al. 1999

## Genus K

**Diagnosis:** Antennae long, at least 4x width of head capsule. Labrum ranging from slightly narrower to slightly broader than clypeus; maximum width 1.7-1.9x length along median line; frontal setae arranged as narrow band; sub-apical setae set back from anterior margin. Mandible with incisors slender. Labium with glossae turned under ventrally. Legs banded, all segments slender; tarsal claws smooth. Abdominal gills present on segments 1-7, ranging from linear to narrowly lanceolate. Posterior margins of abdominal terga bearing series of minute spines, usually single; postero-lateral spines present on abdominal segments 7 or 8-9.

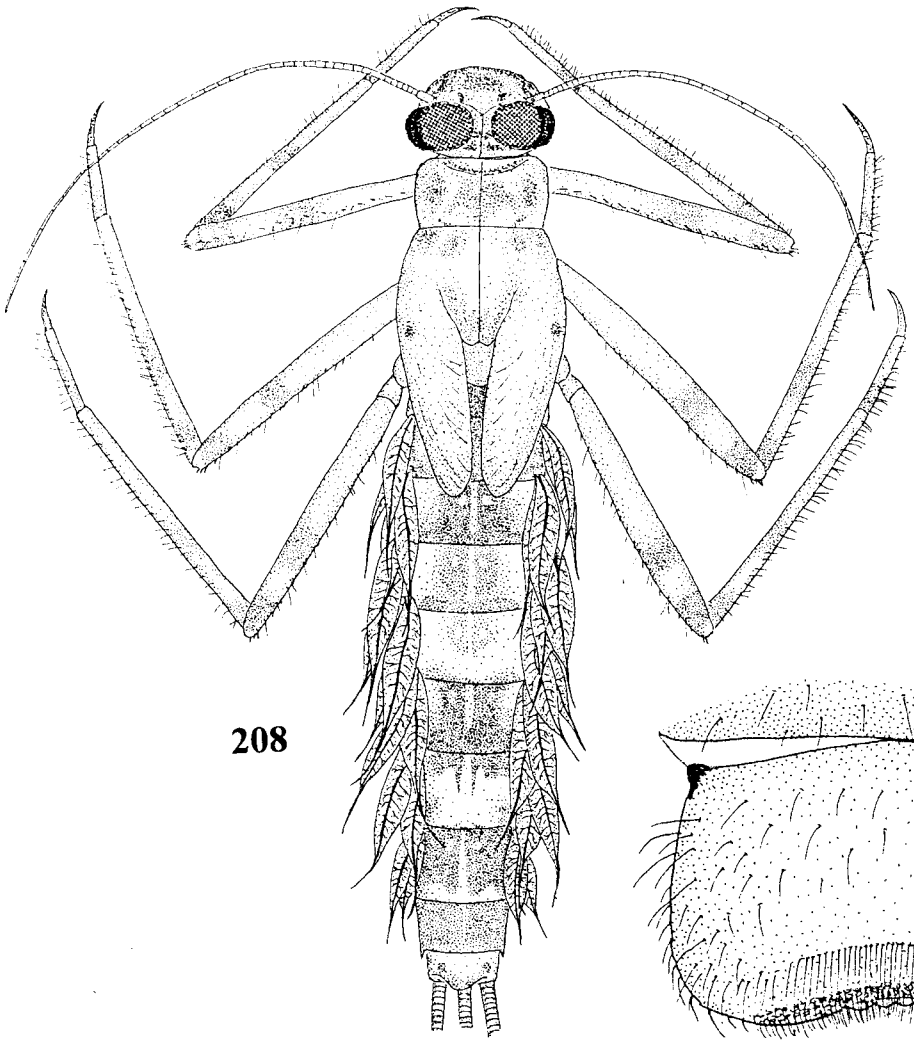
**Taxonomy:** Nymphs of the four species included here are rather similar in morphology, and all appear to prefer still water. They have been collected from lakes and from deeper pools and backwaters of streams. A new genus is being described to accommodate 'species AV4' (Dean et al, in press), and when adults of the remaining three species are known it is likely they will prove congeneric with 'species AV4'. It is possible that nymphs from south-western Australia, previously assigned to 'Genus S' (Dean and Suter, 1996), also belong in 'Genus K'. In the present work they have been retained as separate genera, pending availability of information on the adults.

### Checklist of species included in the key

| | |
|---|---|
| Genus K sp.AV1 | NSW, eastern Vic |
| Genus K sp.AV2 | N Qld |
| Genus K sp.AV3 | NSW |
| Genus K sp.AV4 | Tas |

### Key to nymphs of Australian species

| | | |
|---|---|---|
| 1 | Anterior margin of labrum shallowly concave (Fig 209); Tasmania | **Genus K sp.AV4** |
| - | Anterior margin of labrum with broad v-notch (Figs 213, 216); mainland Australia | 2 |
| 2(1) | Foretarsus with about 50 ventral spines | **Genus K sp.AV3** |
| - | Foretarsus with about 20 ventral spines (Fig 214) | 3 |
| 3(2) | North Queensland | **Genus K sp.AV2** |
| - | South-eastern Australia | **Genus K sp.AV1** |



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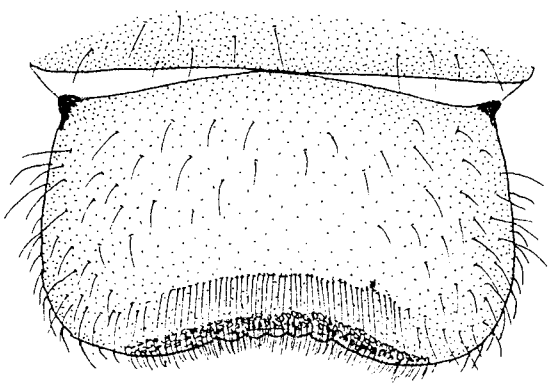

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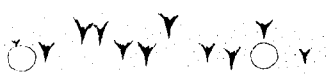

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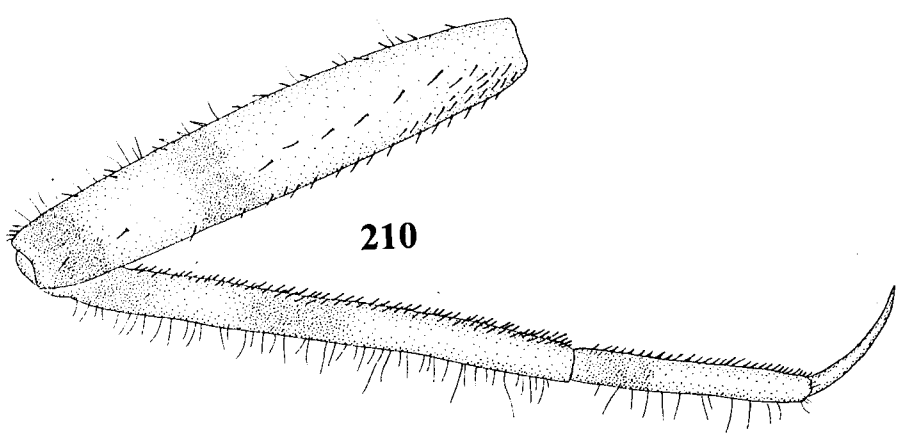

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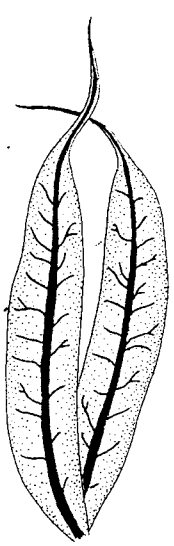
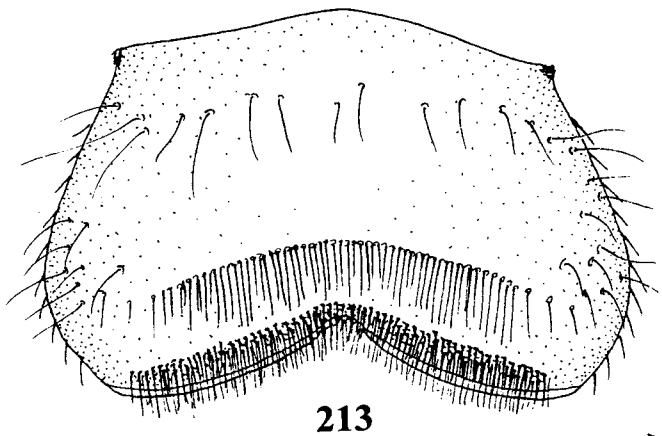


212

**Genus K sp.AV4:** 208, whole nymph; 209, labrum; 210, foreleg; 211, spines on posterior margin of abdominal tergum IV; 212, fourth abdominal gill.



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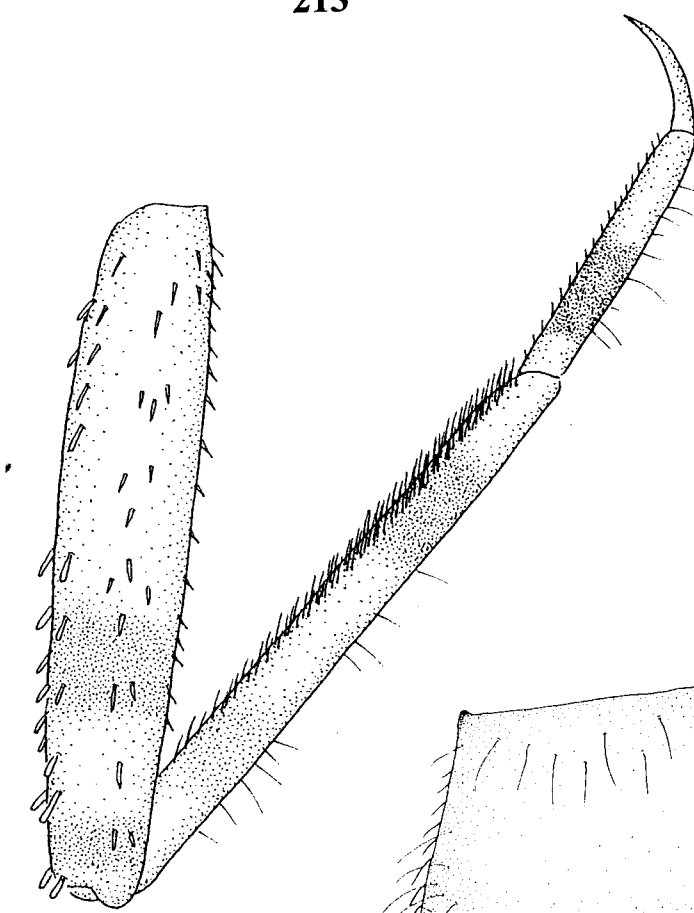
215



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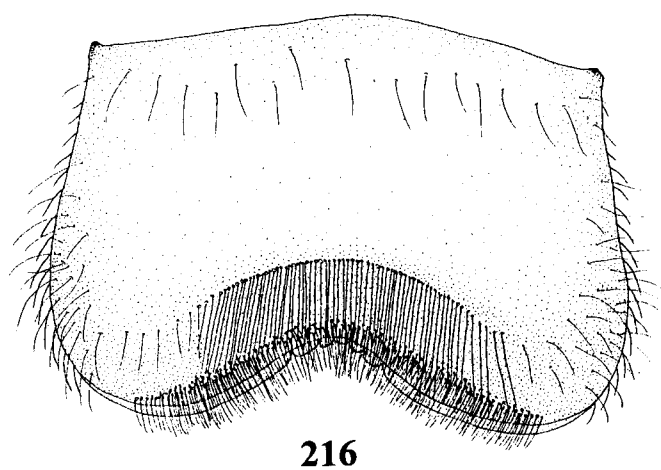


216

**Genus K sp.AV1:** 213, labrum; 214, foreleg; 215, third abdominal gill. **Genus K sp.AV3:** 216, labrum.

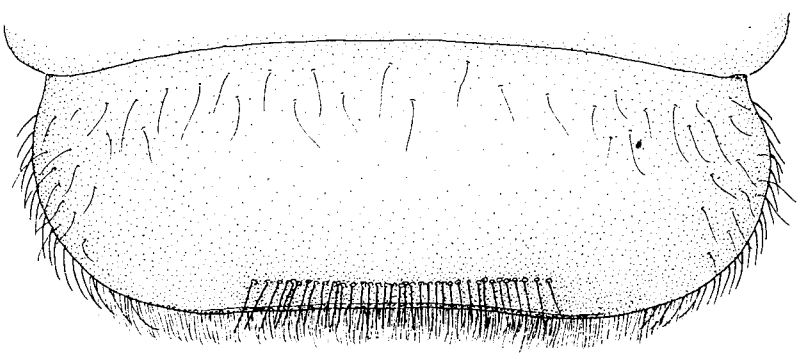
# Genus O

**Diagnosis:** Nymph small, robust. Antennae slightly longer than width of head. Labrum narrower than clypeus; very short, maximum width almost 3x length along median line. Pronotum broad and short. Legs short, all segments broad; tarsal claws with ventral teeth. Abdomen with postero-lateral spines on segments 3-9. Gills lanceolate, lateral tracheae strongly developed.

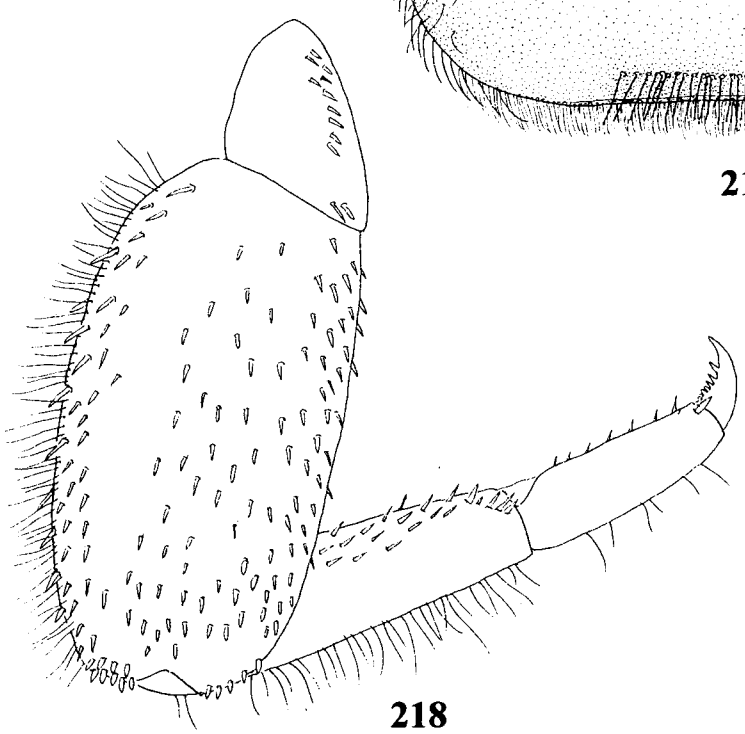
**Taxonomy:** The single known species has only been recorded from small forest stream sites in northern New South Wales and southern Queensland. It appears to be most closely related to *Nousia*.

## Checklist of recognised species

Genus O sp.AV1 SE Qld, northern NSW



**217**



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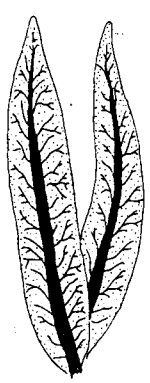


**219**

**Genus O sp.AV1**: 217, labrum; 218, foreleg; 219, fourth abdominal gill.

# Genus P

**Diagnosis:** Length of antennae about 2x width of head capsule. Labrum slightly broader than clypeus; anterior margin either medially notched or with a broad concavity; maximum width about 2x length along median line; upper surface finely reticulate. Labium with glossae turned under ventrally. Outer margins of femora with series of slender spines; tarsal claws either smooth or with ventral series of short teeth. Postero-lateral spines on abdominal segments 6-9. Gill lamellae moderately broad in basal 2/3, with a narrow apical filament, the base of which is flanked on each side by a short projection.

**Taxonomy:** The genus is restricted to the western and central regions of northern Australia, with three known species, all undescribed. The species AV1 and AV3 have previously been recorded by Suter (1992) as *Bibulmena* sp.2 and sp.1 respectively.

## Checklist of species included in the key

| | |
|---|---|
| Genus P sp.AV1 | NT |
| Genus P sp.AV2 | NW Aust, NT |
| Genus P sp.AV3 | NT |

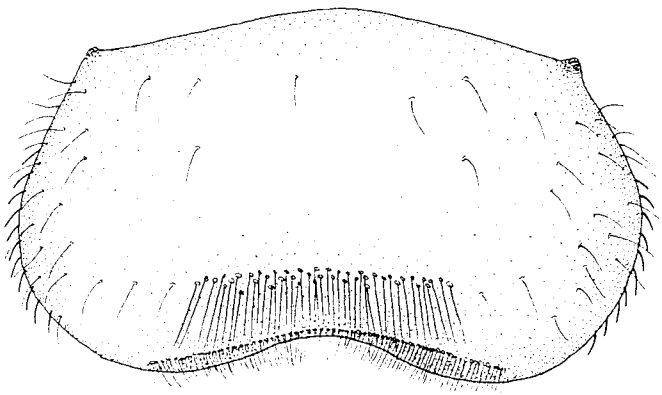
## Key to nymphs of Australian species

1 Tarsal claws with ventral teeth (Fig 223); anterior margin of labrum with medial notch, base concealed beneath short overhang (Fig 222) ..... **Genus P sp.AV2**

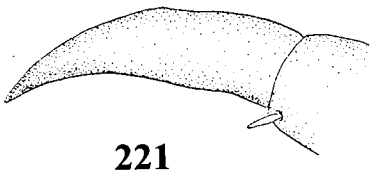
\- Tarsal claws smooth (Fig 221); anterior margin of labrum with medial concavity (Figs 220,225) ..... 2

2(1) Labrum broadest at about midlength; frontal setae arranged as single row; anterior margin with shallow concavity (Fig 220) ..... **Genus P sp.AV1**

\- Labrum broadest at about 2/3 length; frontal setae arranged as narrow band; anterior margin with deep concavity (Fig 225) ..... **Genus P sp.AV3**



220



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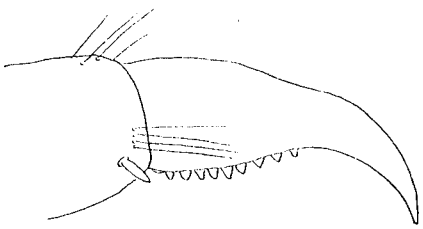
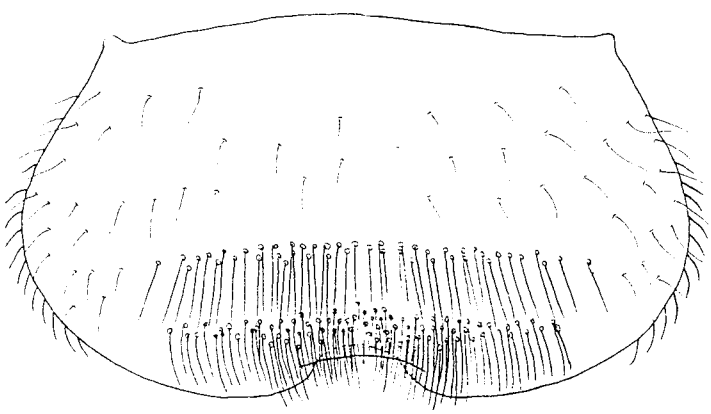


223



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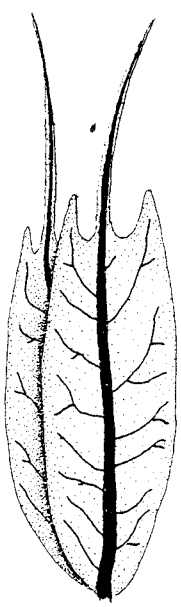
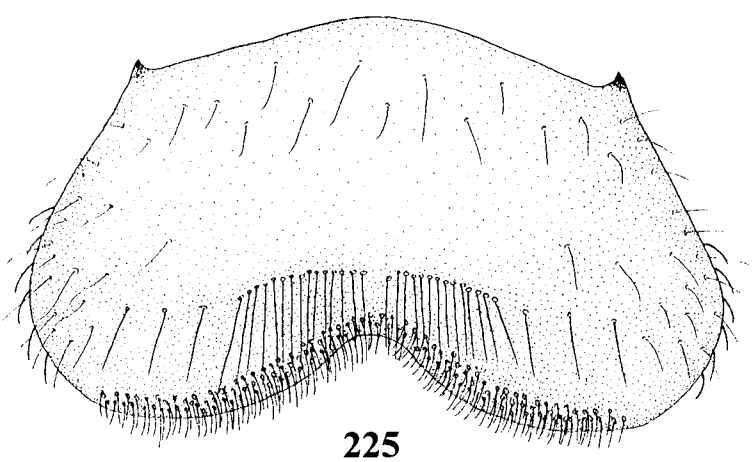


224



225

**Genus P sp.AV1**: 220, labrum; 221, foretarsal claw. **Genus P sp.AV2**: 222, labrum; 223, foretarsal claw; 224, fourth abdominal gill. **Genus P sp.AV3**: 225, labrum.

## Genus Q

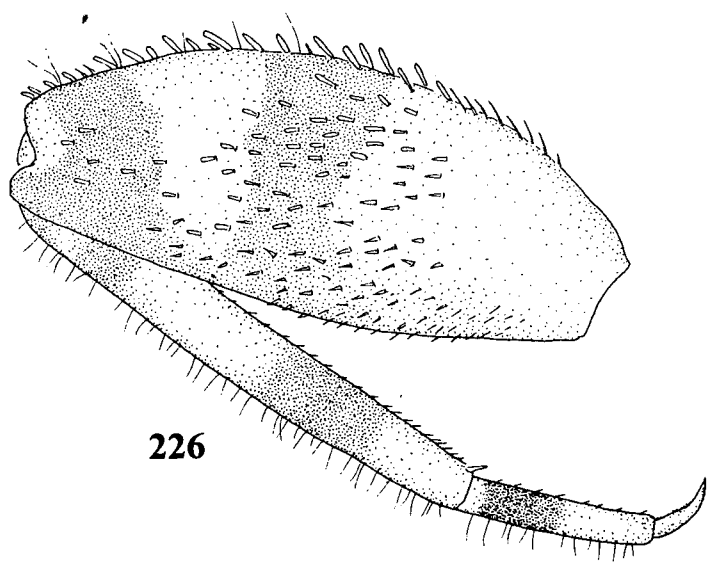
Kaninga Dean 2000

**Diagnosis:** Nymph robust. Length of antennae about 2x width of head capsule. Pronotum broader than head capsule. Labrum slightly broader than clypeus; width about 2x length along median line; anterior margin with shallow median concavity; anterior denticles conspicuous. Mandibles with outer incisor slender. Maxillae with palp short. Labium with glossae turned under ventrally. Legs large, all segments banded; femora robust, outer margin with row of stout spines, upper surface with numerous short spines; tarsal claws with about twenty small ventral denticles. Abdominal segments with transverse row of conspicuous spines along posterior margin; postero-lateral spines on segments 4-9. Gills on abdominal segments 1-7, each gill with both lamellae broadly lanceolate, narrowing at about 2/3 length, lateral tracheae moderately developed.

**Taxonomy:** The single known species is undescribed, and restricted to south-western Australia.

### Checklist of recognised species

Genus Q sp.AV1 SW Aust



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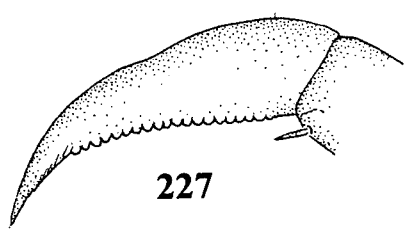
228



227

**Genus Q sp.AV1**: 226, foreleg; 227, foretarsal claw; 228, fourth abdominal gill.

# Genus S

**Diagnosis:** Labrum slightly broader than clypeus; maximum width about 1.9-2.0x length along median line; frontal setae arranged as narrow band; sub-apical setae set back from anterior margin. Mandibles with incisors slender. Labium with glossae turned under ventrally. Legs strongly banded; all segments moderately slender; tarsal claws smooth. Abdominal gills present on segments 1-7, lamellae ranging from linear to narrowly lanceolate. Abdominal segments with posterior margins of terga bearing series of minute spines, usually single; postero-lateral angles produced into spines on abdominal segments 7 or 8-9.

**Taxonomy:** The genus includes two species, and is restricted in distribution to south-western Australia. Nymphs are morphologically very similar to nymphs of 'Genus K' from eastern Australia, and as previously mentioned the two genera may be synonomous.

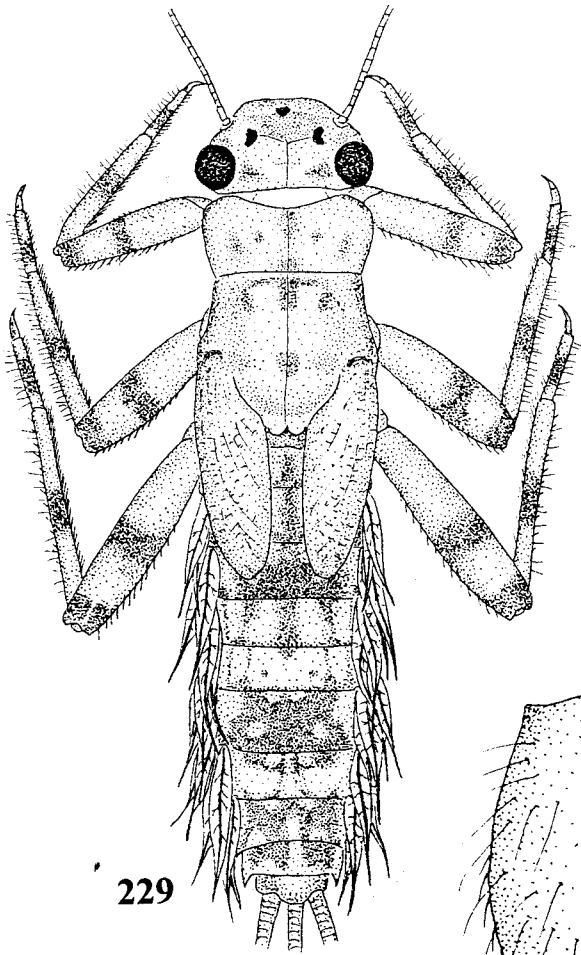
## Checklist of species included in the key

| | |
|---|---|
| Genus S sp.AV1 | SW Aust |
| Genus S sp.AV2 | SW Aust |

## Key to nymphs of Australian species

1 Fore tarsus with 30-35 ventral spines; abdominal gills relatively narrow, lateral tracheae absent or poorly developed (Fig 231); labrum with anterior margin shallowly concave (Fig 230) ..... ..... **Genus S sp.AV1**

\- Fore tarsus with about 20 ventral spines; abdominal gills relatively broader, lateral tracheae moderately developed (Fig 233); anterior margin of labrum with broad V-notch (Fig 232) ..... **Genus S sp.AV2**



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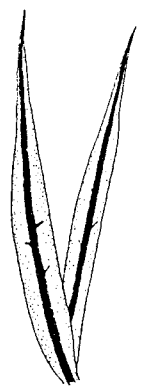

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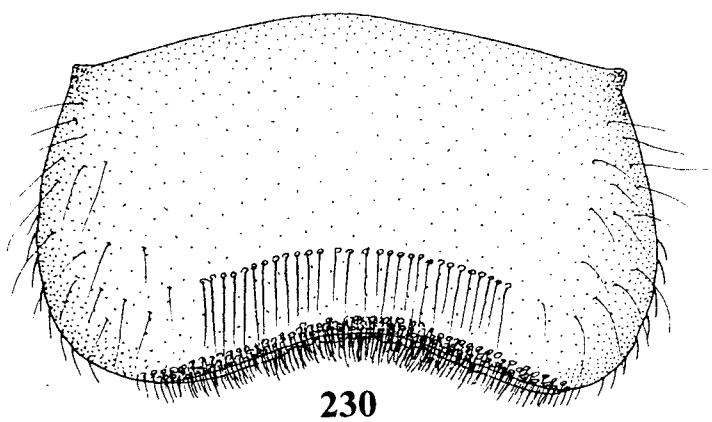

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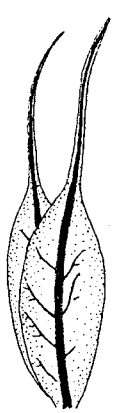

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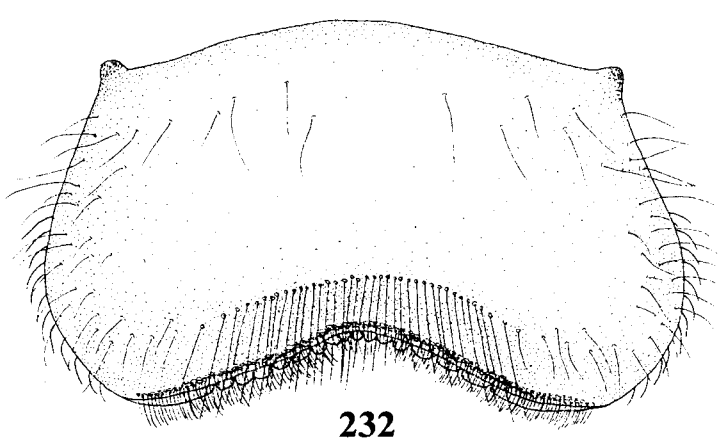


232

**Genus S sp.AV1:** 229, whole nymph; 230, labrum; 231, third abdominal gill. **Genus S sp.AV2:** 232, labrum; 233, third abdominal gill.

Manggabora Doan + Suter 2004

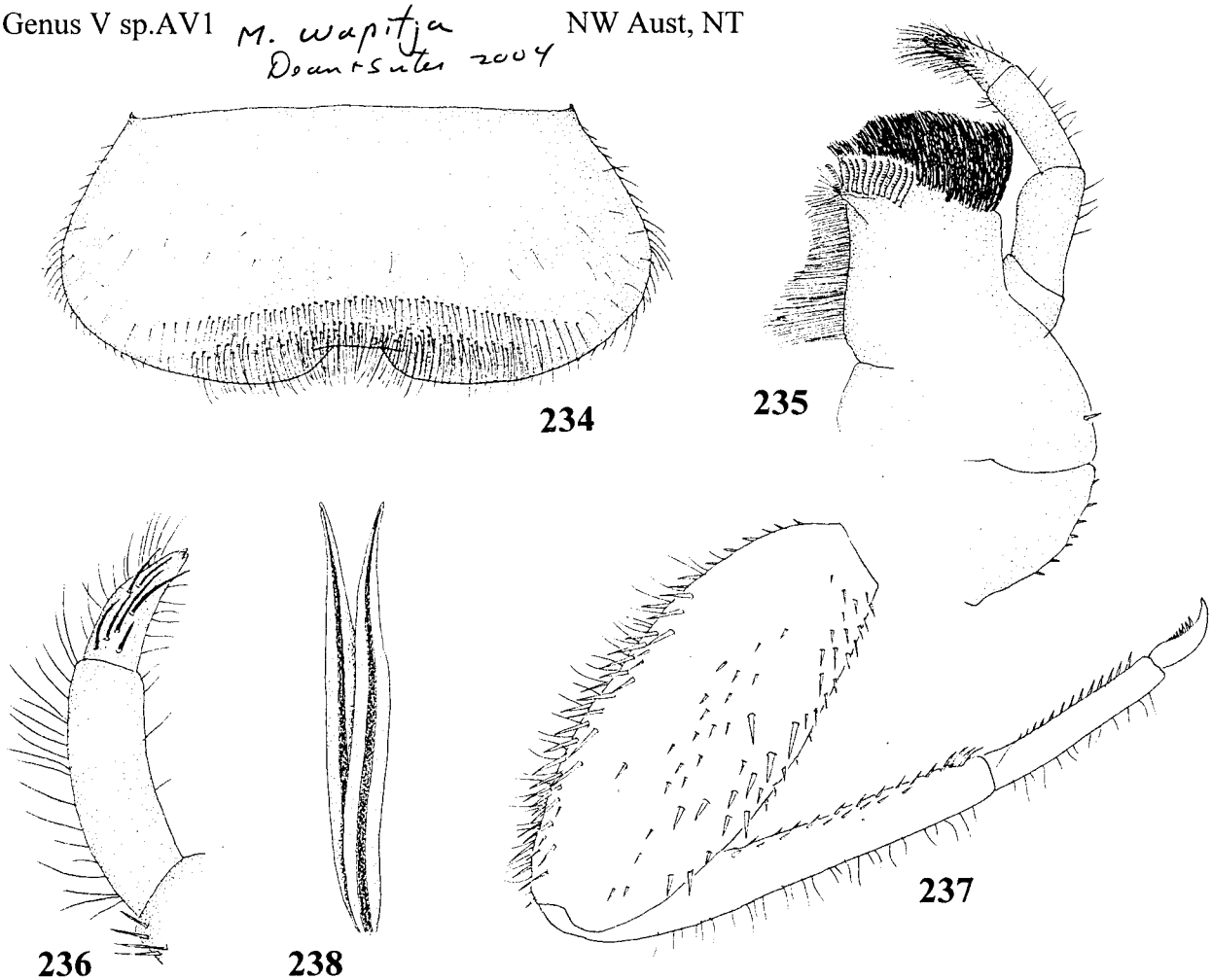
## Genus V

**Diagnosis:** Length of antennae about 2x width of head capsule. Labrum a little broader than clypeus; maximum width about 2.3x length along median line; anterior margin with central notch, overhung by canopy; frontal setae sparse, arranged as narrow band. Maxillae with subapical row of about 10 pectinate setae on ventral surface. Mandibles with outer incisors slender. Labium with glossae lying slightly dorsal to paraglossae, not turned under ventrally; labial palp with terminal segment about half length of middle segment. Femora of all legs with long, stout spines along outer margin; tarsi with stout ventral spines of relatively uniform length, about half width of tarsus; tarsal claws with ventral teeth. Gills linear, lateral tracheae very weakly developed or absent.

**Taxonomy:** The single recognised species occurs in north-western Australia and the Northern Territory, and has previously been designated 'Leptophlebiidae Genus A sp.1' by Suter (1992).

### Checklist of recognised species

Genus V sp.AV1 M. wapitja Doan+Suter 2004 NW Aust, NT




**Genus V sp.AV1**: 234, labrum; 235, left maxilla, ventral; 236, labial palp; 237, foreleg; 238, fourth abdominal gill.

# Genus W

**Diagnosis:** Labrum slightly broader than clypeus; maximum width 1.7-1.9x length along median line; anterior margin with shallow to moderate concavity; frontal setae arranged in single row. Labium with glossae turned under ventrally. Legs banded; femora variable, ranging from moderately narrow to moderately broad; tarsal claws smooth. Abdominal gills lanceolate, lateral tracheae moderately developed. Posterior margins of abdominal terga bearing series of long robust spines interspersed with minute spines.

**Taxonomy:** The genus is apparently restricted to Tasmania, where nymphs have been collected both from rivers and lakes. The two recognised nymphal species have been associated with adults, and one is either *Atalophlebia ida* Tillyard or a very closely related species.

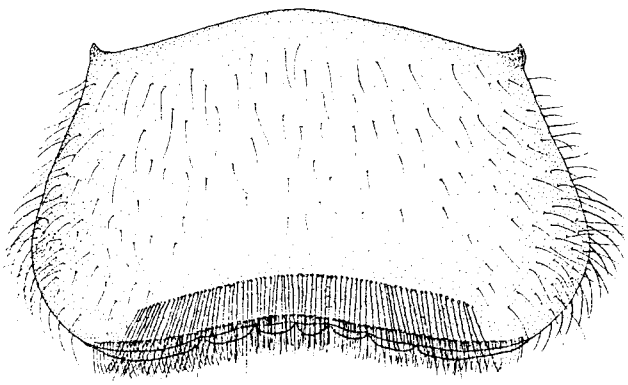
## Checklist of species included in the key

| | |
|---|---|
| Genus W sp.AV1 | Tas |
| Genus W sp.AV2 | Tas |

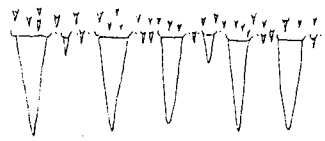
## Key to nymphs of Australian species

1 Fore tarsus with 30-40 ventral spines; forefemur relatively narrow, spines along outer margin short (Fig 240) ..... **Genus W sp.AV1**

- Fore tarsus with 15-20 ventral spines; forefemur relatively broad, spines along outer margin long (Fig 243) ..... **Genus W sp.AV2**



239



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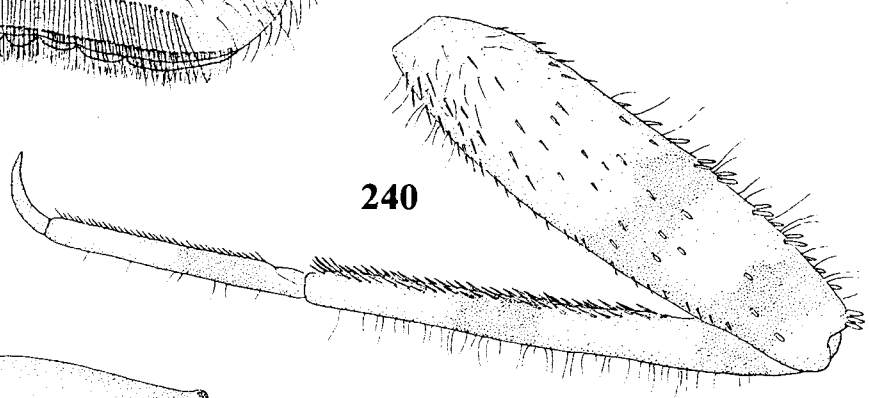

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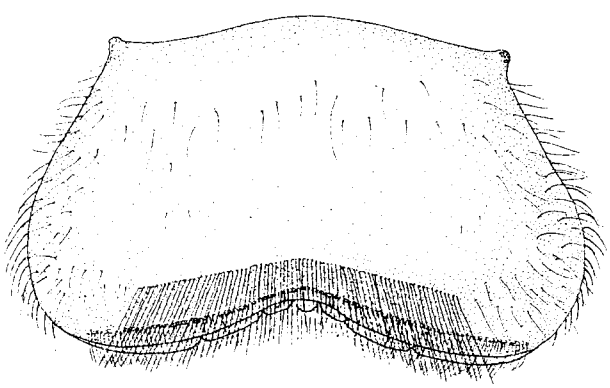
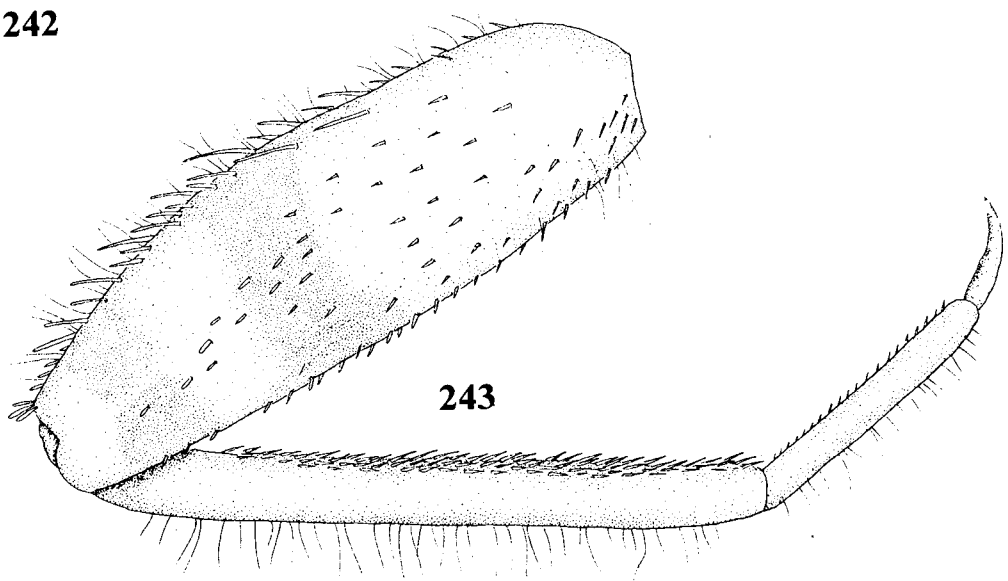


242



243

**Genus W sp.AV1:** 239, labrum; 240, foreleg; 241, spines on posterior margin of abdominal tergum IV.
**Genus W sp.AV2:** 242, labrum; 243, foreleg.

# Genus Z

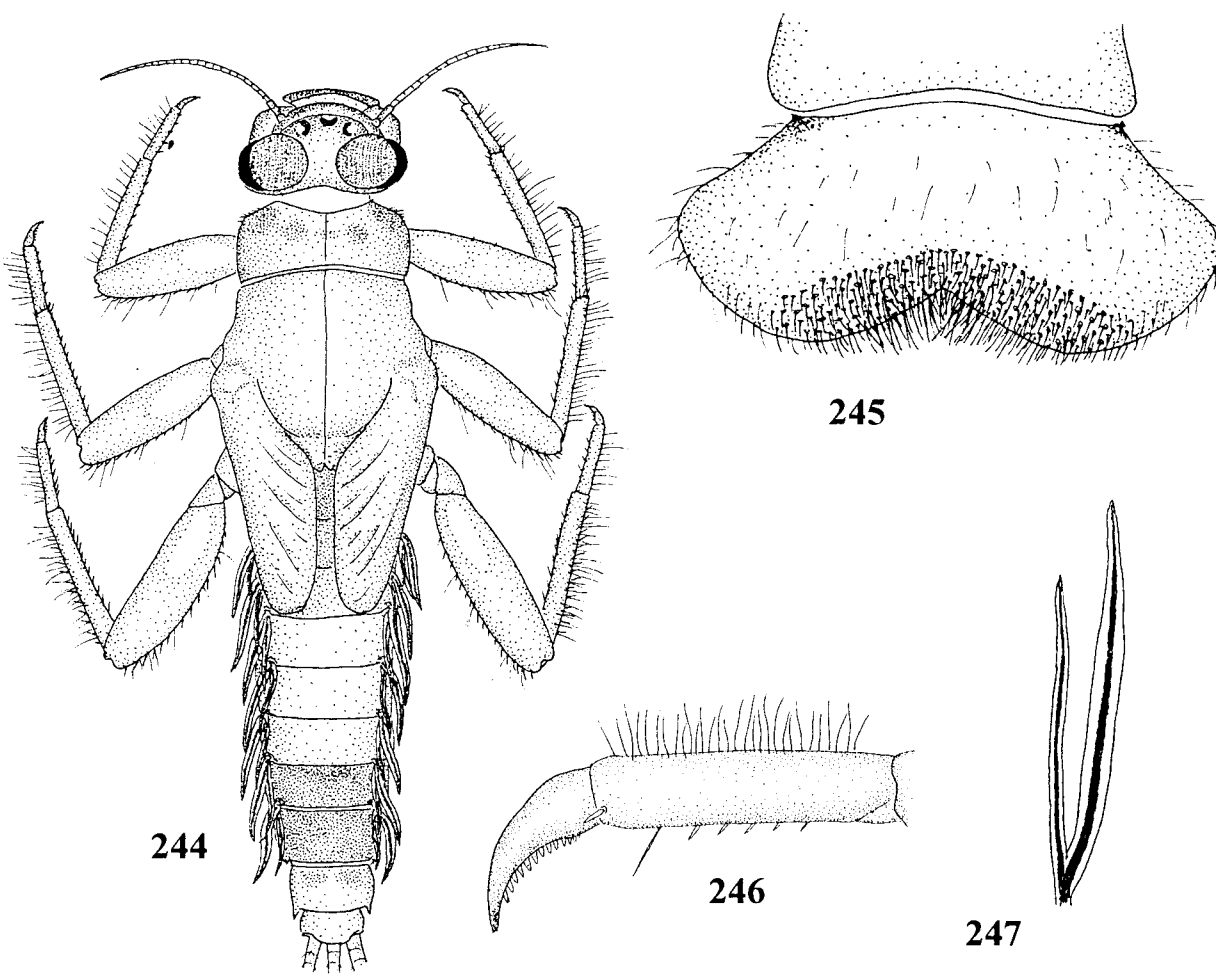
**Diagnosis:** Nymph small. Antenna a little longer than head width. Labrum broader than anterior margin of clypeus, width about 2.7x length along median line; anterior margin with deep V-notch; broad band of setae across anterior 1/3 of labrum, sub-apical setal fringe either merged or absent. Labial palp with terminal segment less than 1/2 length of middle segment. Tarsi of all legs with elongate ventral spine in apical third; tarsal claws with ventral teeth. Abdomen with segments 7 and 8 darker than remaining segments; lateral margins without setal fringe; postero-lateral spines on abdominal segments 6-9. Gills narrow, linear, without lateral tracheae.

**Taxonomy:** The single recognised species has only been recorded from a handful of sites in central Victoria and north-east Tasmania, and appears to be most closely related to *Austrophlebioides*.

.

**Checklist of recognised species**

Genus Z sp.AV1 Vic, Tas




**Genus Z sp.AV1**: 244, whole nymph; 245, labrum; 246, foretarsus; 247, third abdominal gill.

## ACKNOWLEDGMENTS

Preparation of this report has been funded by the Land and Water Resources Research and Development Corporation as an MRHI Research & Development project. The Environment Protection Authority of Victoria has provided support and facilities. Dr Ken Walker, Curator of Entomology, Museum of Victoria, is thanked for making available material held in the collections of the museum.

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