

## THREE NEW GENERA, A NEW SUBGENUS AND A NEW SPECIES OF LEPTOPHLEBIIDAE (EPHEMEROPTERA) FROM AUSTRALIA

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### Abstract

*Austrophlebioides* gen. n. is described for *A. pusillus* (Harker), comb. n., which is redescribed and designated as type species, and *A. unguicularis* (Ulmer), comb. n. *Garinjuga* gen. n. is described as monotypic for *G. maryannae* sp. n. and *Koorronga* gen. n. is described for *K. inconspicua* (Eaton), comb. n. (type species), *K. fusca* (Ulmer), comb. n., *K. simillima* (Ulmer), comb. n., *K. brunnea* (Tillyard), comb. n., *K. parva* (Harker), comb. n. and *K. pilosa* (Suter), comb. n. *Australonousia* subgen. n. is described within *Nousia* Navás for two Australian species: *N. (A.) fuscula* (Tillyard), comb. n. (type species) and *N. (A.) delicatula* (Tillyard), comb. n..

### Introduction

Certain aspects of the taxonomy of Australian leptophlebiid mayflies have been confused for some time. Nine species, including several of the most common in southeastern Australia, have been placed in *Deleatidium* Eaton (type species *D. lillii* Eaton from New Zealand): *D. strigatum* (Eaton), *D. mjobergi* and *D. unguiculare* (Ulmer), *D. annulatum* and *D. crassum* (Harker) and *D. bundutum*, *D. decipiens*, *D. nanatum* and *D. pusillum* Harker. Phillips (1930) established *Atalophlebioides* as a subgenus of *Deleatidium* for New Zealand species with double abdominal gills, and Harker (1954) placed the 3 Australian species whose nymphs had been described at that time (*D. annulatum*, *D. bundutum* and *D. crassum*) in the same subgenus. The elevation of *Atalophlebioides* to generic rank proposed by Traver (1946) and completed with the designation of *Atalophlebioides cromwelli* (Phillips) as type species (Peters and Edmunds 1964) brought these species into that genus. A fourth species, *D. mjobergi*, was transferred to *Ulmerophlebia* Demoulin by Demoulin (1955a). Williams' (1968) key included *Atalophlebioides* but not *Deleatidium* and made the taxonomically inaccurate comment "Deleatidium is now regarded as Atalophlebioides". Riek (1970) also omitted *Deleatidium* from his discussion of the Australian mayfly fauna. Williams' comments and key were based on unpublished information supplied by Riek, who presumably based his conclusions on the fact that nymphs with single gill lamellae appear to be absent from Australia.

Towns and Peters (1978) redescribed *Atalophlebioides* as a monotypic genus restricted to New Zealand. As a result 8 of the 9 species listed above in *Deleatidium* became species *incertae sedis* since none have *Deleatidium* type abdominal gills and none can be placed within *Atalophlebioides*. In this study *D. pusillum* is redescribed from material collected at the type locality and designated the type species of a new genus, *Austrophlebioides*, in which the species *D. unguiculare* is also placed. The affinities of the remaining 7 species will only be established with further study.

A second new genus, *Garinjuga*, is described with *G. maryannae* sp. n. as type species. The nymphal abdominal gills of this or a related species appear to have been previously illustrated by Riek (1970) as the gills of "genus nr *Massartella*" Lestage.

Pescador and Peters (1985) confirmed the original synonymy by Navás (1925) of *Atalonella* Needham and Murphy with *Nousia* Navás and showed that a female imago identified by Navás as belonging to the type species *N. delicata* Navás was conspecific with the female imago of *Atalonella ophis* Needham and Murphy, the type species of *Atalonella*. Thus *A. ophis* is a junior synonym of *N. delicata*. They included in *Nousia* 6 species from South America, but did not specifically include species previously assigned to *Atalonella* from Australia. Tsui and Peters (1975) commented that differences between South American and Australian species of *Atalonella* were indicative of a polyphyletic genus which could be further divided. In this paper a third new genus, *Koorronga*, is established to include several of the Australian species previously assigned to *Atalonella* and *Nousia*, and the new subgenus *Australonousia* is raised to include those species which correctly belong to *Nousia*.

## Methods

Material was prepared using the methods suggested by Edmunds, Jenson and Berner (1976) and illustrations were prepared either with the aid of a drawing tube attached to a stereomicroscope or a microprojector. Morphological terms and conventions are consistent with those used by Towns and Peters (1978). Measurements are in mm, normally with the mean value followed by the range in parentheses. In the lists of specimens examined, adults were imagos unless specified otherwise. Abbreviations: ANIC, Australian National Insect Collection, Canberra; BM, British Museum (Natural History); CIT, Chisholm Institute of Technology; sub, subimago; n, nymph.

### **Austrophlebioides gen. n. (Figs 1-21, 82)**

Type species *Deleatidium pusillum* Harker.

#### *Imago*

Body length: ♂ 8.9 (8.3-9.9), ♀ 8.6 (8.1-9.0). Fore wing length: ♂ 8.6 (8.3-9.1), ♀ 8.8 (8.6-9.3); breadth: ♂ 3.5 (3.3-3.6), ♀ 3.3 (3.2-3.5).

**Male**—Eyes fused on meson of head, lower portion 0.75 length of upper portion. Fore wing (Fig. 1) with Rs forked at 0.2 distance from base to margin; MA symmetrically forked at less than half distance from base to margin; MP not forked, crossvein attaches  $MP_2$  at base to CuA and  $MP_1$ , attachment of  $MP_2$  to  $MP_1$  at less than 0.2 length of  $MP_1$ , and nearer to wing-base than to fork in Rs, base of  $MP_2$  closer to CuA than to  $MP_1$ ; ICu<sub>1</sub> attached at base to CuA and CuP with crossveins, these numerous in Cu area. Hind wing (Fig. 2) with costal margin concave slightly basal to midlength, apex acute, rounded; width a little over half length, length a little less than 0.33 fore wing length; Sc more than 0.9 wing length, crossveins numerous anterior to MP. Length ratios of fore leg 0.70-0.98 : 1.00 (2.95-3.25) : 0.03-0.05 : 0.45-0.56 : 0.41-0.55 : 0.24-0.31 : 0.10-0.11. Claws dissimilar, one of each pair apically hooked, one pad-like (Fig. 3). Genitalia (Figs 5-7): forceps segments 2 and 3 subequal, each ca 0.25 of length of segment 1, which narrows quite abruptly at ca 0.4 length, tip of segment 3 rounded or sometimes indented; styliger plate 1.25 times as long as wide, with shallow indentation (Fig. 6); penes fused 0.67 length, tips with rounded apical knobs, a prominent dorsolateral spine on each lobe at about 0.67 length and a series of fine ventral spines (Fig. 7). Three caudal filaments present.

**Female**—As for ♂ except: eyes separated on meson of head by 2-3 times maximum width of eye. Abdominal sternum 9 (Fig. 8) rounded apically with shallow cleft.

#### *Mature nymph*

Body length 7.75-9.75.

Head prognathous; antennae twice head length. Mouthparts (Figs 11-19): labrum length ca 0.4 breadth, dorsally 2 prominent subdistal even rows of hairs (Figs 11-12) and submedian, anterosubmedian and anterolateral hairs ventrally; anteromedian emargination shallow, hooded, with a series of small denticles (Fig. 12); lateral margins rounded. Clypeus (Fig. 12) with sides diverging distally. Left mandible (Fig. 13) with small marginal tuft of hairs and fine hairs medially to it; incisors with serrated apical teeth (Fig. 14); prosthecal tuft well developed. Hypopharynx (Fig. 15) with lingua having well developed lateral processes, submedian lobes with a single row of long bristles anterolaterally; superlingua (Fig. 15) with dense hair row along anterior margin and blunt lateral margins. Maxillae with apical half of galea-lacinia expanded medially (Fig. 16) with subapical row of ca 25 large spines, palpi with segments 1 and 2 subequal, segment 3 ca 0.75 length of segment 2. Labium (Fig. 17) with segments 1 and 2 of palp subequal, segment 3 less than half length of segment 2 with a row of about 5 large bristles and a smaller row of short bristles subapically (Figs 18-19); glossae slightly dorsal to paraglossae, submentum without spines.

Pronotum with several minute spines on anterolateral margins. Legs: all femora with numerous denticles and small spines except for distinct bare patches proximally (Fig. 20), inner surface of tarsi with 1 large and several smaller spines, apex of claw hooked and narrow with a row of denticles increasing in size distally (Fig. 21). Gills (Fig. 10) present on segments 1-7, lanceolate and progressively smaller posteriorly; dorsal and ventral lamellae similarly shaped. Tracheae with prominent central trunk and fine lateral branches. Abdomen with posterolateral spines on segments 2-9; terminal filament slightly longer than cerci, each segment with distal whorl of denticles.

#### *Species included*

*Austrophlebioides pusillus* (Harker), comb. n.

*Deleatidium pusillum* Harker 1954: 253.

*Austrophlebioides unguicularis* (Ulmer), comb. n.

*Ephyurus unguicularis* Ulmer, 1916: 13.

*Deleatidium unguiculare*: Ulmer, 1920: 115.

#### *Notes*

*Austrophlebioides* can be distinguished from all other genera of Leptophlebiidae by the following combination of characters. Imago: fore wing with  $MP_1$  attached to  $MP_2$  by a crossvein nearer the base of the wings than to fork in Rs (Fig. 1); hind wing with Sc more than 0.9 wing length (Fig. 2); claws of a pair dissimilar, one hooked with

an opposing hook, other pad-like (Fig. 3); basal 0.67 of penes fused and each penis lobe with 1 large dorsolateral spine and a series of small spines in apical 0.33. Nymph: anterior margin of labrum with a dorsally hooded, shallow anteromedian emargination (Fig. 12); anterior margin of labrum with 2 even rows of hairs (Fig. 12); abdominal gills with 2 well developed lanceolate lamellae (Fig. 10); posterolateral spines present on abdominal segments 2-9.

*Austrophlebioides* is a member of the *Atalophlebioides* lineage of Towns and Peters (1980) [= *Meridialaris* lineage of Pescador and Peters (1980)] and is based on the following derived character states: anterior margin of labrum with a dorsally hooded, shallow anteromedian emargination (Fig. 12); lateral margins of submentum without setae (Fig. 17); lateral margins of clypeus strongly divergent apically (Fig. 11). *Austrophlebioides* seems to be most closely related to several undescribed genera in the *Atalophlebioides* lineage and to *Atalophlebioides* itself, but can be distinguished from the latter by the following combination of characters. Imago: hind wing with Sc more than 0.9 of the wing length (Fig. 2); basal 0.67 of penes fused (Fig. 5); each penis lobe with 1 large dorsolateral spine and a series of small ventral spines in apical 0.33 (Fig. 7); ICu<sub>1</sub> of fore wing with a series of veinlets reaching posterior margin of wing (Fig. 1). Nymph: anterior margin of labrum with 2 even rows of hairs (Fig. 11); labrum broad with lateral margins acutely angular (Fig. 11); outer margin of mandibles not indented near base of outer incisor (Fig. 13); prosthecal tuft well developed (Fig. 13).

### ***Austrophlebioides pusillus* (Harker), comb. n.**

*Deleatidium pusillum* Harker, 1954: 253.

**Types**—NEW SOUTH WALES: holotype ♂, paratypes 1 ♂, 1 ♀, 1 ♀ sub., Bolairo, 10.ii.1936, R. J. Tillyard (BM).

**Other materials examined**—NEW SOUTH WALES: 9 ♂♂, 5 ♀♀, 1 ♀ sub., 5 n, Murrumbidgee R., Bolairo, 24.xi.1978; 1 ♂, same locality, 14.x.1985; 2 ♀♀, same locality, 12.xi.1985; VICTORIA: 1 ♂, 1 ♀, 5n, Wellington R. nr Breakfast Ck, 22. ix. 1985.

#### ***Male imago* (in ethanol)**

Head brown, carinae dark; antennae light brown; upper portion of eyes light brown, lower portion dark grey; ocelli pale grey. Thorax: pronotum light brown with lateral carinae black; mesonotum uniform light brown, scutellum and carinae darker; pleura brown with paler areas, sterna brown. Legs pale brown. Wings (Figs 1-2) hyaline, veins brown, fore wing pterostigmal area lightly washed with very pale brown. Abdomen: light brown with a mid to dark brown pattern (Fig. 4), segments 4-5 and sometimes segment 3 distinctly paler than remainder. Genitalia (Figs 5-7) pale brown, penes with a row of 5-10 fine ventral spines, at least 3 distal to dorsolateral spine.

#### ***Female imago* (in ethanol)**

Head brown, carinae pale, antennae light brown, eyes dark grey, ocelli pale grey with black bases. Thorax as for ♂. Abdomen as for ♂ but with sternum 9 as in Fig. 8.

#### ***Male and female subimago* (in ethanol)**

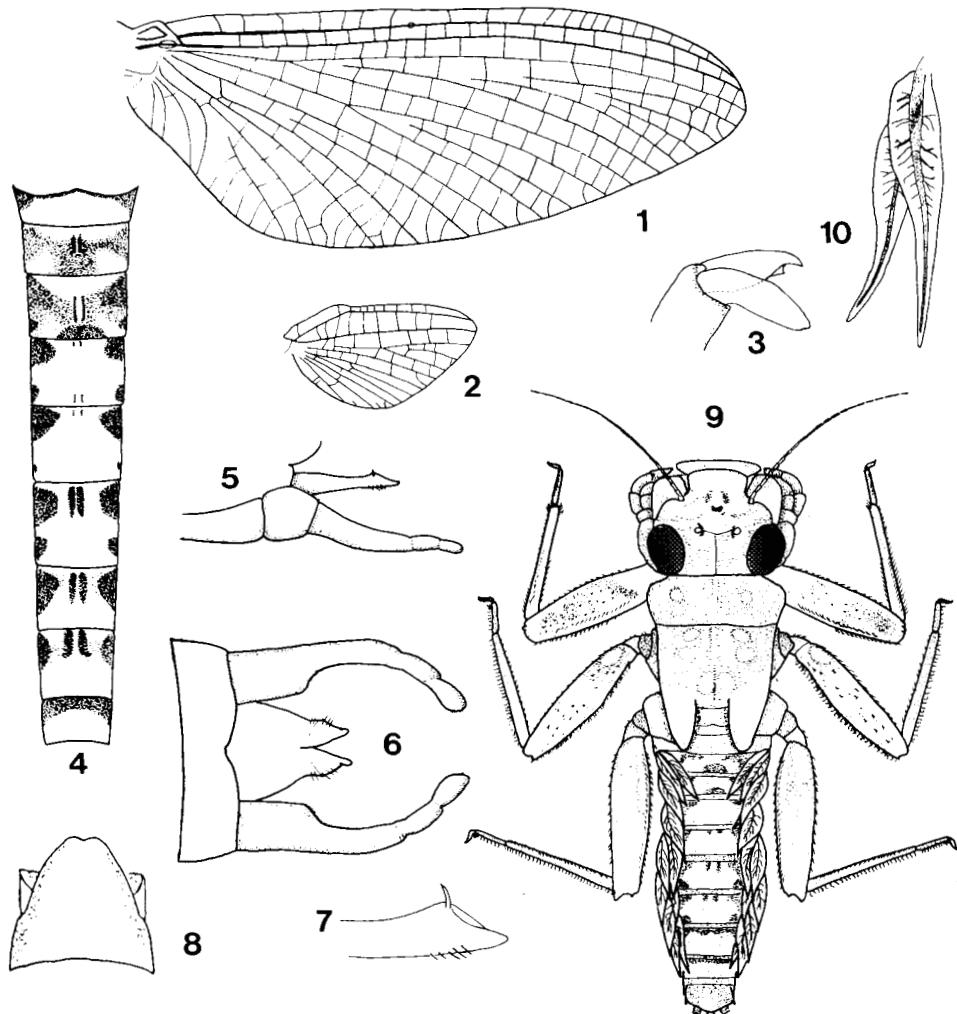
Head as for imagos; thorax with carinae more strongly etched in black, wings uniform light grey; abdomen pale brown with lateral patches of midbrown.

#### ***Nymph* (in ethanol)**

Head dark brown with lighter patches, black around ocelli, eyes black, antennae light brown. Mouthparts as in Figs 11-19. Thorax: dark brown with paler patches (Fig. 8), pale grey ventrally, often with conspicuous dark grey ganglia. Legs light brown without prominent markings apart from conspicuous bristle-free pale patches proximally on femora (Fig. 20). Abdomen with dark brown, almost black, pattern (Fig. 9), giving a banded appearance at first glance, mid to pale grey ventrally.

#### ***Egg* (Fig. 82)**

Ovoid, 0.15 x 0.07, chorion with circular adhesion structures in a hexagonal array; several sperm guides, simple circular orifices.



Figs 1-10—*Austrophlebioides pusillus*: (1-8) imago: (1) fore wing; (2) hind wing; (3) tarsal claws; (4) dorsal abdominal pattern; (5) ♂ genitalia, lateral; (6) same, ventral; (7) detail of tip of penis; (8) ♀ abdominal sternite 9; (9-10) nymph: (9) dorsal; (10) abdominal gill.

#### Notes

The present redescription is based on material collected and reared from the type locality. The species appears to be extremely widespread in stony upland streams in southeastern Australia, where it is perhaps the most commonly encountered mayfly.

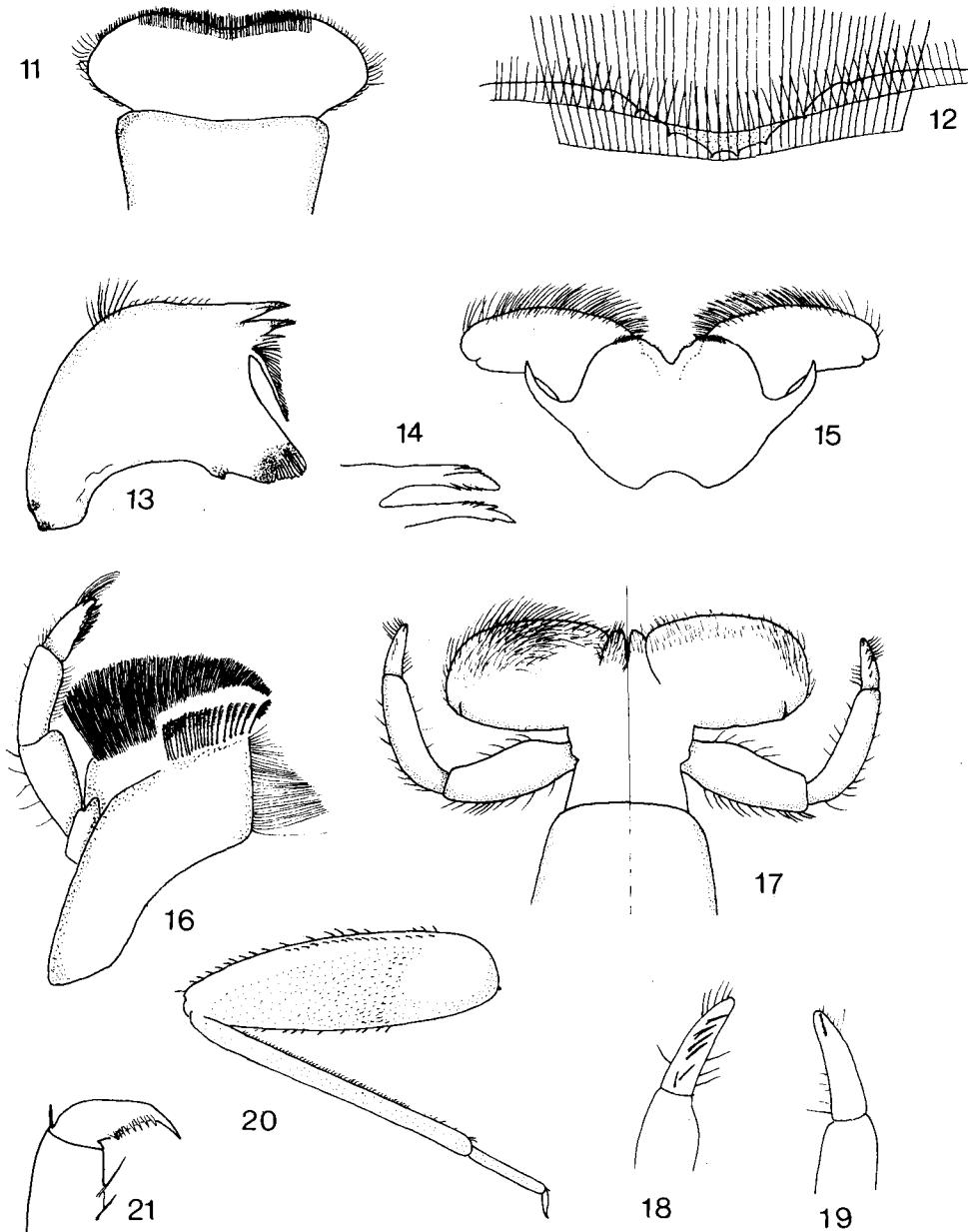
We have been unable to examine the type material of *A. unguicularis*, but using the illustrations of Ulmer (1916) the species may be distinguished in the male imagos by the ventral spines on the penes which are both proximal and distal to the dorsolateral spine in *A. pusillus* but distal only in *A. unguicularis*. It is possible that the 2 species will eventually prove synonymous.

#### **Garinjuga gen. n. (Figs 22-49, 83)**

Type species *Garinjuga maryannae* sp. n.

#### *Imago*

Body length: ♂ 10.2-11.8, ♀ 11.3-11.5. Fore wing length. ♂ 9.3-10.3, ♀ 10.6-11.5; breadth: ♂ 3.0-3.7, ♀ 3.5-4.2.



FIGS 11-21—*Austrophlebioides pusillus*, nymph: (11) labrum, dorsal; (12) labrum, detail of emargination; (13) left mandible; (14) detail of mandibular incisors; (15) hypopharynx; (16) maxilla; (17) labium, dorsal view to left; (18) dorsal and (19) ventral detail of segment 3 of labial palps; (20) fore leg; (21) tarsal claw.

**Male**—Eyes almost touching, but not fused on meson of head, lower portion 0.67 length of upper portion. Fore wing (Fig. 22) with  $R_s$  forked at 0.2 distance from base to margin;  $MA$  symmetrically forked at ca half distance from base to margin;  $MP$  not forked, crossvein attaching  $MP_2$  at base to  $MP_1$  and  $CuA$  at less than 0.2 length of  $MP_1$ , base of  $MP_2$  closer to  $CuA$  than to  $MP_1$ ;  $ICu_1$  arising from  $CuA$  and  $ICu_2$  arising from  $ICu_1$ , neither with crossveins to  $CuP$ . Hind wing (Fig. 23) with slight concavity in costal margin at a little less than midlength, apices bluntly rounded, length between 0.25 and 0.33 fore wing length;  $Sc$  less than 0.9 of wing length. Length ratios of fore leg 0.76-0.95 : 1.00 (2.4-3.3 mm) : 0.05-0.06 : 0.32-0.39 : 0.33-0.38 : 0.23 : 0.31 : 0.12-0.15. Claws of a pair alike, both hooked (Fig. 24). Genitalia (Figs 25-27): forceps segments 2 and 3 subequal, each about 0.2 length of segment 1, which narrows quite abruptly near midlength. Segment 3 slightly indented; styliger plate ca 0.4 as long as wide, shallowly indented distally (Fig. 25); penes long, reaching well beyond narrowing of forceps, each with a rounded knob apically and a prominent dorsolateral spine subapically (Fig. 27).

*Female*—As for ♂ except: eyes separated on meson by ca twice maximum width of eye. Abdominal sternum 9 (Fig. 28) with a prominent V-shaped cleft.

### Mature nymph

Body length 12.8-13.9.

Head prognathous; antennae 1.2 times head length. Mouthparts (Figs 38-46): labrum length ca half breadth, prominent row of subdistal hairs dorsally (Figs 38-39), submedian and anterolateral hairs ventrally; anteromedian emargination shallow with 5 large irregular denticles; rounded lateral margins. Clypeus subequal width to labrum, lateral margins diverging distally. Left mandible (Figs 40-41) with marginal tuft of hairs and a row of long hairs curving diagonally across dorsal surface, incisors as in Fig. 41. Hypopharynx (Fig. 42) with lingua having well developed lateral processes, submedian lobes only shallowly cleft. Superlingua (Fig. 42) with dense hair anteriorly and blunt lateral margins. Maxillae (Fig. 43) with apical half of galea-lacinia expanded medially with a subapical row of ca 20 pectinate spines, palpi with segments decreasing in length apically with segment 2 ca 0.8 length of segment 1 and segment 3 a little more than 0.8 the length of segment 2. Labium (Figs 44-46) with palpal segments decreasing in size apically with segment 2 ca 0.9 length of segment 1 and segment 3 ca 0.75 length of segment 1; glossae bulbous, densely hairy anteriorly, in same plane as paraglossae, submentum with sparse fringing hairs. Legs (Fig. 47) with femora having scattered spines; tibia with dense row of spines on inside edge, tarsi with a single spine distally, tarsal claws (Fig. 48) hooked with a row of 8 large denticles increasing in size apically. Gills (Figs 31-37) present on abdominal segments 1-7, those on segments 6 and 7 markedly reduced in size; the 2 lamellae on gills 1-3 and 7 quite different in shape, thus gills 1-3 with outer lamella sub-ovate with a narrow terminal extension and inner lamella is broadly lanceolate. Abdomen with small lateral spines on segments 8 and 9 only; terminal filament longer than cerci, each segment with a distal whorl of fine hairs, each nearly as long as the next segment (Fig. 49).

### Notes

*Garinjuga* can be distinguished from all other genera of Leptophlebiidae by the following combination of characters. Imago: fore wing with MP<sub>2</sub> strongly recurved (Fig. 22); claws of a pair similar, apically hooked with an opposing hook (Fig. 24); penis lobes each with a prominent subapical dorsolateral spine (Fig. 25); segments 2 and 3 of genital forceps partially fused to the preceding segment (Fig. 25). Nymph: labrum and clypeus of equal width; anteromedian emargination of labrum with 5 large irregular teeth; glossae of labium bulbous (Fig. 44); small posterolateral spines present on abdominal segments 8-9.

*Garinjuga* is a member of the *Penaphlebia* lineage of Pescador and Peters (1980) based on the following derived character states: lateral margins of labrum rounded (Fig. 38); outer margin of mandibles rounded (Fig. 40); right outer incisor of mandibles without broad denticles (Fig. 41); inner margin of segment 3 of labial palpi with few peg-like spines (Figs 45-46); inner margin of segment 2 of maxillary palpi with pectinate spines (Fig. 44).

*Garinjuga* appears to be most closely related to an undescribed Western Australian genus and to *Penaphlebia* Peters and Edmunds, but can be distinguished from the latter by the following combinations of characters. Imago: penis lobes each with a prominent subapical dorsolateral spine (Fig. 27); segments 2 and 3 of genital forceps partially fused to preceding segment (Fig. 25); eyes in male nearly meeting dorsally. Nymph: a row of hair curving diagonally across dorsal surface of mandibles; glossae of labium bulbous (Fig. 44); abdominal gills 1-3 with dissimilar lamellae, ventral lamella with a slender terminal process and dorsal lamella leaf-shaped (Figs 31-37); small postolateral spines present on abdominal segments 8-9.

### Etymology

From “garinjug” meaning “wide” in the Wembawemba aboriginal language, referring to the shape of the gills; feminine.

### *Garinjuga maryannae* sp. n.

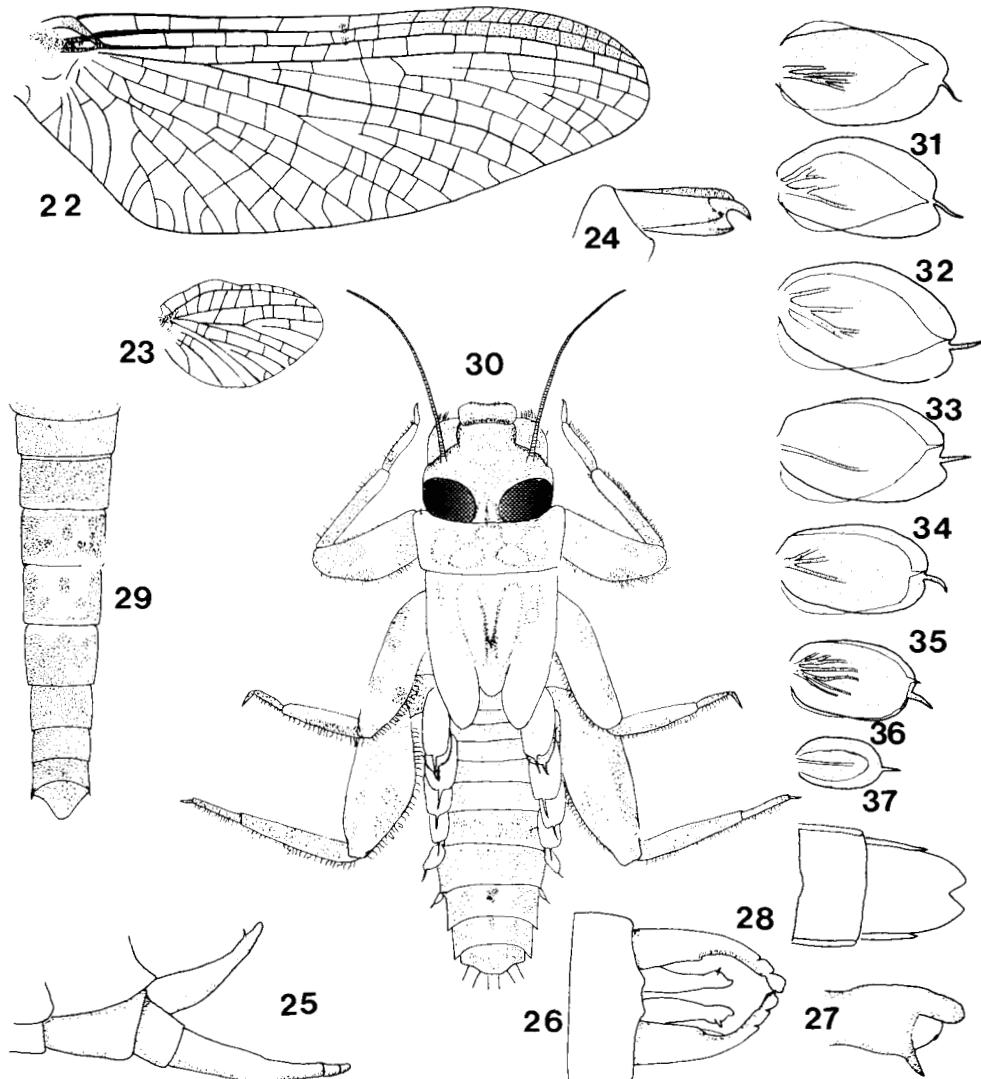
*Types*—NEW SOUTH WALES: holotype ♂, Thredbo R. below bridge on summit road at entrance to Kosciusko National Park, 19.x.1985, emerged in lab. 26.x.1985, I. Campbell (ANIC); paratypes 4 ♂♂, 2 ♀♀ sub, same locality and date, emerged 20-28.x.1986, I. Campbell (ANIC).

*Male imago (in ethanol)*

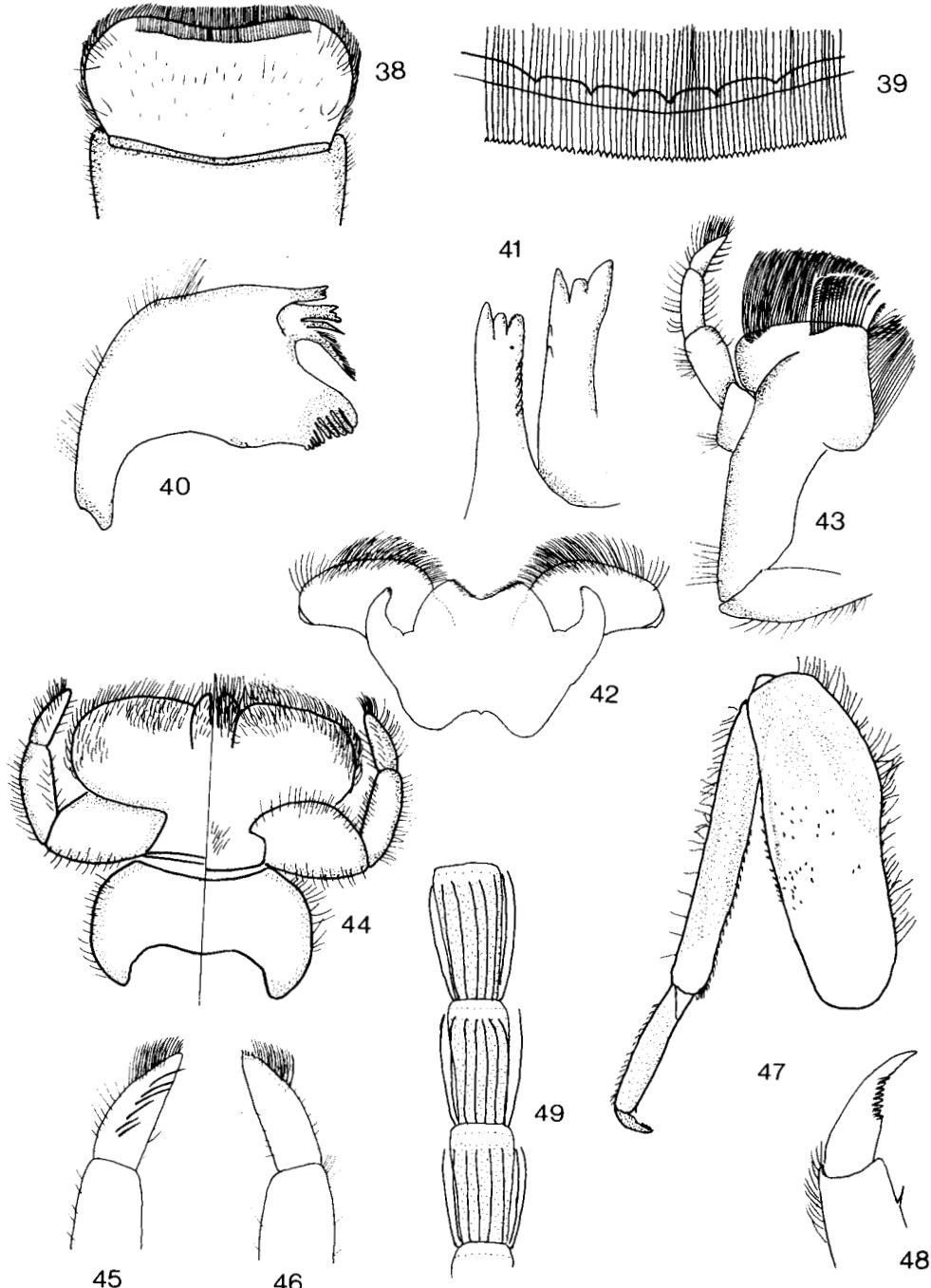
Head: very dark brown to black; paler areas beneath bases of antennae, antennal bases very dark brown, first segments paler, flagella paler still; upper portion of eyes mid-brown, lower portion dark grey, ocelli black with white tips. Thorax: pronotum black; mesonotum shiny black with a distinct pale brown subcircular patch opposite each wing base; anterolateral and posterolateral edges light brown; pleura and sterna very dark brown to black with light brown unsclerotised areas. Legs: very dark brown. Wings: (Figs 22-23) hyaline; fore wing with pterostigmal area lightly washed in brown and with a dark brown patch basally completely filling spaces between Sc and R and partially filling space between C and Sc basal to the costal strut, veins dark brown. Abdomen very dark brown to black with pattern (Fig. 29) in mid to light brown, segments 4-5 appearing paler than remainder. Genitalia (Figs 25-27) mid brown, penes with a prominent dorsolateral spine.

*Female imago (in ethanol)*

Differs from ♂ as follows. Head: paler, dark brown washed with black; pale patches beneath antennal bases broader, eyes dark grey. Thorax: pronotum dark brown washed in black, carinae black; mesonotum very dark brown, carinae and grooves black, pale patches at wing bases less conspicuous; pleura and sterna paler. Abdomen: dark brown dorsally, segments 4-5 paler, pattern absent, dark brown ventrally; sternum 9 (Fig. 28) with V-shaped cleft.



Figs 22-37—*Garinjuga maryannaee*: (22-27) imago: (22) fore wing; (23) hind wing; (24) tarsal claw; (25) ♂ genitalia, lateral; (26) same, ventral; (27) detail of tip of penis; (28) ♀ abdominal sternite 9; (29) dorsal abdominal pattern; (30-37) nymph: (30) dorsal; (31-37) gills 1-7.



FIGS 38-49—*Garinjuga maryannae*, nymph: (38) labrum, dorsal; (39) labrum, detail of emargination; (40) left mandible; (41) detail of mandibular incisor; (42) hypopharynx; (43) maxilla; (44) labium, dorsal view to left; (45) dorsal and (46) ventral detail of segment 3 of labial palps; (47) fore leg; (48) tarsal claw; (49) section of terminal filament.

#### *Male and female subimago (in ethanol)*

Differs from imago as follows. Thorax: mesothorax with 3 prominent light brown longitudinal stripes dorsally, 1 medial and 2 lateral along grooves at edges of central dome of mesothorax. Wings grey with darker

shadowing fringing veins. Abdomen: darker than imago but segments 4-5 still appearing paler than remainder.

### Nymph (in ethanol) (Fig. 30)

Head dark brown with midbrown patches, black around ocelli; eyes black; antennae pale grey; mouthparts as in Figs 38-46. Thorax dark brown, pattern lighter brown, ventrally light brown. Legs light brown with darker patches giving a slightly banded appearance to femora. Abdomen dark to midbrown with conspicuous lighter colouration on segments 4-5 and 8-9 giving a 2-spotted appearance which is obvious in nymphs of all sizes. Gills brown through to grey, tracheation darker grey with only main trunks conspicuous.

### Egg (Fig. 83)

Ovoid, 0.12 x 0.08, chorion uneven with dispersed circular adhesion structures each surrounded by a ring of smaller protuberances forming a daisy-like pattern; several simple circular orifices forming sperm guides.

### Notes

This species occurs in upland streams in southeastern mainland Australia, mostly under rocks in rapid currents.

### Etymology

The species is named for Ms Maryanne McKaige who first collected the nymphs for I.C. from the Thredbo River.

### Koorrhonga gen. n. (Figs 50-69, 85)

Type species *Leptophlebia inconspicua* Eaton.

### Imago

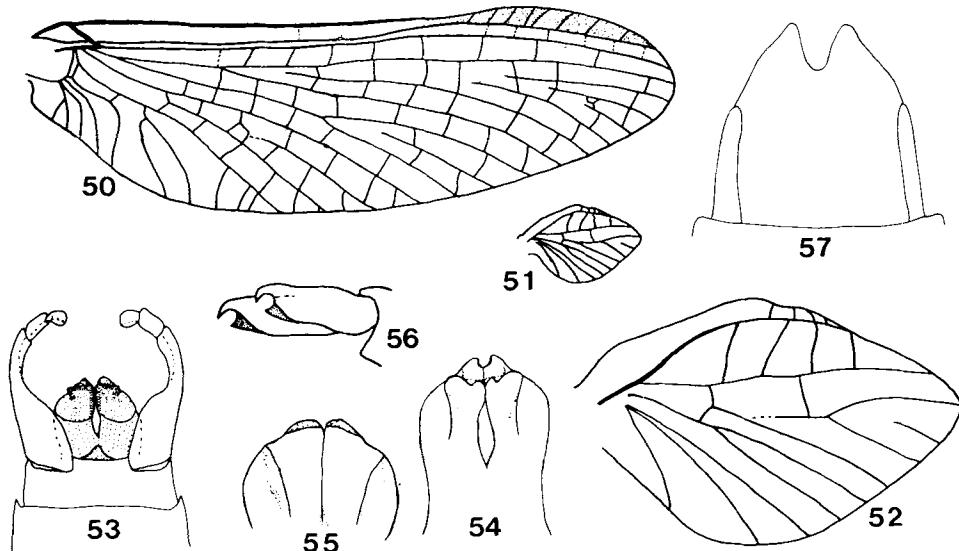
Body length: ♂ 6.0-9.1, ♀ 5.5-12.0. Fore wing length: ♂ 5.7-9.5, ♀ 5.5-9.2; breadth: ♂ 2.0-2.6, ♀ 2.0-3.1.

**Male**—Eyes separated on meson of head by 0.33 to 0.2 width of median ocellus, lower portion just less than length of upper portion. Fore wing (Fig. 50) with Rs forked 0.33 or a little less distance from base to margin; MA asymmetrically forked slightly less than half distance from base to margin; MP<sub>1</sub> moderately recurved, attached at base to MP<sub>1</sub> with a crossvein in proximal 0.33 of wing; ICu<sub>1</sub> attached at base to CuA and divergent; costal and subcostal space with crossveins present in distal region only. Hind wing (Figs 51-52): costal margin slightly humped with a concavity ca half distance from base to apex; apex obtuse; Sc 0.75 wing length; MP forked in proximal half of wing; crossveins absent in anal and cubital regions. Legs: tarsal segment 1 partially fused to tibia; length ratios of fore leg 0.66-0.68 : 1.00 (1.9-2.1) : 0.05-0.10 : 0.32-0.33 : 0.31-0.34 : 0.22-0.25 : 0.10-0.12; claws of a pair similar each apically hooked with an opposing hook (Fig. 56). Genitalia (Figs 53-55); forceps with segment 2 equal to or slightly longer than segment 3 and 0.17 of segment 1; base of segment 1 broad, with an angular bend midway; styliger plate length 0.33-0.5 width; basal 0.67 of penis lobes fused, remainder divided, parallel, tubular, lacking a small sclerotised process on inner margin (Figs 54-55). Terminal filament longer than cerci or absent.

**Female**—As for ♂ except: eyes separated on meson of head by 4-5 times width of eye; fore legs not longer than others; sternum 9 cleft apically (Fig. 57) ca 0.67-0.5 sclerite length.

### Mature nymph

Head prognathous; antennae longer than head length. Mouthparts (Figs 58-64): labrum (Fig. 58) length 0.5-0.6 times width, smoothly curved laterally, anteromedian emargination with 4-6 smooth regular denticles (Fig. 59), 2 rows of setae just posterior to anteromedian emargination, posterior row less than half width of anterior row. Clypeus (Fig. 58) narrower than labrum, lateral margins parallel. Outer margin of mandibles smoothly curved, with a median hair tuft (Figs 61-62), incisors with 2-3 apical teeth, lateral margins of outer and inner incisors with minute spines, prostheca of left mandible slender (Fig. 61). Galea-lacinia of maxillae square with 10-15 pectinate setae apically, inner margin with pinnate setae (Fig. 64); segment 2 of palp 0.7-0.9 times length of segment 1, subequal to segment 3; inner margin of segment 1 without setae. Lingua of hypopharynx (Fig. 63) with well developed lateral processes, anterior margin concave; sublingua with hairs along anterior margin; lateral margins rounded. Segment 1 of labial palp 1.3 times length segment 2, segments 2 and 3 subequal, segment 1 broad, 0.5 times length; glossae straight and bulbous (Fig. 60); submentum with 7-15 long lateral spines. Pronotum narrower than head, short spines on anterolateral margins, lateral margins without setae. Legs (Fig. 65); length of femora of fore and mid legs equal, hind femora longer, fore and mid tibiae shorter than hind; denticles on tarsal claw progressively larger apically, apical denticle not greatly enlarged (Fig. 66). Gills on segments 1-7 alike, dorsal and ventral lamellae slender, lanceolate to broadly lanceolate (Fig. 67); gills 3-5 largest, progressively smaller posteriorly and anteriorly; main trachea along median line, with branches on both sides. Posterolateral projections on abdominal segments 6-9; posterior margins of terga with broad single spine with small spines between them (Figs 68-69). Terminal filament longer than cerci.



Figs 50-57—*Koornnonga* spp.: (50-54, 56-57) *K. inconspicua*: (50) fore wing; (51) hind wing to same scale; (52) hind wing enlarged; (53) ♂ genitalia, ventral; (54) detail of penes, ventral; (56) tarsal claw of ♂ imago; (57) sternum 9 of ♀ imago; (55) *K. pilosa*, penes, ventral.

### Egg

Ovoid, 0.12 x 0.09; polar cap with 2 rings of tubular processes, chorion with small circular tubules regularly spaced over surface, at least 2 circular sperm guides (Fig. 85).

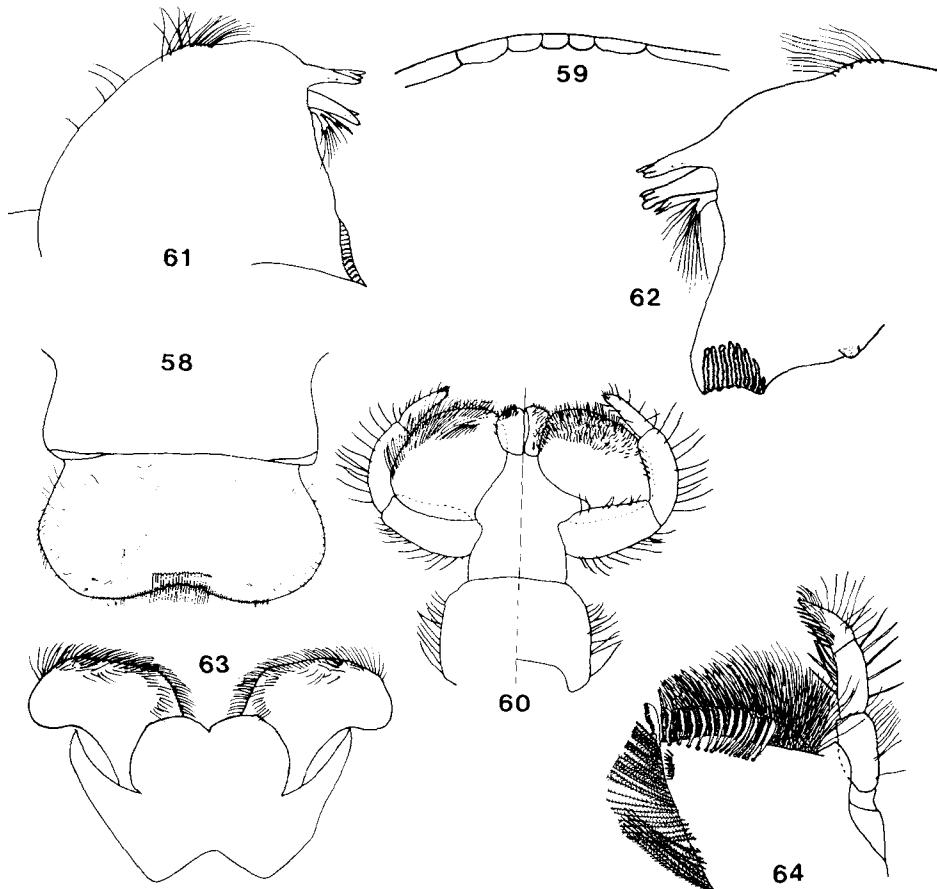
### Species included

- Koornnonga inconspicua* (Eaton), comb. n.  
*Leptophlebia inconspicua* Eaton, 1871: 79.  
*Atalophlebia inconspicua*: Eaton, 1883-88: 87.  
*Nousia inconspicua*: Suter, 1986: 347.
- Koornnonga fusca* (Ulmer), comb. n.  
*Atalophlebia fusca* Ulmer, 1919: 20.  
*Atalonella fusca*: Needham and Murphy, 1924: 35.
- Koornnonga simillima* (Ulmer), comb. n.  
*Atalophlebia simillima* Ulmer, 1919: 16.  
*Atalonella simillima*: Harker, 1954: 243.
- Koornnonga brunnea* (Tillyard), comb. n.  
*Atalophlebia brunnea* Tillyard, 1936: 43.  
*Atalonella brunnea*: Harker, 1954: 243.
- Koornnonga parva* (Harker), comb. n.  
*Atalophlebia parva* Harker, 1950: 14.  
*Atalonella parva*: Harker, 1954: 243.
- Koornnonga pilosa* (Suter), comb. n.  
*Nousia pilosa* Suter, 1986: 350.

### Notes

The placement of *K. simillima* and *K. parva* in *Koornnonga* is tentative, and may be revised once specimens of these species are examined. *K. simillima* differs in the genitalia as illustrated by Ulmer (1919), with a very broad base and very narrow apically. *K. parva* has no terminal filament in the imago and the gills are distinctively broad at the base narrowing rapidly at 0.67 length. The egg morphology and genitalia of *K. parva* are consistent with those of *Koornnonga*. *K. brunnea* is also placed in the new genus although Tillyard (1936) illustrated the penis lobes as widely divergent. However he described the lobes as "slightly diverging . . . separated by a deep semi-circular embayment", and they may well have separated upon being mounted on slides. The wing characteristics are consistent with those of *Koornnonga*.

*Koornnonga* can be distinguished from all other genera of Leptophlebiidae by the following combination of characters. Imago: in fore wing basal half of costal and subcostal spaces lack cross veins (Fig. 50); in hind wing Sc joins C at 0.75 wing length (Fig. 52); claws of a pair similar, each hooked with an opposing hook (Fig. 56); penis



Figs 58-64—*Koorrnonga inconspicua*, nymphal mouthparts; (58) clypeus and labrum; (59) detail of emargination of labrum; (60) labium, dorsal view to left; (61) right mandible, ventral; (62) left mandible, ventral; (63) hypopharynx; (64) maxilla.

lobes fused, held parallel, without a short sclerotised process on inner margin (Figs 54-55). Nymph: clypeus narrower than labrum, margins parallel (Fig. 58); labrum 1.5-2.0 times wider than long, with anteromedian emargination with 4-6 smooth blunt denticles (Fig. 59), 2 rows of setae just posterior to the anteromedian emargination, posterior row half length of anterior row (Fig. 58); outer margin of mandibles smoothly curved with a median tuft of setae (Figs 61-62); tarsal claws with 12-16 denticles, progressively larger apically (Fig. 66); posterolateral projections on abdominal segments 6-9; abdominal gills on segments 1-7 similar, lanceolate to broadly lanceolate (Fig. 67); posterior margin of abdominal terga with single large spines and smaller spines between them (Figs 68-69). Eggs: with a polar cap of 2 coronae of tubular processes; chorion with small circular tubules regularly spaced and at least 2 circular sperm guides (Fig. 85).

*Koorrnonga* is closely related to *Nousia*, but can be distinguished from it by the following characters. Imago: MA in the fore wing forked slightly less than half distance from base to margin (Fig. 50); male fore wings without crossveins in distal half of costal and subcostal spaces (Fig. 50); lobes of the penes fused at the base and parallel; penes lacking a sclerotised process on inner margin (Figs 53-55). Nymph: anteromedian emargination of labrum with 4-6 smooth regular denticles (Fig. 59); labrum with 2 rows of setae posterior to the emargination, posterior row half length of anterior row (Fig. 58); segment 1 of labial palp 1.3 times longer than segment 2 (Fig. 60); posterior margin of abdominal terga with broad single spines with smaller spines between them (Figs 68-69). Egg: with a polar cap with 2 rings of tubular processes and 2 sperm guides (Fig. 85).

### *Etymology*

From "koorrnonga" meaning "creek which dries up in summer" in an Aboriginal language, and describing the habitat in which the type species occurs in South Australia; feminine.

### **Nousia** Navás, 1918

Type species *Nousia delicata* Navás, by original designation.

The description of this genus was revised by Pescador and Peters (1985), and having examined *N. delicata* from South America and *N. fuscula* from Australia we found them to be very similar. The similarities in the ♂ imago include the structure of the hind wings (Figs 71-72) and the structure of the penes which include a small sclerotised process (Figs 74-75). In the nymph the labrum is smoothly curved laterally, length ca half width, anteromedian emargination broad with 5 irregular denticles (Figs 76-77); denticles on tarsal claws progressively larger apically (Fig. 78); posterior margins of terga with broad basal spines (Fig. 81).

However there are sufficient differences in the adults and the nymphs between the Australian and South American species that we consider that the Australian material should be placed in a new subgenus, *Australonousia*.

### Subgenus **Nousia** Navás, 1918

#### *Imago*

In fore wing MA forked slightly more than half distance from base to margin; penis lobes fused in basal 0.67, remainder divided, tubular, each with a short sclerotised process on inner margin.

#### *Mature nymph*

Lingua of hypopharynx with anterior margin shallowly cleft; prostheca of left mandible slender.

#### *Egg*

Ovoid, polar cap absent, chorion granulated with scattered circular ridges enclosing a short cylindrical process, 1 oval sperm duct.

#### *Species included*

- Nousia (Nousia) delicata* Navás, 1918: 213.
- Nousia (Nousia) bella* Pescador and Peters, 1985: 117.
- Nousia (Nousia) crena* Pescador and Peters, 1985: 105.
- Nousia (Nousia) grandis* (Demoulin).
  - Atalonella grandis* Demoulin, 1955b: 21.
  - Nousia grandis*: Pescador and Peters, 1985: 109.
- Nousia (Nousia) maculata* (Demoulin).
  - Atalonella maculata* Demoulin, 1955b: 18.
  - Nousia maculata*: Pescador and Peters, 1985: 101.
- Nousia (Nousia) minor* (Demoulin).
  - Atalonella minor* Demoulin, 1955b: 16.
  - Nousia minor*: Pescador and Peters, 1985: 114.

#### *Notes*

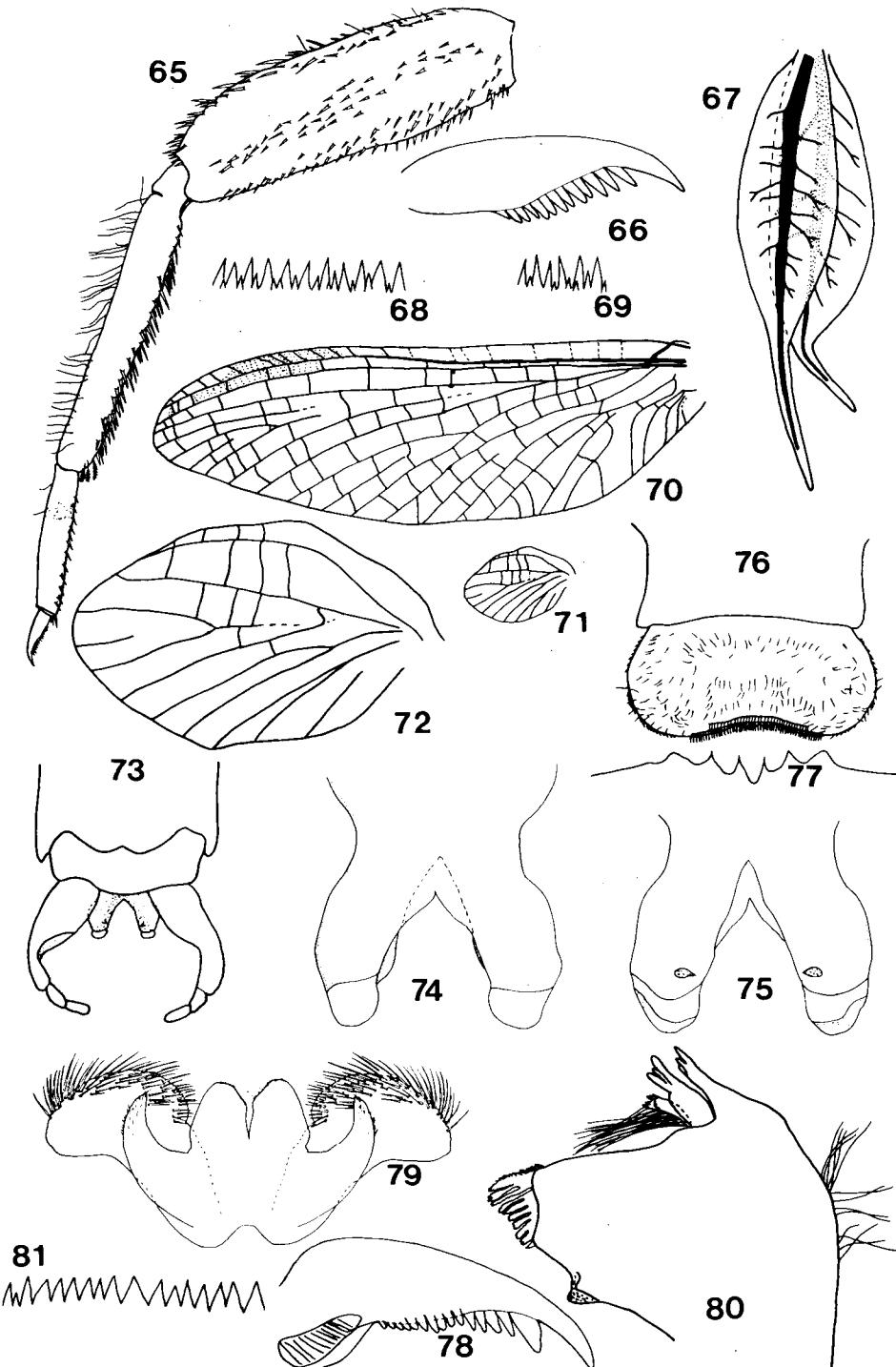
The subgenus *Nousia* includes all those species recorded from South America and placed in the genus *Nousia* by Pescador and Peters (1985). The characters distinguishing the subgenus were all illustrated by Pescador and Peters and will distinguish it from the new subgenus below.

### **Australonousia** subgen. n.

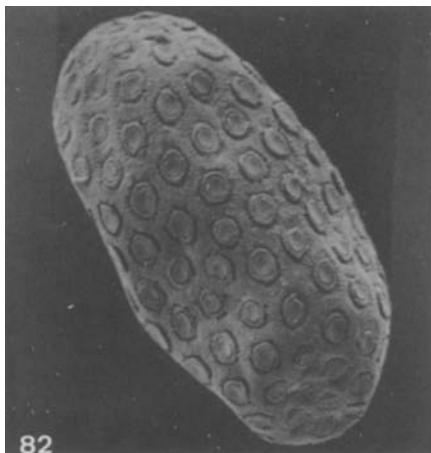
Type species *Atalophlebia fuscula* Tillyard.

#### *Imago*

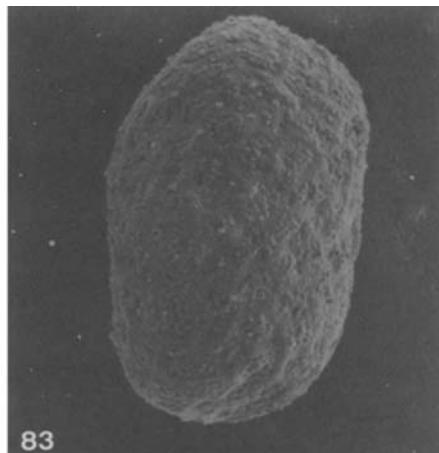
Fore wing (Fig. 70) with MA asymmetrically forked slightly less than half distance from base to margin. Penis lobes fused in basal 0.67, remainder divided and divergent, tubular, each with a small, dorsal, sclerotised process (Figs 73-75).



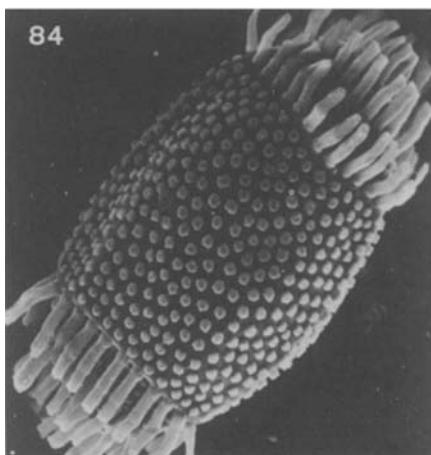
Figs 65-81.—*Koornnonga* and *Nousia* spp.: (65-68) *K. inconspicua*, nymph: (65) fore leg; (66) tarsal claw; (67) abdominal gill 3; (68) spines on posterior margin of abdominal terga; (69) *K. pilosa*, nymph, spines on posterior margin of abdominal terga; (70-81) *Nousia (Australonousia) fuscula*: (70-75) imago: (70) fore wing; (71) hind wing to same scale; (72) hind wing enlarged; (73)♂ genitalia, enlarged; (74) detail of penes, ventral; (75) detail of penes, dorsal; (76-81) nymph: (76) clypeus and labrum; (77) detail of emargination of labrum; (78) tarsal claw of fore leg; (79) hypopharynx; (80) left mandible, ventral; (81) spines on posterior margin of abdominal terga.



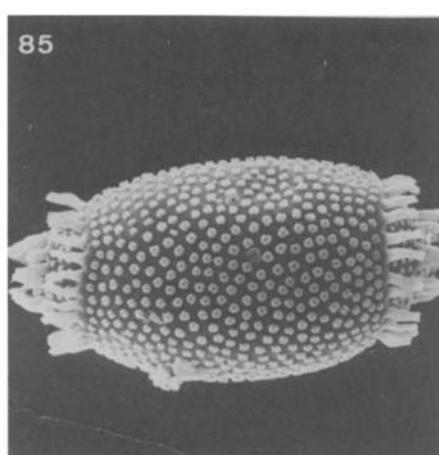
82



83



84



85

Figs 82-85—SEM micrographs of eggs: (82) *Austrophlebioides pusillus*; (83) *Garinjuga maryannae*; (84) *Nousia (Australonousia) fuscula*; (85) *Koorronga inconspicua*.

### Mature nymph

Hypopharynx with lingua having anterior margin deeply cleft (Fig. 79); prostheca of left mandible robust and serrated (Fig. 80).

### Egg

Ovoid, polar cap with 3 rings of tubular processes, chorion with small circular tubules regularly placed over surfaces, at least 2 circular sperm guides (Fig. 84).

### Species included

- Nousia (Australonousia) fuscula* (Tillyard).
- Atalophlebia fuscula* Tillyard, 1936: 44.
- Atalonella fuscula*: Harker, 1954: 243.
- Nousia fuscula*: Suter, 1986: 348.
- Nousia (Australonousia) delicatula* (Tillyard), comb. n.
- Atalophlebia delicatula* Tillyard, 1936: 47.
- Atalonella delicatula*: Harker, 1954: 243.

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Prof. W. Peters and Mrs J. Peters helpful comments on the manuscript, especially Prof. Peters advice on the phylogenetic relationships of the genera, are much appreciated.

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