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Bradbury, J. H., and W. D. Williams, 1997. The amphipod (Crustacea) stygofauna of Australia: description of new taxa (Melitidae, Neoniphargidae, Paramelitidae), and a synopsis of known species. *Records of the Australian Museum* 49(3): 249–341. [22 December 1997].

doi:10.3853/j.0067-1975.49.1997.1270

ISSN 0067-1975

Published by the Australian Museum, Sydney

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The Amphipod (Crustacea) Stygofauna of Australia: Description of New Taxa (Melitidae, Neoniphargidae, Paramelitidae), and a Synopsis of Known Species

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ABSTRACT. Freshwater amphipods from Australian subterranean waters are discussed. Five new genera and fourteen new species are described; the genus *Wesniphargus* Williams & Barnard is rediagnosed and specimens assigned to *W. nicholli* (Straškraba) are fully described; a synopsis of subterranean species is provided.

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Introduction

The diversity of Australian sub-surface (stygobiont) amphipods was, until recently, considered to be relatively low; only four or possibly five species were regarded as subterranean (Williams, 1986). However, in a separate footnote to the paper by Williams (1986: 556), Knott foreshadowed greater diversity and noted that a range of undescribed subterranean amphipods occurred in Western Australia. Without formal description of taxa, comments supporting this note were separately published (Knott, 1983, 1985). Descriptions of several subterranean species (Williams & Barnard, 1988; Stock & Iliffe, 1991; Barnard & Williams, 1995; Bradbury & Williams, 1995, 1996a,b, 1997) have provided substantive confirmation that a diversity of forms occur, a phenomenon which includes—as elsewhere—both troglotic and trogliphilic forms (i.e. obligate and facultative sub-surface forms). Bradbury & Williams (1997) discussed and drew attention to this diversity, listed all described sub-surface forms, and noted the occurrence of several further undescribed taxa.

The main aim of the present paper is to describe the further taxa referred to by Bradbury & Williams (1997). Given their number and diversity, the opportunity is taken to update the synopsis of described forms and discuss them briefly. The opportunity is also taken to revise the generic description of *Wesniphargus* Williams & Barnard, 1988, in the light of additional material of *W. nichollsi* collected from a stream flowing from a cave and from a temporary pool.

Although the taxa described herein significantly increase the already considerable known diversity of subterranean Australian amphipods, still further new taxa await description; material is in our possession or known to us which points to the likelihood of new stygobiont taxa from Queensland (*Chillagoe* sp.), New South Wales, South Australia (northwestern, east-central, and southeastern), Tasmania, and Western Australia (Barrow Island, Varanus Island, Ashburton River, Nullarbor Plain). However, given the pressing need to focus attention on surface forms of Australian amphipods,

rather than provide an exhaustive study of sub-surface forms, this material will form the basis of a subsequent paper.

While the major aim of this paper is taxonomic, we recognise—together with an increasing number of others (see especially: Christiansen, 1992; Culver *et al.*, 1995; Holsinger, 1994a,b; Kane & Culver, 1992)—that cave faunas, amphipods in particular, are of considerable scientific interest beyond their taxonomy, but that taxonomic studies like ours nevertheless continue to dominate studies of cave faunas. Notwithstanding this recognition, given the only recent knowledge of the extensive diversity of sub-surface amphipods in Australia and its still indeterminate limits, we believe taxonomic studies essential prerequisites at this stage.

Methods of dissection and description

These follow Bradbury & Williams (1996a).

The notation **M**, with an appended number, indicates the position of an object as a fraction of the distance from the base to the apex of an appendage; **S**, large robust seta; **s**, small robust seta. Abbreviations used in the figures are as follows: **A**, antenna; **Abd**, abdomen; **acc**, accessory; **C**, coxa; **d**, dorsal; **dact**, dactylus; **E**, epimeron; **fl**, flake; **flag**, flagellum; **g**, gill; **G**, gnathopod; **Hd**, head; **i**, inner; **juv**, juvenile; **L**, left; **lac**, lacinia mobilis; **lat**, lateral; **LL**, lower lip; **MD**, mandible; **med**, medial; **mol**, molar; **MP**, maxilliped; **MX**, maxilla; **O**, oostegite; **opp**, opposite; **p**, palp; **P**, peraeopod; **pl**, plate; **Pp**, pleopod; **R**, right; **st**, sternal gill; **T**, telson; **U**, uropod; **UL**, upper lip; **UR**, urosome; **1, 2, 3 ...7**, first, second, third ...seventh article, segment, somite or epimeron (as appropriate).

Mandibular palp setae are described using the notation of Karaman (1969) and Barnard & Barnard (1983). Lowry & Stoddart (1993) proposed a modified notation which removed many discrepancies, but as the former notation was developed for freshwater crangonyctoids it has not been necessary to employ the more detailed ones of Lowry & Stoddart (1993).

Melitidae Bousfield, 1973***Norcapensis* n.gen.**

Type species. *Norcapensis mandibulis* n.sp.

Diagnosis. Pleonite six with two small dorsolateral robust setae, rostrum obsolescent, lateral cephalic lobes strongly projecting, broad, no antennal sinus, eyes absent. First antenna: elongate, longer than second antenna, ratio of peduncular articles 34:31:12, accessory flagellum 2-articulate, second article tiny. Second antenna: very short, flagellum much shorter than peduncle, calceoli absent. Upper lip: symmetrical, ovate. Mandible: palp three-articulate, articles reduced with few setae; accessory blades (rakers) on mandibles few with two plumose setae anteriorly; few small setae beyond rakers on to base of molar. Lower lip: with inner lobes. Maxillae: moderately to well setose medially; inner plate of first maxilla ovate with medial and distal plumose setae; outer plate with seven or more denticulate robust setae, palps symmetric, each with thin apical robust setae. Inner plate of second maxilla with row of plumose medial setae extending to the apex, some facial; both plates of second maxilla with plumose apical setae of medium to moderate length. Inner plate of first maxilla and medial and lateral margins of second poorly pubescent. Maxilliped: inner plate long with distofacial row of plumose setae extending apically, blunt naked tooth like robust setae terminally; outer plate large with apical plumose setae continuous with paired rows of curved facial setae extending medially and submarginally from the base; anteromedial margin carved into sinuosities without marginal robust setae; palp articles 2 and 3 with few lateral setae, moderately setose medially; article 3 without setae or comb rows at base of the dactyl, distolaterally and facially pubescent; apex not produced, dactyl unguiform, multispinous, facially pubescent with short nail and terminal accessory spinule. Coxae 1-7 short, broader than long; coxae 1-4 lacking posterior robust setae; coxa 1 not expanded below; coxa 4 not excavate posteriorly; coxa 5 as long as four. Gnathopods: diverse, dactyls lacking inner tooth like robust seta, lacking nail. First gnathopod: small, feeble, carpus equal to propodus, not lobate, merus lacking hyaline lobe, without rastellate seta, palm transverse, robust setae not symmetrically bifid, rather with small subapical trigger like extensions; armaments at corner of palm few lateral and medial robust setae, setae along palm sparse and simple. Second gnathopod: enlarged, 3.3× gnathopod 1; carpus short and lobate, hand enlarged and ovate, palm strongly oblique, spinose and irregularly setose, defining corner with strong lateral and medial robust setae. Peraeopods: three and four of proportions similar to peraeopods 5-7; posterior robust seta sets on article 6 of peraeopods 3 and 4 unevenly spaced; peraeopods 5-7 moderately long, peraeopods 6 and 7 subequal, longer than five, article 2 moderately expanded, ovatorectangular, posteroventrally extended, slightly lobate on peraeopod 6, lobate on peraeopod 7; dactyls of peraeopods lacking accessory spinules. Coxae 2-6 each with a single flask-shaped gill, that of coxa 6 not reduced. No sternal gills. Oostegites: present on coxae 2-5; thin, strap like, poorly setose. Epimera: posteroventral tooth of epimera 1 to three absent; posterior margins smooth to sinuous with few setae; epimera 2 and 3 with facial robust setae near the ventral margin. Pleopods: peduncles with few setae, rami extending equally, basomedial setae of inner rami not bifid; retinaculae two per pleopod, no accessory robust setae. Uropods: apicolateral corner of peduncles of uropods 1 and 2 with one or two robust setae; mediodorsal margin of peduncle of first uropod spinose, of second naked, mediobasal margin of first

uropod with two robust setae; first uropod with basofacial robust seta; lateral rami of uropods 1 and 2 shorter than medial, rami of both uropods mostly with two robust seta rows; third uropod: strongly extended, peduncle short, outer ramus large, inner ramus short, scale like, medial setae of outer ramus sparse, peduncular robust setae few, medial and distal. Urosome: ventrodorsal robust seta on urosomite 1 at base of uropod 1 absent. Telson: longer than broad, cleft 90%, laterally convex, bearing, short, marginally subapical setae with one or two long lateral penicillate setae and small, paired lateral penicillate setules.

Relationship. It is difficult to determine the relationship of *Norcapensis* to other melitids, and as an ongoing taxonomic review of the Melitidae is underway (Lowry, pers. com.) it would be premature to speculate on this. However, attention should be drawn to the presence of eriopisid characters, including: absence of eyes; medial setosity of the maxillae; symmetry of the first maxilla palps; dissimilarity of the gnathopods; non-lobate fourth coxa; peduncular basofacial spine present on the first uropod; elongate third uropod; and deeply cleft, apically notched tapering telson bearing few setae. Among the three eriopisid genera, *Norcapensis* has several characters in common with *Victoriopisa* Karaman & Barnard, including: fusion of the basal articles of the flagellum of the second antenna; seven denticulate apical spines present on the outer plate of the first maxilla; elongate carpus and transverse, convex palm on the first gnathopod; broad, ovate coxal gills. The genus differs, however, from *Victoriopisa* in that: C setae are present and A setae absent from the mandibular palp; inner plate of the first maxilliped is ovate rather than ovatotriangular; fourth article of the seventh peraeopod is not dilated; outer ramus of uropods 1 and 2 are shorter than inner.

This genus appears related to *Nedsia* Barnard & Williams, a marine invader or "crawlout" from the lowland coastal plains of North West Cape and Barrow Island (Barnard & Williams, 1995; Bradbury & Williams, 1996a). *Norcapensis*, nevertheless, differs from *Nedsia* in several minor ways: relatively short first and third articles of the peduncle and the longer flagellum of the first antenna; the upper lip is not excavate below; there are three rather than two articles of the mandibular palp; a greater number of setae on the inner plate of the first maxilla; setae of the outer plate of the maxilliped are not blunt and are more numerous and the distal plumose setae are not accompanied by a bent naked medial robust seta, the apex of the maxillipedal palp is not produced even weakly and the dactyl bears additional accessory setules. The carpus of the first gnathopod is equal in length to the propodus rather than longer, with reduction in the length of the lateral setae at the palmar corner and greater numbers of setae and robust setae along the palm; the second gnathopod is enlarged with a strongly oblique and more setose palm, the palmar corner marked by two or three stout lateral and medial robust setae rather than a single robust seta; the sixth peraeopod is subequal to the seventh, article 2 of peraeopods 6 and 7 is progressively lobate rather than without lobes as found in *N. douglasi* Barnard & Williams. There are additional setae on the peduncle of the pleopods and

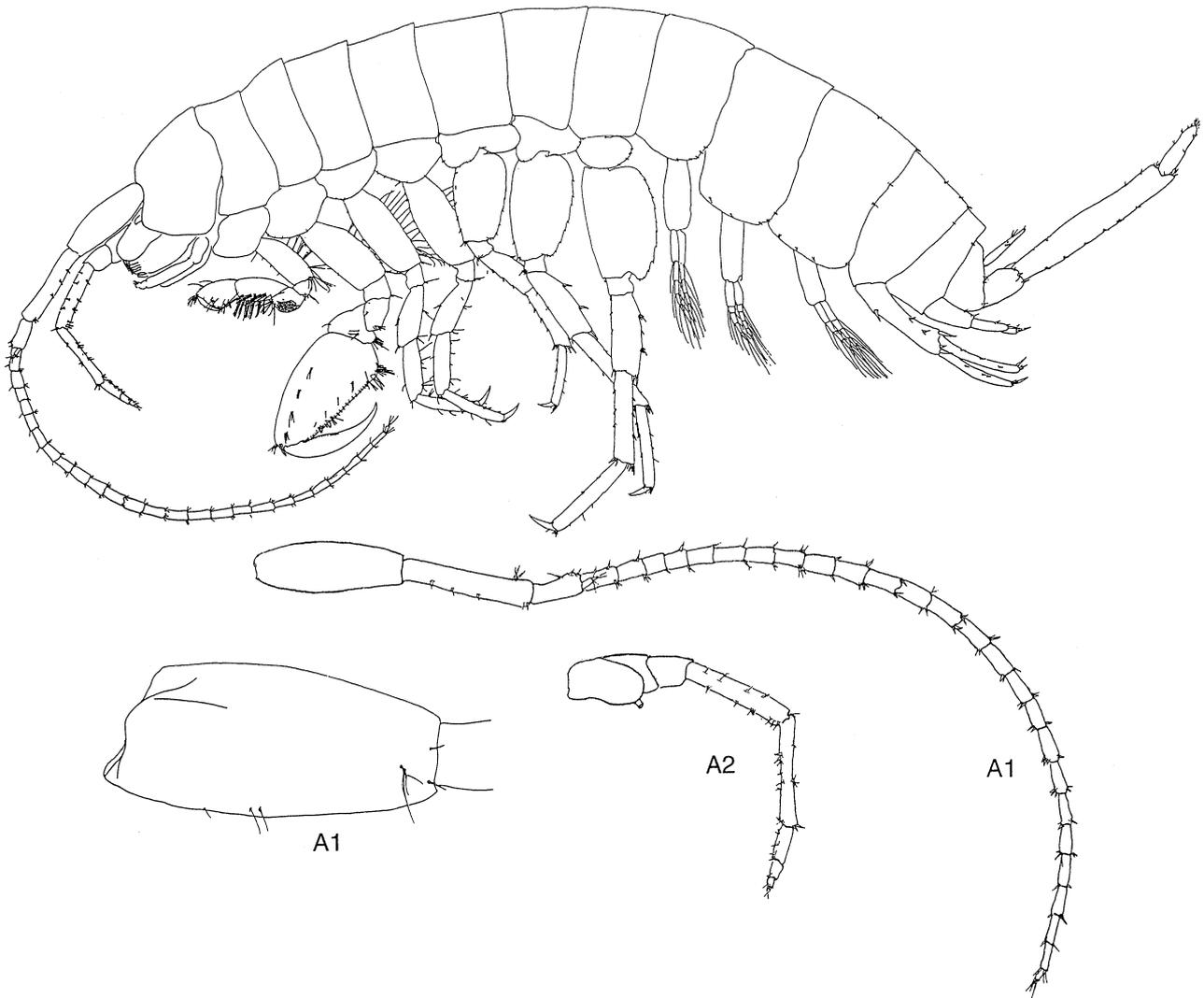


Fig. 1. *Norcapensis mandibulis* n.sp. holotype female "p"; body and antennae.

the rami are equal with no accessory robust setae to the retinacula; the medial margin of the peduncle of the second uropod is without robust setae and the medial ramus bears a single, rather than two robust seta rows; the inner ramus of the third uropod is reduced and the outer ramus long and slender rather than phyllode-like. The telson of *Norcapensis* is cleft 90% rather than 100%, as in *Nedsia*.

The relationship of *Norcapensis* with the other hadzioid genus (*Brachina* Barnard & Williams, 1995) from Australian fresh waters is less close. The genus differs from *Brachina* in: mandibular palp is well developed; lower lip bears inner lobes; inner plate of first maxilliped is ovate, medially setose and pubescent; palp of maxilliped distofacially pubescent and inner plate basofacially pubescent; coxae reduced, all of about the same length; gnathopods and peraeopods 1 and 2 bearing long posterior setae on the second article, dactyls of peraeopods without nail; second article of third uropod elongate; telson slender, with few apical robust setae or setae, cleft 90% rather than 100%.

Norcapensis mandibulis n.sp.

Figs 1-4

Etymology. Named for the presence of well-developed mandibular palps.

Type locality. Underground water, Cape Range, North West Cape, Western Australia.

Material examined. Cape Range, Western Australia. HOLOTYPE (WAM 511-97) female "p" 10 mm, in type series; ALLOTYPE (WAM 512-97) male "t" 12 mm, 7 other female PARATYPES (WAM 513-97), Western Australia Museum: collection CR1989 3236, in gravel in freshwater pool in deep limestone cave, 22°07'S 113°59'E, collected by hand net, R.D. Brooks, 23 June, 1989. Other material: female "q" 10 mm (WAM 514-97), and 4 other females (WAM515-97); station CR1989 3241, in freshwater canal outflow of limestone cave, 22°09'S 114°00'E, collected by hand net, R.D. Brooks, 29 June, 1989; female "r" 9 mm (WAM 516-97) and 2 other females (WAM 517-97), station CR1989 3212, freshwater pool in deep limestone cave, 22°05'S 113°59'E, collected by hand

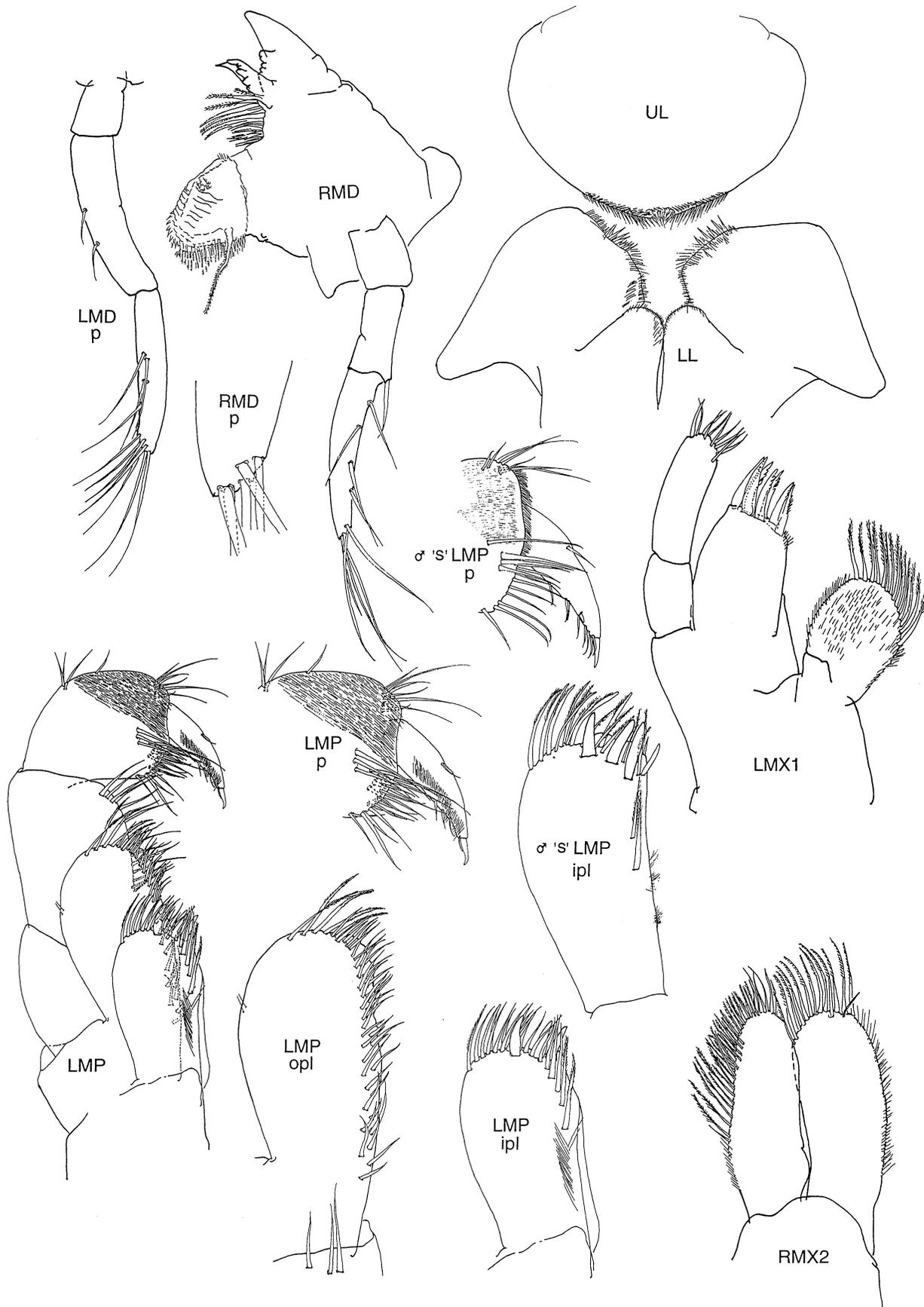


Fig. 2. *Norcapensis mandibulis* n.sp. holotype female "p"; mouthparts (all drawings except those indicated). Male "s" maxilliped inner plate and palp.

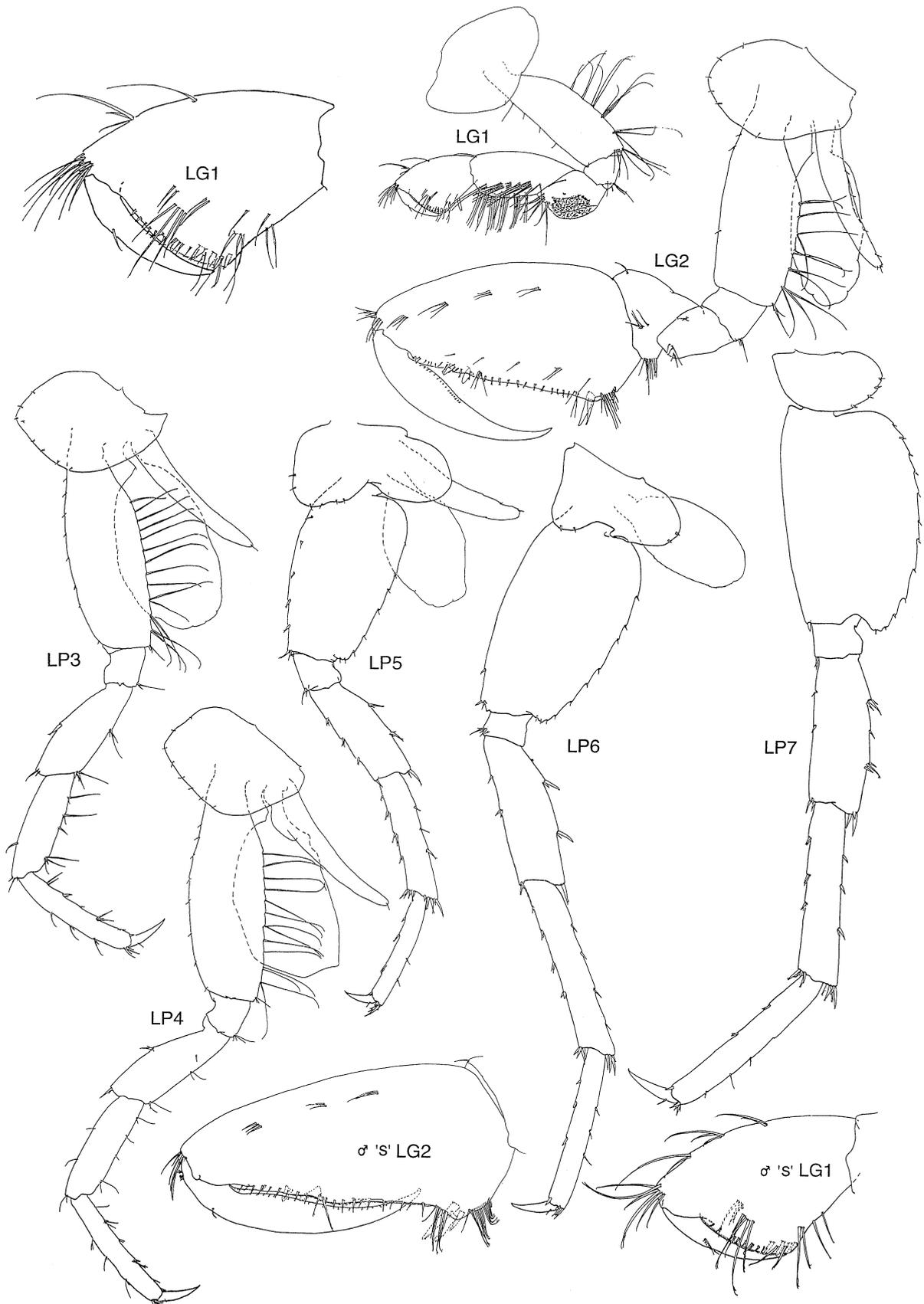


Fig. 3. *Norcapensis mandibulis* n.sp. holotype female "p"; legs (all drawings except those indicated). Male "s" propodus gnathopods 1 and 2.

net, B. Vine, 26 June, 1989; male "s" (WAM 518-97) and 8 females (WAM 519-97), station CR1989 3225, freshwater pool in deep limestone cave, 22°03'S 114°01'E, collected by hand net, B. Vine, 27 June, 1989.

Diagnosis. As in the genus.

Description of holotype (female "p"). *Body* (Fig. 1): urosome poorly armed dorsally, length 10 mm. *Head*: rostrum obsolescent, eyes absent. *First antenna* (Fig. 1): length about 0.7× body, 2.7× second antenna; flagellum longer than peduncle, of 26 articles; peduncle articles 1 and 2 approximately equal, 1 longest, 3 shortest, article 1 with few robust setae or setae, bearing a mediobasal group of three setae but no robust seta, setae sparse on articles 2 and 3; calceoli and aesthetascs absent; accessory flagellum two-articulate, small, second article tiny, extending to M0.5 on first article of primary flagellum. Primary flagellum articles uniform, sparsely setulate. *Second antenna* (Fig. 1): length 0.2× body, peduncle much longer than flagellum, articles 4 and 5 equally long, sparsely setulate, other articles with few setae or robust setae; flagellum short, 5-articulate, few setae, lacking calceoli. *Upper lip* (Fig. 2): symmetrical, ovate, apically pilose. *Lower lip* (Fig. 2): bi-lobed, outer lobes with spinous setae and pilia medially, inner lobes distally pilose. *Left mandible* (Fig. 2): palp three-articulate, ratio of articles 5:7:14, article 1 naked, article 2 linear, subequal to article 1 with two medial setae, article 3 sublinear lacking A or B setae, with 3C1D5E setae; incisor five-teeth, lacinia mobilis six teeth, molar with distal plumose seta and peripheral posterior pubescence. *Right mandible* (Fig. 2): similar, palp ratio of articles 5:13:13, article 2 bearing a single distal seta, setae of article 3 3CID7E. *First maxilla* (Fig. 2): left and right sides asymmetrical; inner plate ovate to round bearing fourteen plumose apical setae, covered in short pubescence; outer plate bearing seven denticulate terminal robust setae on the left side, ten on the right; palp article 2 terminating in ten long robust setae on the left, eight on the right. *Second maxilla* (Fig. 2): lateral edge of outer plate and basomedial margin of inner plate pubescent; outer plate terminating in 13 long plumose setae (the spinules being restricted to the medial face), and one short naked seta; inner plate bearing five long terminal setae, some naked robust setae mediobasal to distal, and many plumose medial setae extending mediobasally on the face. *Maxilliped* (Fig. 2): peduncle bearing three facial robust setae basal to inner plate; inner plate bearing a medial submarginal row of pubescence; palp article 3 with a row of medial robust setae progressing to submarginal/facial distally, a single distomedial robust seta basal to the dactyl, and two rows of subdistal facial robust setae; adjacent the apex a row of seven robust setae marginal to ventrofacial; distal face covered in non-organised fine setae. *First gnathopod* (Fig. 3): coxal plate with two small setae, one anterodorsal and one ventral; article 4 posteriorly bulbous, but not lobate, covered in short pubescence; article 5 subquadrate, not lobate, bearing clusters of slender robust setae; propodus trapezoidal, expanded apically, longer than wide, few posterior robust setae, cluster of eight robust setae terminally at dactyl base; palmar corner defined by four stout medial robust setae (the first three evenly spaced) and two slender lateral robust setae, palms convex, transverse to slightly oblique, setae along palm small, slender, mostly submarginal, row of fine robust setae proximal to corner; dactyls without medial spination, length short of palmar corner. *Second gnathopod* (Fig. 3): coxal plate broadly rounded, few anterior and one ventral setae; article 4 posteriorly expanded; carpus moderately lobate; propodus enlarged, 3× first gnathopod, ovate, longer than wide, with

a row of clusters of facial robust setae dorsally and ventrally; palm strongly oblique, palmar corner rounded, marked by a pair of moderately long, stout robust setae, robust setae along palm mostly small, with triggers, and a pair of distal stout, blunt robust setae; dactyl short of palmar corner, with a submarginal row of small trigger robust setae along the proximal edge. *Peraeopods* (Fig. 3): peraeopods 3–5 equal in length, longer than gnathopods; coxa 3 rounded, subquadrate, slightly broader than long, few marginal setae anteriorly and ventrally; coxa 4 similar, slightly broader, not posteriorly excavate; coxae 5–6 bilobed, small, irregular, coxa 5 without posterior setae, coxa 6 with two small posterior robust setae; coxa 7 lacking anterior lobe, with four small posterior robust setae. Peraeopods 3 and 4, article 2 with long, straight, distally curved posterior setae, articles 3 and 4 with few to moderate armaments, articles 5 and 6 with mixed robust setae and setae, the posterior robust seta formulae of articles 6 = 2s,sS,S,3s,S,S and s,3s,2s,2S,s,S with only single locking robust setae on each. Peraeopods 5–7, article 6 armaments few, articles 2–5 moderately spinose with strong apical spination on article 5, dactyls without accessory robust setae except for a single outer penicillate setule. *Gills*: those of coxae 2–6 flask-shaped, that of coxa 6 not reduced. *Oostegites*: present on coxae 2–5 and simple, strap like, poorly setose. *Pleopods* (Fig. 4): each bearing two retinacula with no accessory robust seta, rami equal in length; peduncle of second pleopod with three short median, one apicoposterior and one apical seta, basal articles of rami each with one seta; peduncle of pleopod 3 bearing one mid-median, one apicomedian, one apical and one short apicoposterior seta; rami with one to two setae on basal articles. *Epimera* (Fig. 4): 1 and 2, post-ventrally rounded, bearing five and three small robust setae respectively, epimeron 2 with one moderate anteroventral robust seta and one small mid-ventral robust seta; posterior margin of epimeron 1 slightly concave, epimeron three with small rounded extension posteriorly, one small post-ventral robust seta as well as four small to moderate ventromarginal robust setae, one post-dorsal and one posterior dorsolateral small setae. *Pleon*: pleonite 3 bearing single small posterior dorsal and dorsolateral setae; three small dorsal setae on pleonite 4, pleonites 4 and 5 bearing single dorsolateral setae on the posterior margin, pleonite 6 with small posterior robust setae paired dorsolaterally and single robust seta ventrolaterally. *Uropods* (Fig. 4): length of uropods relative to uropod 1—uropod 2 0.5×, uropod 3 1.8×. Uropod 1, peduncle length 1.2× inner ramus, basofacial robust seta present, and a moderate lateral row of 2-1-1-0-1 robust setae the last being subdistal, two small sublateral distal spurs, one large apicolateral robust seta and one large medial sub apical trigger robust seta; rami of subequal length, the inner being the longer, each with lateral and medial rows of two or three robust setae and a cluster of five terminal robust setae. Second uropod smaller than first, peduncle subequal to lateral ramus, bearing two apicolateral and one apicomedian robust setae; outer ramus 0.75× inner with two sparse rows of single marginal robust setae and four apical robust setae; inner ramus lateral robust setae absent, two medial robust setae, terminal cluster of five robust setae. Third uropod, strongly extended, 0.3× body, peduncle short, 0.25× length of article 1 of the outer ramus, bearing a small ventral robust seta at M0.4, a single ventrodorsal robust seta, paired mediobasal and laterodorsal short robust setae and a pair of short apicodorsal robust setae; inner ramus small, scale-like, 0.5× peduncle, naked except for a single ventrodorsal robust seta and a small distal seta; outer ramus elongate, 2-articulate, proximal article linear, sub rectangular, width to length ratio of 0.2, armed with marginal ranks of short robust setae and setae and a

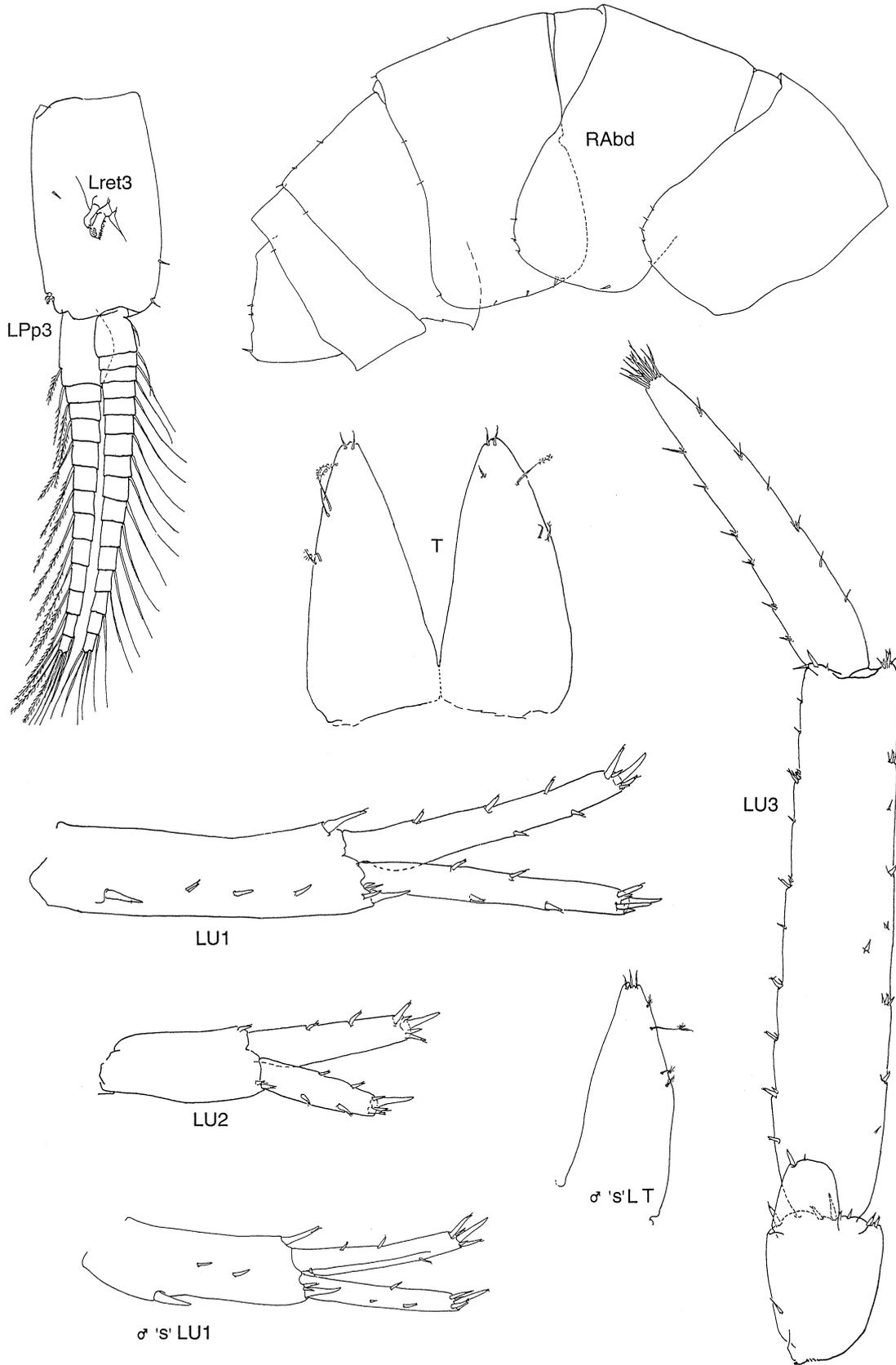


Fig. 4. *Norcapensis mandibulis* n.sp. holotype female "p"; abdomen, pleopod, uropods and telson (all drawings except those indicated). Male "s" left telson.

single facial robust seta at M0.5, a lateral apical cluster of two short robust setae and four setae, the medial apex bearing one robust seta and two setae, distal article 0.6× proximal, slender, similarly armed marginally, tapering from base to apex, terminating in a cluster of 12 slender robust setae. *Telson* (Fig. 4): length twice width, longer than urosomite three (75:60), cleft 90% of length, apices notched, two short marginally sub apical setae on either lobe, with one or two moderately long penicillate dorsal setae at M0.9 and short, paired dorsolateral penicillate setules at M0.7.

Description of allotype (male “t”). *Body*: length 12 mm. *Mandibles*: palps three-articulate, ratio of articles 5:10:12 (cf. 5:7:14 L or 5:13:13 R), setae of article 3 left 4C2D5E, right 1C1D4E. *Maxillae*: inner plate of first maxilla bearing 12 (cf. 14 in the holotype) plumose apical setae; palp article 2 terminating in long robust setae, 8L,7R (cf. 10,8). *Maxilliped*: peduncle bearing two (cf. 3) facial robust setae basal to the inner plate; inner plate with plumose mediolateral seta replaced with medium naked robust seta on L side palp article 3 apex with five rather than seven ventrofacial/marginal robust setae. *First gnathopod*: six anteroapical robust setae of propodus at base of dactyl (cf. 8). *Second gnathopod*: larger than gnathopod 1 3× (cf. 3.3×); defining corner of palm with three strong medial trigger robust setae, and marginally and laterally two long slender trigger robust setae, two similar but distally serrate, and one short slender robust seta distally serrate. *Peraeopods*: article 6 of peraeopods 3 and 4 with posterior robust seta formulae; peraeopod 3: s,2S,s,s2S,s,S and peraeopod 4: 2sS,2s,S,s,s. *Pleopods*: peduncles without setae except a single apicolateral seta on pleopod 2. *First uropod*: peduncle with lateral row of 1-1-0-1 robust setae (cf. 2-1-1-0-1), without small sublateral distal spurs; trigger present on the single apicolateral robust seta, but absent from the medial sub apical robust seta (cf. reverse in the type). *Second uropod*: peduncle bearing a single apicolateral robust seta (cf. 2), outer ramus short 0.7× inner (cf. 0.75). *Third uropod*: peduncle without short apicodorsal robust setae (cf. 2); inner ramus 0.6× peduncle (cf. 0.5) bearing a pair of small distal setae (cf. 1); outer ramus proximal article bearing a lateral apical cluster of three robust setae and three setae (cf. 2&4) the medial apex two robust setae and two setae (cf. 1&2). The distal article terminating in 11 slender robust setae (cf. 12). *Telson*: apices with a single notch, three short, subapical setae on either lobe; plumose dorsal setae at M0.5, 0.6, 0.8; single dorsolateral penicillate setules at M0.7.

Description of other material. Specimen “q”, female. *Body*: length 10 mm. *First antenna*: flagellum of 30 articles. *Mandibles*: ratio of lengths of articles of left palp 5:12:11 (cf. 5:7:14), second article not reduced, longer than article 1; setae of article 3 3C2D5E; lacinia mobilis with four teeth, ratio of lengths of articles of right palp 5:10:9.5, setae of article 3 4C1D5E. *Maxillae*: inner plate of first maxilla bearing 13 apical plumose setae, right outer plate bearing 11 denticulate terminal robust setae; outer plate of second maxilla terminating in 12 long plumose setae; inner plate of second maxilla bearing one long terminal seta and many short, curved setae. *Maxilliped*: palp inner plate without facial pubescent row, several distomedial robust setae basal to dactyl and five robust setae adjacent the apex. *First gnathopod*: coxal plate bearing eight small setules; three anterodorsal, one apical, and four ventral. *Second gnathopod*: corner of palm marked by one lateral and two medial robust setae; palmar robust setae include three rather than two stout, blunt distal robust setae. *Peraeopods*: coxa of peraeopod 5 bearing four small submarginal and ventral posterior setae; posterior robust seta formulae of

articles 6 of peraeopods 3 and 4 2sS,S,s2S,s,S and s2S,S,s2S,s,S respectively. *Uropods*: lengths of uropods relative to uropod 1; uropod 2 0.6×, uropod 3 2.1×; length of peduncle of uropod 1 1.1× inner ramus; with lateral row of 1-1-1-1 robust setae; outer ramus of second uropod bearing five apical robust setae; lateral robust setae present on inner ramus, and one medial robust seta. Peduncle of uropod 3 with two small ventral robust setae at M0.4, three mediolateral and laterodistal short robust setae, and three apicodorsal robust setae; medial apex of outer ramus bearing two robust setae and three setae. *Telson*: apices bearing a single notch, a single terminal robust seta within the notch, displaced laterally, submarginal robust setae at M0.5 and M0.7, long penicillate setules at M0.9 and short single penicillate setule at M0.7.

Specimen “r”, female. *Body*: length 9 mm. *Mandibles*: ratio of articles of palp; 5:12:12, setae of article 3 of left palp 2C3D5E of right palp 3C1D6E; left lacinia mobilis with four teeth (cf. 6). *Maxillae*: inner plate of first maxilla bearing 12 plumose setae, palp article 2 terminating in eight robust setae (cf. 10). *Maxilliped*: peduncle bearing two facial robust setae basal to inner plate; palp with row of five robust setae adjacent the apex. *First gnathopod*: coxa bearing a distal marginal row of six setae, two ventral to the apex, four dorsal; corner of palm defined by two stout medial bifid robust setae (cf. 4) and two slender lateral robust setae. *Second gnathopod*: palm with a single stout, blunt distal robust seta (cf. 2). *Uropods*: uropod 1 peduncle with 0-0-1-1-2 robust setae in lateral row, rami with lateral and medial rows of 1-2 robust seta (cf. 2-3). second uropod; two apicolateral robust setae of peduncle displaced medially, outer ramus with a sparse row of marginal robust setae, inner ramus with one medial robust seta; uropod 3 peduncle without small ventral robust seta at M0.4; inner ramus small, 0.65× length of peduncle, bearing two rather than a single distal seta; proximal article without facial robust seta at M0.5; lateral apical group of two robust setae and three setae; distal article 0.5× proximal (cf. 0.6). *Telson*: apices notched unevenly, one notch displaced laterally, retaining two short marginally sub apical setae on both sides, but with single short penicillates at M0.9

Specimen “s”, male. *Body*: length 10 mm. *First antenna*: flagellum of 28 articles (cf. 26). *Mandibles*: palp ratio of articles 5:10:12 (cf. 5:7:14), article 2 naked, incisor of left mandible with six teeth (cf. five), setae of right palp; 2C2D4E. *First maxilla*: inner plate bearing 11 plumose apical setae (cf. 14); left outer plate bearing five terminal robust setae (cf. 7). *Maxilliped* (Fig. 2): peduncle bearing two (cf. 3) facial robust setae basal to the inner plate; inner plate plumose mediolateral seta replaced with medium naked robust seta on left side; palp article 3 apex with five rather than seven ventrofacial/marginal robust setae. *First gnathopod* (Fig. 2): coxal plate with several small submarginal anterior setae rather than one anterodorsal and one ventral seta; propodus with nine rather than eight robust setae in a terminal cluster at the base of the dactyl. *Peraeopods*: coxal plate five bearing a single small posterior seta; coxa 7 with three small posterior robust setae (cf. 4); peraeopods 3 and 4, articles 5 and 6 with posterior robust seta formulae 2sS,S,s2S,s,S and S,sS,s2S,s,S. *Epimera*: posterior margin of epimera 1 bearing three mid-lateral to dorsal small setae; epimeron three with small post-ventral notch, three rather than four ventral marginal robust setae. *First uropod*: peduncle with 1-1-1-0-1 lateral row of robust setae, no sub marginal lateral distal spurs. *Second uropod*: peduncle bearing one apicolateral robust seta and a single medial robust seta on the inner ramus. *Third uropod*: peduncle with single (cf. paired) mediolateral

and laterodistal short robust setae and a single short apicodorsal robust seta (cf. 2); outer ramus without facial robust seta at M0.5, but with five rather than three robust setae at the medial apex: distal article short (perhaps regenerate) $0.28 \times$ proximal, with few marginal armaments, terminating in a cluster of eight (cf. 12) slender robust setae. *Telson* (Fig. 4): apices with single rather than paired notches bearing single setae; single dorsolateral setae at M0.6, M0.7 and M0.9. *Penis*: paired penial processes laterally on sternum adjacent coxal plates of P7.

Distribution. Cape Range, North West Cape, Western Australia.

Neoniphargidae Bousfield, 1977

The family Neoniphargidae was established by Bousfield (1977). It was subsequently redefined by Bousfield (1982) and by Williams & Barnard (1988) who reduced it to one of entirely Australian content. In their redefinition, Williams & Barnard (1988) eliminated several earlier characters, but introduced two new and significant ones: dendritic sternal gills, and rugosities on gnathopods and maxillipedal palps. Gnathopodal and maxillipedal rugosities were recognised as characters common to all known neoniphargids. Bousfield (1977, 1982) had earlier recognised dendritic gills as a frequent, but not obligatory, character. However, Williams & Barnard (1988) foreshadowed further familial emendment stating (p. 115f) "... we recognise the case for a more formal re diagnosis of the Neoniphargidae—but—given the likelihood of discovery of further neoniphargid species in Australia (and thus familial emendation), we do not consider it appropriate to do this at present."

We describe herein two new genera (*Neocrypta*, *Wombeyanus*) and seven new species. All of these we consider to be neoniphargids. However, they do not exactly fit the family diagnosis as outlined by Williams & Barnard (1988) in so far as they do not bear dendritic sternal gills. Furthermore, in addition to these new genera and species we possess numbers of both epigeal and hypogean species from Tasmania, Victoria, and New South Wales, yet to be described, which also have simple gills but which are otherwise undoubted neoniphargids. In a separate study (Bradbury, *et al.*, in press), we confirm the taxonomic significance of gnathopodal and maxillipedal rugosities as definitive diagnostic markers for the family. These rugosities are found on the new species as well as all known neoniphargids.

We believe that a definitive family diagnosis is not possible at this stage of knowledge of Australian neoniphargids. However, it is clear that for practical purposes some further emendation is appropriate even now. Accordingly, the family Neoniphargidae is redefined, taking into account the earlier works of Bousfield (1977, 1982) and Williams & Barnard (1988), the characters of known species, and those displayed by new genera and species described in this report: antennal sinus of head weak or absent; molar of mandible well developed, triturative; outer plate of maxilla 2 with one kind of seta apicolaterally; outer plate of maxilliped of ordinary size; rugosities present on maxillipedal palp and

gnathopods; gnathopods small or of medium size, almost mittenform, first not dominant, carpi short and post-ventrally lobate or bearing keel, propodi attached to carpi normally, robust setae on palms not of bifid crangonyctoid form; posterior lobes of coxae 5–7 dominant; oostegites narrow to broad; sternal gills 2–6 present; urosomites separate; inner ramus of uropod 3 present as well as short article 2 of the outer ramus; telson cleft, with few robust apical setae, lobes truncate, apically notched.

No previously described neoniphargids are confirmed troglobites. Differences observed among the new species we report here, including morphological modifications such as loss of eyes and attenuation of bodies, are characteristic of troglobites (Holsinger, 1994a). Exclusion from the family definition of characters such as body form and possession of eyes (Williams & Barnard, 1988), previously included by Bousfield (1977, 1982), is therefore supported. Bousfield (1982) defined the third uropod as short; we find the third uropod long in several species, considering it an adaptation to troglobitic habit (Holsinger, 1994a). However, it is noted an inner ramus is always present, and that the outer ramus always bears a second, albeit small, article. These conditions of the character are noted. Simplification of sternal gills has not been attributed to troglobitic adaptation, yet reduction of dendritic to "incipiently dendritic" gills has been observed in the troglomorphic *Wesniphargus nicholli* (Straškraba); the troglobitic *W. yanchevi* n.sp. and *Jasptorus solepti* n.sp., both bearing lumpy or "incipiently dendritic" sternal gills, are reported here. Furthermore, the sternal gills of even *Neoniphargus* are not wholly dendritic; anterior gills are simple, and fully dendritic sternal gills occur only on the more posterior sternites. Bousfield (1982) considered dendritic gills frequent rather than obligatory among neoniphargids, thus we remove the dendritic condition as an essential familiar character. The telson of some new species described here is cleft less (14–20%) than among previously known neoniphargids (50–75%), which Bousfield (1982) considered significant. However, the telson of these new species is otherwise similar, with truncate, notched lobes, few apical robust setae, and a pair of dorsal setae in most cases; certain characters of the telson are taken into account.

Neocrypta n.gen.

Etymology. Named for the family, and for the cryptic habit of the genus.

Type species. *Neocrypta primaris* n.sp.

Diagnosis. Pleonites with weak dorsal arms; rostrum small; lateral cephalic lobes weakly to moderately projecting; antennal sinus weak to moderate; eyes absent. First antenna: elongate, longer than second antenna, ratio of lengths of peduncular articles 10:9:5 to 10:13:8, accessory flagellum two-articulate, calceoli absent. Second antenna: peduncle and flagellum without calceoli. Mandibular palp; ratio of articles 8:11:12 to 8:18:17, article 2 naked, article 3 weakly falcate to linear, setae DE, rarely CDE. Labium without inner lobes. Maxillae inner plates not setose medially; first maxilla inner plate

ovatotriangular with two, rarely three apical plumose setae, the outer plate with seven robust setae, the palps asymmetric—left side with thin apical robust setae, the right side broad, with thick apical robust setae, not fused to the article; second maxilla inner plate with no oblique row of facial setae, but upper member of 1–2 main medial setae slightly submarginal, or not. Maxillipedal palp article 3 with a rugose apical lobe. Coxae 1–4 elongate, sparsely to moderately setose ventrally; coxae 1–3 lacking a posterior row of robust setae; coxa 1 weakly tapering below or not; coxa 4 with shallow emargination; coxa 5 much shorter than coxa 4. Gnathopods small, sexual dimorphism minor, carpi short and lobate, articles 2–4 both with or without a posterior rugose lobe, palms slightly oblique and convex, bearing rugosities, three robust setae at the palmar corner, occasionally four, robust setae along palm sparse to moderate, without triggers, dactyls with stiff spinules at inner nail articulation, with additional spinules along inner dactyl margin. Peraeopods 5–7 moderately elongate, subequal, article 2 broadly expanded, ovate, and weakly to moderately post-ventrally lobate. Peraeopods 3–7 with one marginal and one facial dactylar setules. Coxae 2–6 with sac like gills; sternites 2–6 bearing simple gills without dendricities or lumps. Pleopods reduced; rarely the outer ramus of moderate length and article number, most with one, rarely two articles on the inner ramus, with no or one marginal setae, and two terminal setae, and reduced numbers of articles on the outer ramus; peduncles each with two retinaculae, no accessory retinaculae. Epimera postventral tooth short or absent, some with facial robust setae near the vent margin, posterior margins weakly setulate. Peduncles of uropods 1 and 2 with one subapical robust seta on the apicomedial corner, of moderate length, not long with a complex tip. Basofacial arms absent from the first uropod, rami of both uropods extending unequally, their margins variably spinose, the inner rami usually with one robust seta row, the outer rami one or two rows, never with dense spination. Third uropod strongly extended, parviramous, the peduncle short, outer ramus 2-articulate, the second article very short, the first article without setae, the inner ramus reaching to M0.13 or less of article 1 of the outer ramus. Telson moderately long, cleft 11–20%, the lobes basolaterally weakly tumid with apical and in some mid lateral spination, no major setation or basofacial armaments, paired lateral penicillate setules at M0.6 on either lobe.

Additional description. Upper lip uniform, rounded but weakly asymmetrical below. Mandibular accessory blades (rakers) usually with interraker plumose setae. Very few additional penicillate setae beyond rakers riding onto the base of the molar, rather two to four basal molarial ragged setae. Lower lip uniform, inner lobes indistinct or absent, second maxilla—both plates with long apical setae. Maxillae inner plates and the lateral margins of the second maxilla moderately pubescent. Maxilliped inner plate with few distal plumose setae, two or three blunt naked robust setae, few or no medial plumose setae. The outer plate with a distal row of few plumose setae continuous with a distal row of blunt naked tooth like robust setae. Palp articles 2 and 3 poorly setose laterally, well to moderately setose medially, article 3 with a few non comb robust setae near the base of the dactyl. Dactyls of gnathopods with or without recumbent inner tooth like robust seta with stiff spinules or setules at the inner nail articulation, sometimes with additional spinules along the inner dactylar margin. Pleopods similar, peduncles not strongly setose, rami diverse, inner ramus strongly reduced. Urosomite 1 without an articulated ventrodistal robust seta at the base of the first uropod.

Relationship. The new genus *Neocrypta* is most closely related to *Neoniphargus* (Stebbing), but differs in the following: eyes are absent; the first article of the mandibular palp is relatively long, the second is naked, the third without A or B setae; coxae 1–4 are not as long, and coxa 4 less deeply emarginate; gnathopodal palmar robust setae are simple; thoracic segments 2–6 bear simple rather than dendritic sternal gills; the inner ramus of the pleopods is reduced to one or two articles; the third uropod extends beyond uropods 1 and 2 in the intact specimen and is up to 1.5× the length of the first uropod; the telson is cleft to 20% rather than to 50–75%. As well as in the above characteristics, *Neocrypta* differs from *Wesniphargus* (Williams & Barnard) in that rugosities are borne on propodi of both gnathopods, from *Tasniphargus* Williams & Barnard as antennae bear only short, sparse setae, and the basal articles of the primary flagellum of antenna 1 are short, and from *Yulia* Williams & Barnard in that the pleopod peduncles are not strongly setose, and the outer ramus of male uropod 1 does not bear a long apical spur.

Neocrypta primaris n.sp

Figs 5–9

Etymology. From Latin, *primordius*, the first or most primitive, referring to the type species of the genus and apparently the most plesiomorphic.

Material examined. HOLOTYPE (Australian Museum P51361) female “a” 6.5 mm, ALLOTYPE (Australian Museum P51362) male “c” 6.5 mm. Others in the type series: female “b” 7 mm, and five other specimens. Collected 8 March, 1995 by S. Eberhard from among tree roots in a pool, Limekiln Cave (cave WE14) Wellington, New South Wales, 32°33'S 148°57'E.

Diagnosis. Lateral cephalic lobes moderately projecting, antennal sinus moderate, ratio of lengths of peduncular articles of first antenna 10:12:8; ratio of lengths of mandibular palp articles 8:11:12 to 8:13:14, article 3 linear, setae (C)DE, the inner plate of the first maxilla with two plumose apical setae, inner plate of the second maxilla with two mediobasal submarginal plumose setae. Coxa 1 tapering apically, second article of the first gnathopod and second and third articles of the second gnathopod without posterior rugose hump, robust setae at palmar corner 4–3 respectively, palmar robust setae sparse to moderate, peraeopod 6 longer than seven, articles 2 of legs 5–7 moderately postventrally lobate. Outer rami of pleopods moderately long, inner rami strongly reduced, of one article, with few marginal setae. Epimera without postventral teeth, with facial robust setae on the first and second. Uropods 1 and 2 with no more than one robust seta row on rami, inner ramus of third uropod reaching m0.1 of the outer ramus. Telson cleft 16%, with mid lateral spination.

Description of holotype (female “a”). *Body* (Fig. 5): pleon with few dorsal armaments, pleonite 5 with two mid dorsolateral robust setae, six with one posterodorsal robust seta basal to the telson; length 6.5 mm. *Head*: rostrum small, eyes absent. *First antenna* (Fig. 5): length 0.58× body, 2.2× second antenna, peduncle shorter than flagellum, ratio of article lengths 10:12:8, setae sparse, flagellum of 26 articles, aesthetascs present on articles 3–25, flagellar segments uniform,

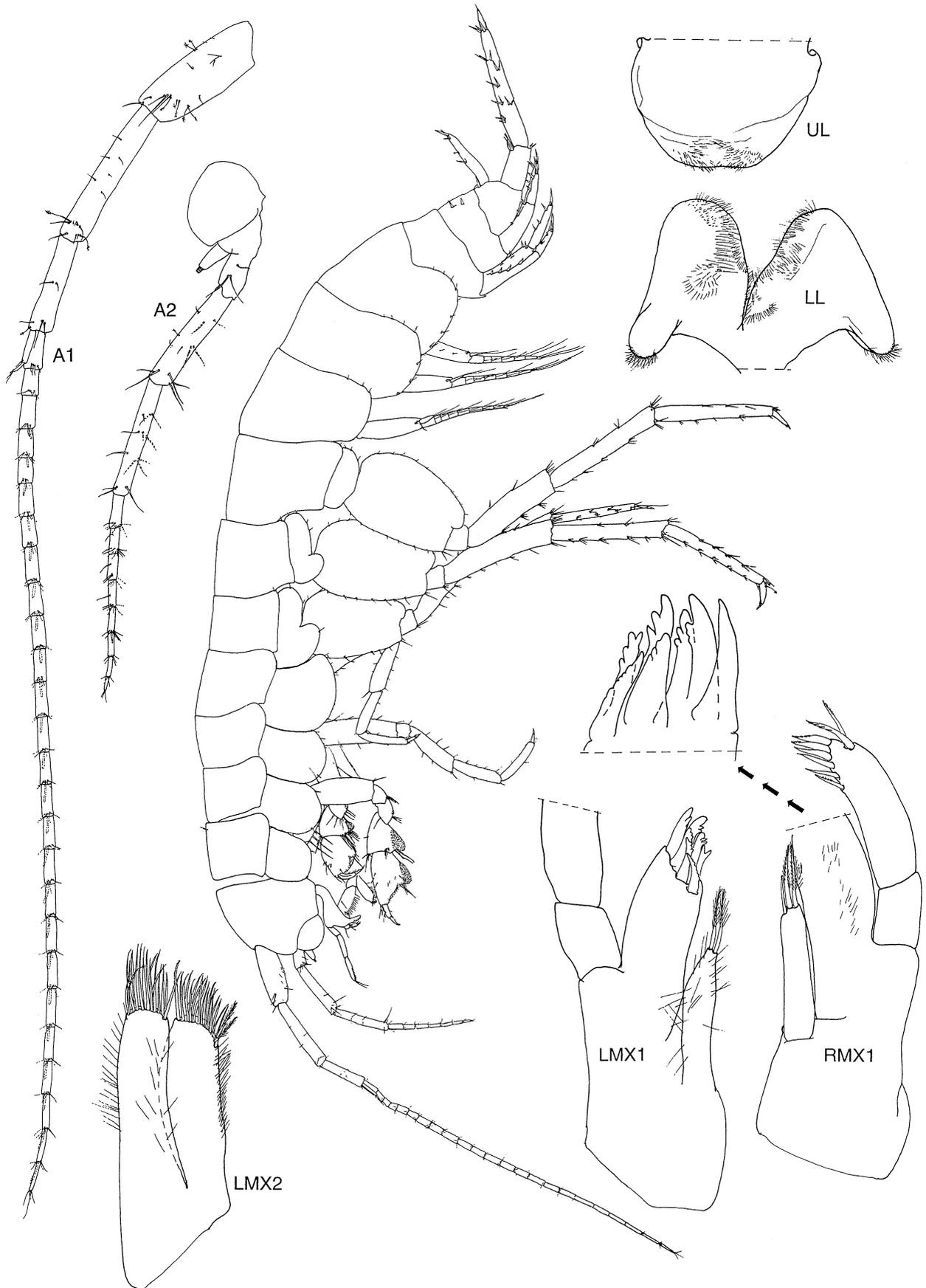


Fig. 5. *Neocrypta primaris* n.sp. holotype female "a"; body, antennae, mouthparts.

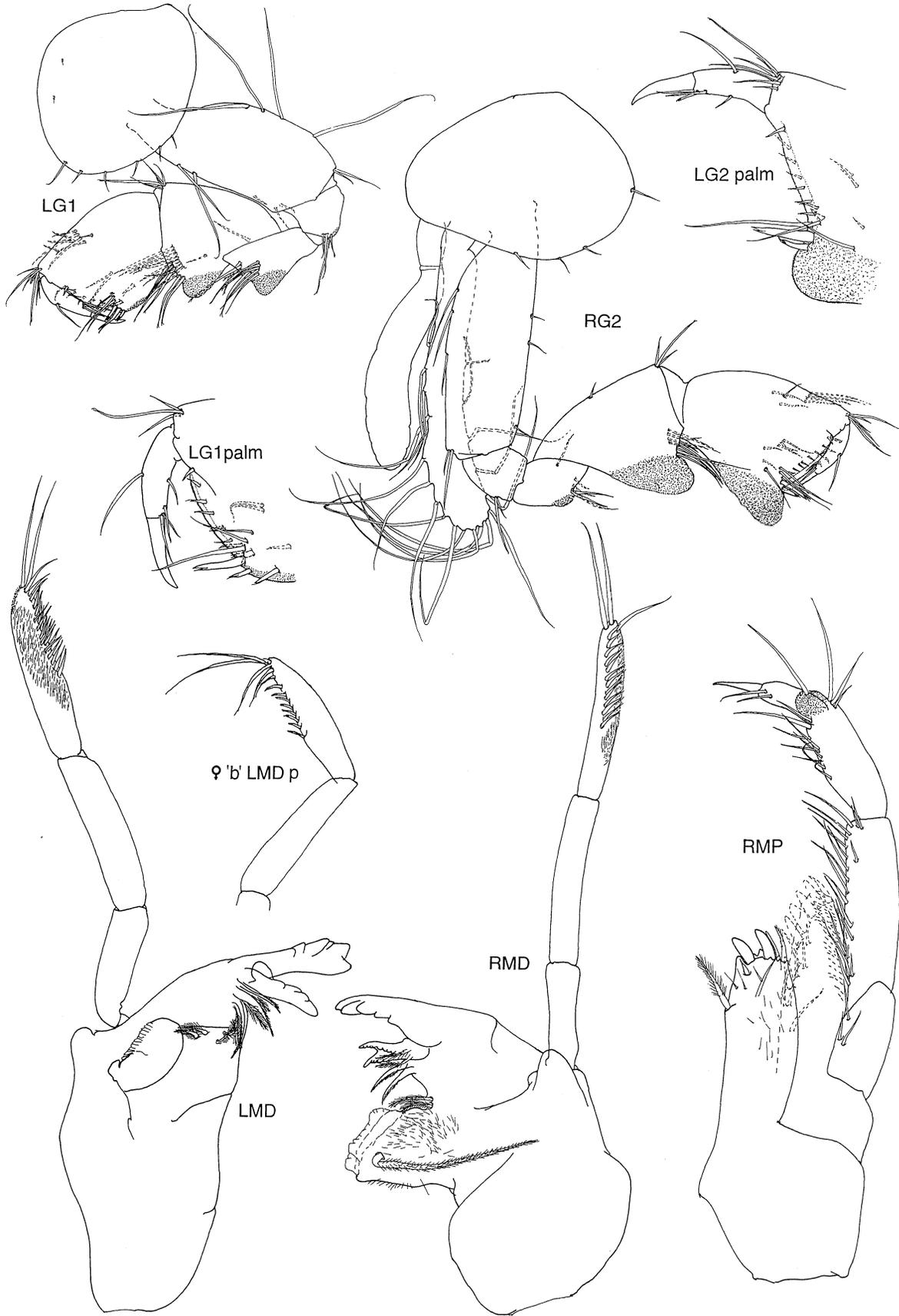


Fig. 6. *Neocrypta primaris* n.sp. holotype female "a"; mandibles, maxilliped, gnathopods (all drawings except those indicated). Female "b" left mandibular palp.

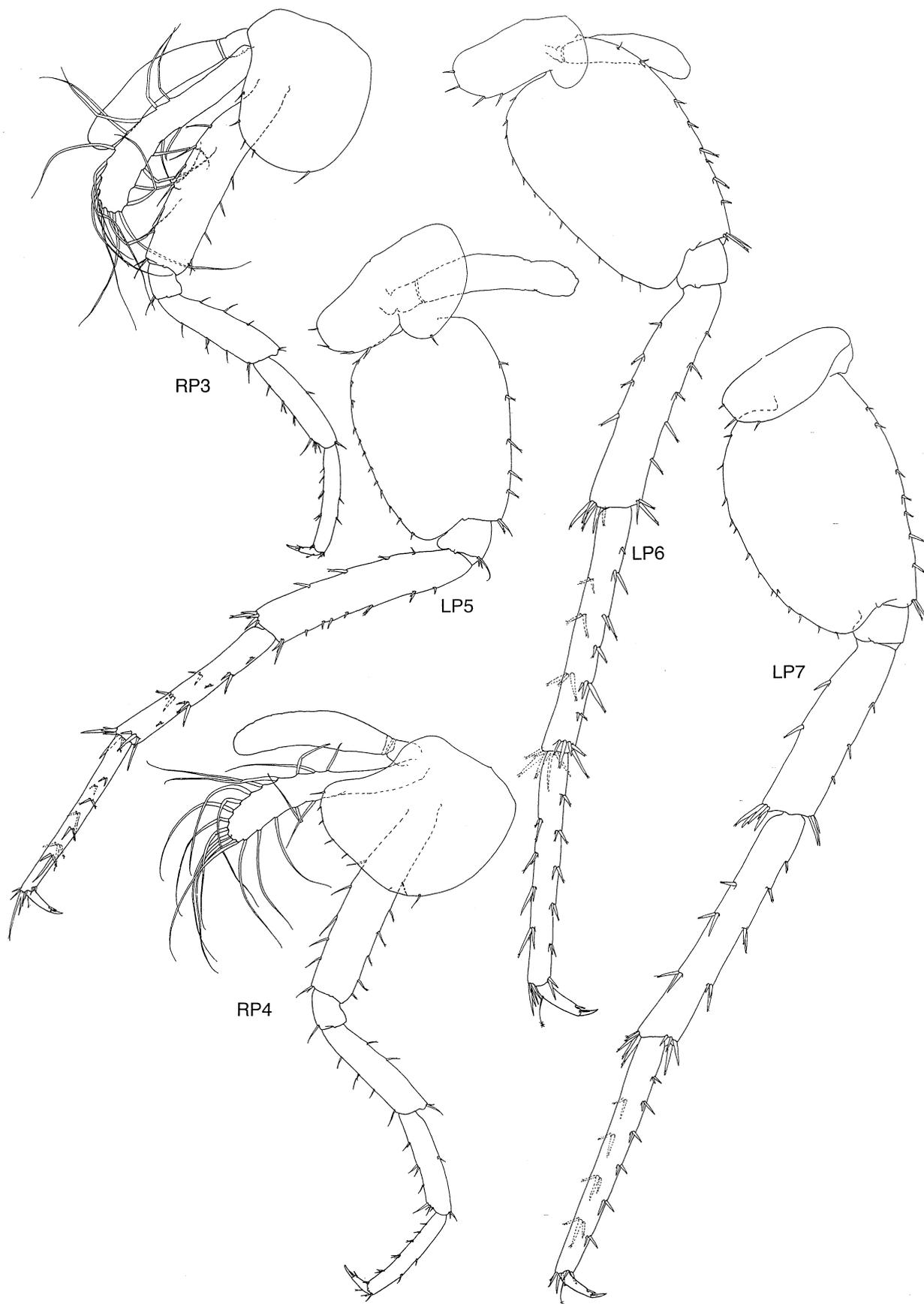


Fig. 7. *Neocrypta primaris* n.sp. holotype female "a"; peraeopods.

sparsely setulate; accessory flagellum 2-articulate, reaching to M0.5 of the second primary flagellum article. *Second antenna* (Fig. 5): length $0.3 \times$ body; peduncle $1.9 \times$ flagellum, articles 4 and 5 subequal (20:25), articles 3–5 with moderate ventral setation; flagellum of eight articles, weakly setose ventrally, aesthetascs absent. *Left mandible* (Fig. 6): palp article 3 longer than 2, ratio of lengths of articles 8:11:12, article 3 linear, facially and apically rugose, setae 5C14D3E, articles 1 and 2 naked; incisor with six teeth; lacinia mobilis four teeth; accessory blades of three chisel robust setae and three plumose robust setae, four brushy setae onto the base of the molar; molar triturate without a posterior seta. *Right mandible* (Fig. 6): palp article 3 with setae 13D3E, laterofacially rugose; incisor with five teeth; lacinia bifid, denticulate; accessory blades of two chisel robust setae and two plumose setae, two plumose robust setae onto the molar base; molar triturate with a long posterior pappose seta. *Maxillae* (Fig. 5). Left first maxilla: palp article 2 with a row of two naked and one armed mediobasal slender robust setae and three armed transverse apical robust setae; outer plate with seven apically denticulate robust setae; inner plate with two apical plumose setae. Right first maxilla: palp article 2 with a mediobasal row of six strong robust setae, naked and armed, and two laterodistal submarginal armed robust setae; the outer plate with seven mostly denticulate robust setae; inner plate with two apical plumose setae and a moderate, simple sub apical seta. Second maxilla: outer plate with one mediobasal naked seta, inner plate apicomedial corner with two weakly submarginal plumose setae. *Maxilliped* (Fig. 6): palp article 3 without inner ventral setae, moderately setate distomedially, three distolateral setae, two setae basofacial to the dactyl and two accessory spinules on the dactyl, apex moderately produced and rugose; inner plate apex with two thick tooth like robust setae, one distolateral armed and one simple seta, a short stout sub marginal, sub distal seta and one medial plumose seta. *Gnathopods* (Fig. 6): coxal plate of first gnathopod broad, apically tapering, with sparse moderate apical setae; article 2 without posterior rugose extension; article 3 with a small posterior rugose hump; articles 4 and 5 with strong posterior rugose lobes; carpus short, lobe rounded, without apical setae; propodus trapezoidal, as wide as long, the posterior angle sub quadrate with a barely expanded posterior rugose area, palmar corner robust setae one medial, three lateral, palmar robust setae moderate, simple; dactyl with accessory spinules on the inner margin, reaching beyond palmar corner robust setae. Second gnathopod: larger than the first; articles 2 and 3 without posterior rugose enlargement; article 4 with a small rugose lobe; carpus and propodus with strong posterior rugose lobes larger than on gnathopod 1; palmar corner marked by one medial and two lateral robust setae, palmar robust setae moderately crowded, simple; dactyl with inner marginal accessory setules and small facial setules, reaching the palmar corner robust setae; coxa weakly setose apically, bearing a long sac like gill and long slender setose oostegite. *Peraeopods* (Fig. 7): coxa 3 with three small apical, and two moderate posterior setae, bearing a long sac like gill and long narrow setose oostegite; coxa 4 moderately emarginate with few apical setae; peraeopods 3 and 4 subequal in length, longer than the second gnathopod, articles 4 and 5 moderately setose posteriorly, articles 6 with robust seta formulae 1-1-3-2 and 1-1-2-3-2 respectively; peraeopods 5–7 similar, 6 and 7 subequal, longer than five, coxae with 4-3-4 weak robust setae on the ventral margin of the posterior lobe, coxae 5 and 6 with moderate sac like gills, articles 2 expanded posteriorly ($5 < 6 < 7$) and moderately lobate postventrally, with weak posteromarginal setae; propodi posterior margins lacking long

setae except for a long basodactylar seta on leg five. *Gills* (Fig. 8): coxae 2–5 bearing sac like gills; sternites 2–6 each with paired simple gills. *Epimera* (Fig. 8): without postventral teeth, posterior margins slightly to moderately convex with weak setation, ventral margins of epimera 2 and four with three and seven facial robust setae respectively. *Pleon* (Fig. 8): pleonites 1–4 with no arms; pleonite 5 with a strong pair of dorsolateral robust setae; pleonite 6 with a single dorsal robust seta basal to the telson. *Pleopods* (Fig. 8): peduncles each with two retinacula; peduncle 1 with a small distal seta basal to the rami; peduncle three with two laterodistal setae; outer rami of pleopods moderately long with 11, 10, 9 articles, inner rami reduced to single articles, only the first ramus with a marginal seta. *Uropods* (Fig. 8): third uropod long, extending well beyond first and second uropods in the intact specimen; uropod lengths relative to uropod 1; uropod 2 $0.8\text{--}0.9 \times$, uropod 3 $1.9 \times$. First uropod peduncle length $1.3 \times$ inner ramus, $2.3 \times$ outer ramus; the outer margin with one slightly subapical distal robust seta and a dorsal row of five robust setae, the inner margin with three short dorsal robust setae and one sub apical robust seta; inner ramus length $1.9 \times$ outer ramus, with two medial and four apical robust setae, outer ramus with four apical robust setae only. Second uropod: left peduncle with a row of two short dorsolateral robust setae and one sub apical robust seta, the inner margin with one sub apical robust seta; right peduncle with an outer marginal row of four short robust setae and one sub apical distal robust seta, the inner margin with only a sub apical distal robust seta; inner ramus length $1.2 \times$ outer, with two medial and four apical robust setae; outer ramus with one lateral robust seta and four apical robust setae. Third uropod: peduncle length $0.3 \times$ outer ramus, greater than the length of urosomite three, without facial robust setae, with one distolateral robust seta and one distomedial robust seta basal to the inner ramus; proximal article of outer ramus with five lateral transverse rows of 1-2-2-2-2 robust setae and six medial transverse rows of 1-1-2-2-1-2 robust setae and three medial and three lateral distal robust setae; distal article with two small apical setules only; inner ramus with a single apical robust seta, length $0.09 \times$ outer ramus. *Telson* (Fig. 8): moderately long, $1.7 \times$ urosomite three, cleft 16%, apices of lobes bearing three right and four left setae, two robust setae laterodorsally at M0.4, paired lateral penicillate setules at M0.6, and small setules on the dorsal face.

Description of allotype (male “c”). *Body*: length 6.5 mm. *First antenna* (Fig. 9): peduncle article 2 longest, ratio of lengths of articles 10:12:8; primary flagellum of 25 articles, all bearing aesthetascs, articles 2, 5, 7, 9, 11 each with two distal aesthetascs, article 4 with three. *Second antenna*: flagellum of seven articles, without aesthetascs. *Mandibles* (Fig. 9): left and right palps similar; naked except for apical setae and rugosities, ratio of lengths of articles 8:14:13, setae of third article 8D4E. Left incisor, lacinia mobilis, accessory blades similar to holotype, molar with one anterior plumose seta, two brushy setae leading to the molar and a moderate posterior pappose seta. Right mandible incisor with five teeth, accessory blades of three chisel robust setae and two plumose setae, with three plumose setae leading to the base of the molar. *First maxilla* (Fig. 9): left palp with four slender armed transverse apical robust setae and two distomedial simple slender robust setae; right palp with four slender distomedial robust setae, and apical slightly stouter distally armed robust seta, and two slender laterodistal armed robust setae; inner plate of both first maxillae with two apical plumose setae. *Second maxilla* (Fig. 9): outer plate with two subdistal lateral

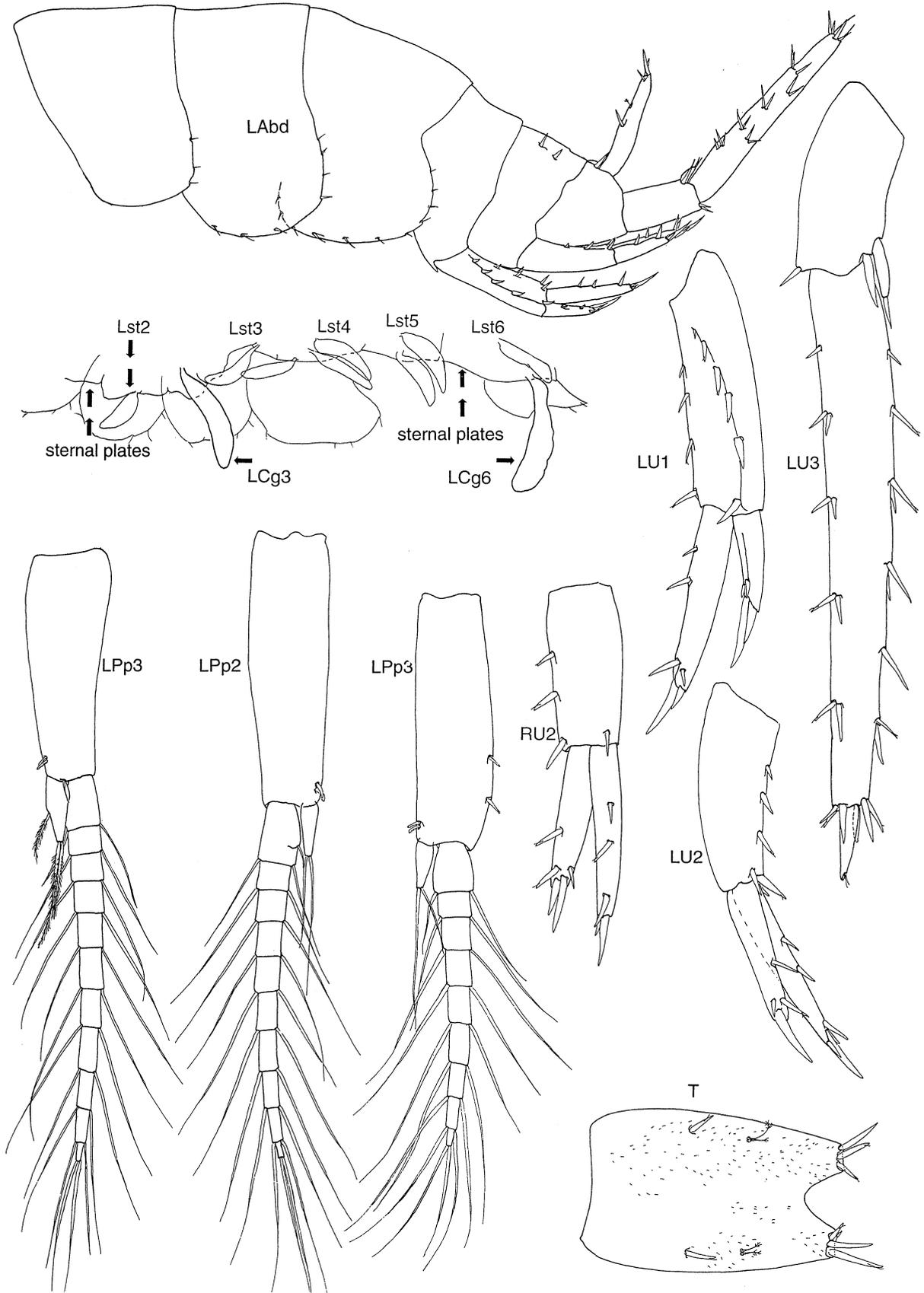


Fig. 8. *Neocrypta primaris* n.sp. holotype female "a"; abdomen, gills, pleopods, uropods, telson.

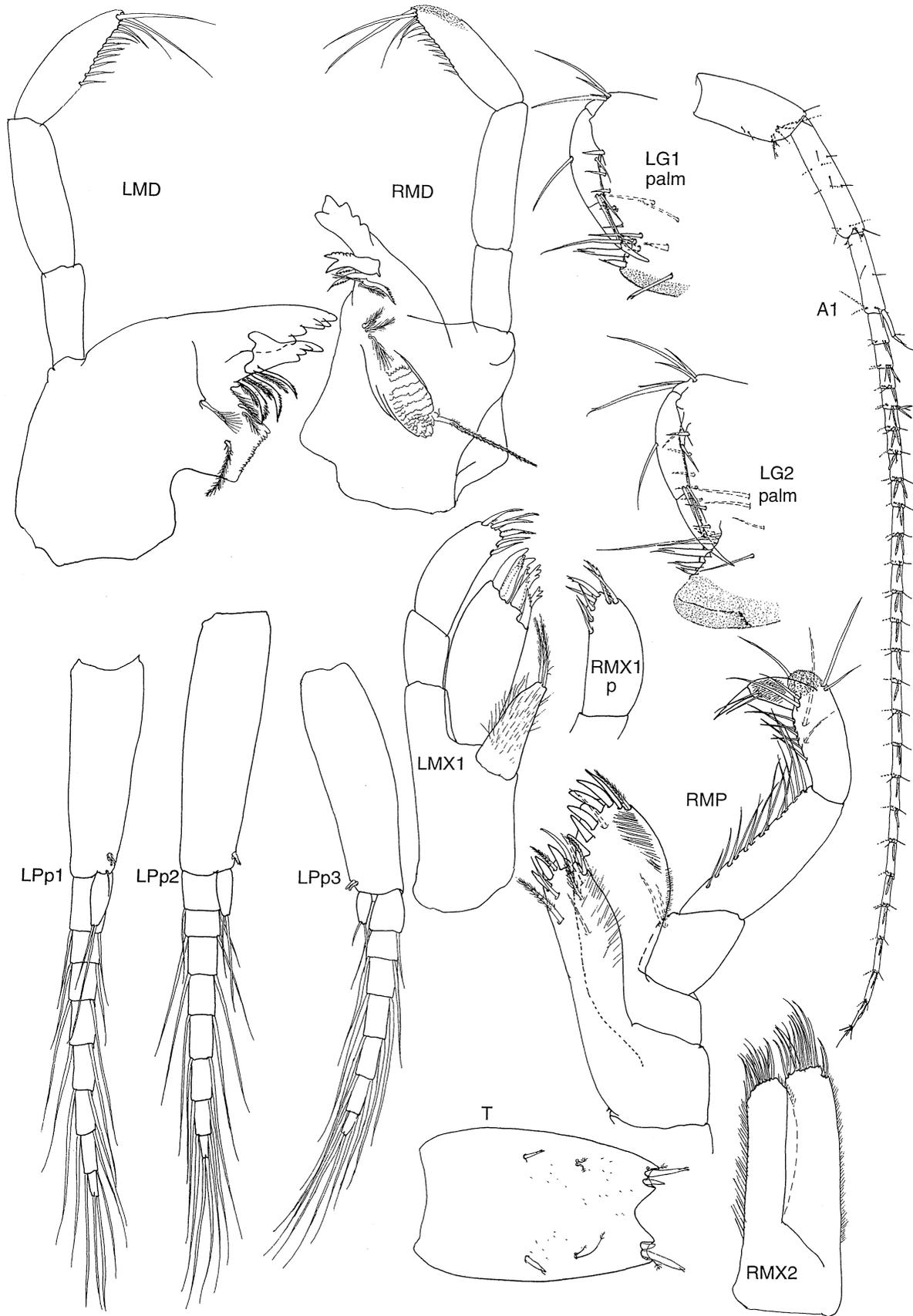


Fig. 9. *Neocrypta primaris* n.sp. allotype male "c"; first antenna, mouthparts, pleopods, telson.

short robust setae, inner plate without two weak submarginal apicomedial plumose setae. *Maxilliped* (Fig. 9): outer plate medial submargin with a row of simple and plumose setae; mid medial to apical face a row of five long naked tooth like robust setae; distolateral margin with slender robust seta and plumose seta. *Pleopods* (Fig. 9): peduncles without arms except a small simple seta basal to the inner ramus on the first pleopod; inner rami each of one article; outer rami of 8, 8, 7 articles. *Telson* (Fig. 9): length 1.5× width; cleft 9%; apices each with one short medial and one longer lateral robust seta and a single lateral penicillate setule; dorsolateral robust setae at M0.4; paired penicillate setules on each side at M0.7; the distodorsal surface with scattered very small setules.

Description of female "b". *Body*: length 7 mm. *First antenna*: with 25 flagellar articles. *Second antenna*: flagellum of seven articles. *Left mandible*: palp third article with small rugosities, setae 9D3E. *Right mandible*: palp article 3 rugose, setae 8D5E. *Pleon*: pleonite 5 with two dorsolateral robust setae, pleonite 6 with one dorsal robust seta basal to telson. *First uropod*: peduncle lateral margin with four dorsal and one apical short robust setae; medial margin with two dorsal and one slightly sub apical robust seta; inner ramus with two medial and four apical robust setae; outer ramus with two lateral, one distomedial and four apical robust setae. *Second uropod*: peduncle lateral margin with two dorsal plus one apical robust seta, medial margin with one small mid dorsal and one apical robust seta; inner ramus with one medial and four apical robust setae, outer ramus with one lateral and four apical robust setae. *Third uropod*: peduncle with only distal robust setae, inner ramus with one apical robust seta, outer ramus proximal article with three lateral ranks of 2-2-2 and three distal robust setae, and four medial ranks of 4-3-3-4 and two distal robust setae; distal article with one small apical spinule. *Telson*: bearing dorsolateral robust setae at M0.5 on either side, paired dorsolateral penicillate setules at M0.7, and with two left and three right apical robust setae.

Distribution. Limekiln Cave, Wellington, New South Wales, 32°33'S 148°57'E.

Neocrypta robinae n.sp.

Figs 10–12

Etymology. Named for the wife of the first author in recognition of her indirect support of amphipod studies.

Type locality. Diprotodon Cave, Cave number CN-10, Canomodine, New South Wales, 33°30'S 148°52'E.

Material examined. HOLOTYPE (Australian Museum P51363) male 6 mm; collected by S. Eberhard; 2 April, 1995.

Diagnosis. Lateral cephalic lobes moderately projecting, antennal sinus moderate, first antenna peduncle ratio of articles 26:24:13, mandibular palp ratio of articles 8:16:16 to 8:18:17, article 3 weakly falcate, setae DE, first maxillae inner plates with two plumose apical setae, inner plate of second maxilla with two distomedial submarginal plumose setae, coxa 1 very weakly tapering apically, gnathopod 1 articles 2 and 3 without posterior rugose hump, gnathopod 2 articles 3 and 4 without rugose hump, palmar corner robust setae 3-3, robust setae along the palm moderately dense, Peraeopod 6 longer than seven, articles 2 of legs 5–7 weakly lobate postventrally. Rami of pleopods reduced; inner rami of pleopod 1 with two

articles on the right, others with only one article, each with a single marginal seta. Epimera with a small postventral tooth like on the second epimeron only, each with ventrofacial robust setae. Rami of the first and second uropods without dorsal robust setae, the inner ramus of uropod 3 0.1× the length of the outer ramus. Telson cleft 12%, without mid lateral spination.

Description of holotype (male). *Body* (Fig. 10): pleon not armed dorsally except for a single dorsal robust seta adjacent the base of the telson; length 6 mm. *Head*: rostrum small, eyes absent. *First antenna* (Fig. 10): length 0.4× body, 1.2× second antenna, peduncle subequal to the length of the flagellum—63:65—ratio of lengths of the articles 10:9:5, flagellum of 11 articles, uniform and sparsely setulate, articles 1–8 with aesthetascs in pairs, nine to 11 with single aesthetascs, accessory flagellum of two articles, reaching to the end of the first article of the primary flagellum. *Second antenna* (Fig. 10): 0.28× length of body, peduncle much longer than flagellum—79:26—articles 4 and 5 subequal—27:28—articles 3–5 with moderate ventral setation; flagellum of four articles, weakly setose ventrally, without aesthetascs. *Left mandible* (Fig. 10): palp; ratio of lengths of articles 8:16:16, article 3 weakly falcate, setae 17D5E, apex rugose, articles 1 and 2 naked; slender seta at the base of the palp; incisor with five teeth; lacinia mobilis four teeth and fine posterior basal setules; accessory blades of three chisel robust setae and three interraker plumose robust setae, with four brushy setae to the base of the molar; molar triturative, with a short posterior pappose seta. *Right mandible* (Fig. 10): palp article 3 with setae 17D5E, apex rugose; incisor with five teeth; lacinia bifid and denticulate, with an area of setules at the base; accessory blades of two chisel robust setae and one plumose seta, with a short plumose and two brushy setae onto the base of the molar; molar triturative with a long posterior pappose seta. *Maxillae* (Fig. 10). Left first maxilla palp article 2 with one apical and one subapical armed and one naked robust seta, one distolateral plumose seta and two disto medial naked setae; outer plate with seven denticulate robust setae, the inner plate with two apical plumose setae. Right first maxilla palp article 2 with a row of four submarginal mediolateral to apical stout robust setae, the apical two terminally armed, a similar distolateral robust seta and a single distofacial seta; outer plate bearing seven denticulate robust setae; inner plate with two plumose apical setae. Second maxilla: outer plate with a small spinule and moderate seta distolaterally, the inner plate with two submarginal distomedial plumose setae. *Maxilliped* (Fig. 10): Palp article 3 without basomedial and with few distomedial setae, two long setae facio basal to the apex, and a ventral row of three setae basal to the dactyl; apex moderately produced and rugose, dactyl facially pubescent with two accessory spinules basal to the nail; article 2 moderately to well setose medially; apex of inner plate with two thick tooth like robust setae, a stout plumose seta and a naked seta, two ventrofacial setae and one mediofacial seta; outer plate with an apical transverse row of three slender and one stout pappose robust setae, a barely facial medial row of four basally pappose moderate robust setae, a distofacial slender seta and five basomedial setae arranged 1-2-2. *Gnathopods* (Fig. 11): coxal plate of gnathopod 1 with one postventral, one anteroventral and two mid facial setae as well as several small facial setules; articles 2 and 3 without posterior rugose extension, article 4 with a small posterior rugose lobe; carpus short, strongly lobate and rugose posteriorly, the lobe rounded, without apical setae; propodus trapezoidal, longer than wide, the post-lateral edge subquadrate, faintly rugose, with one medial and two lateral

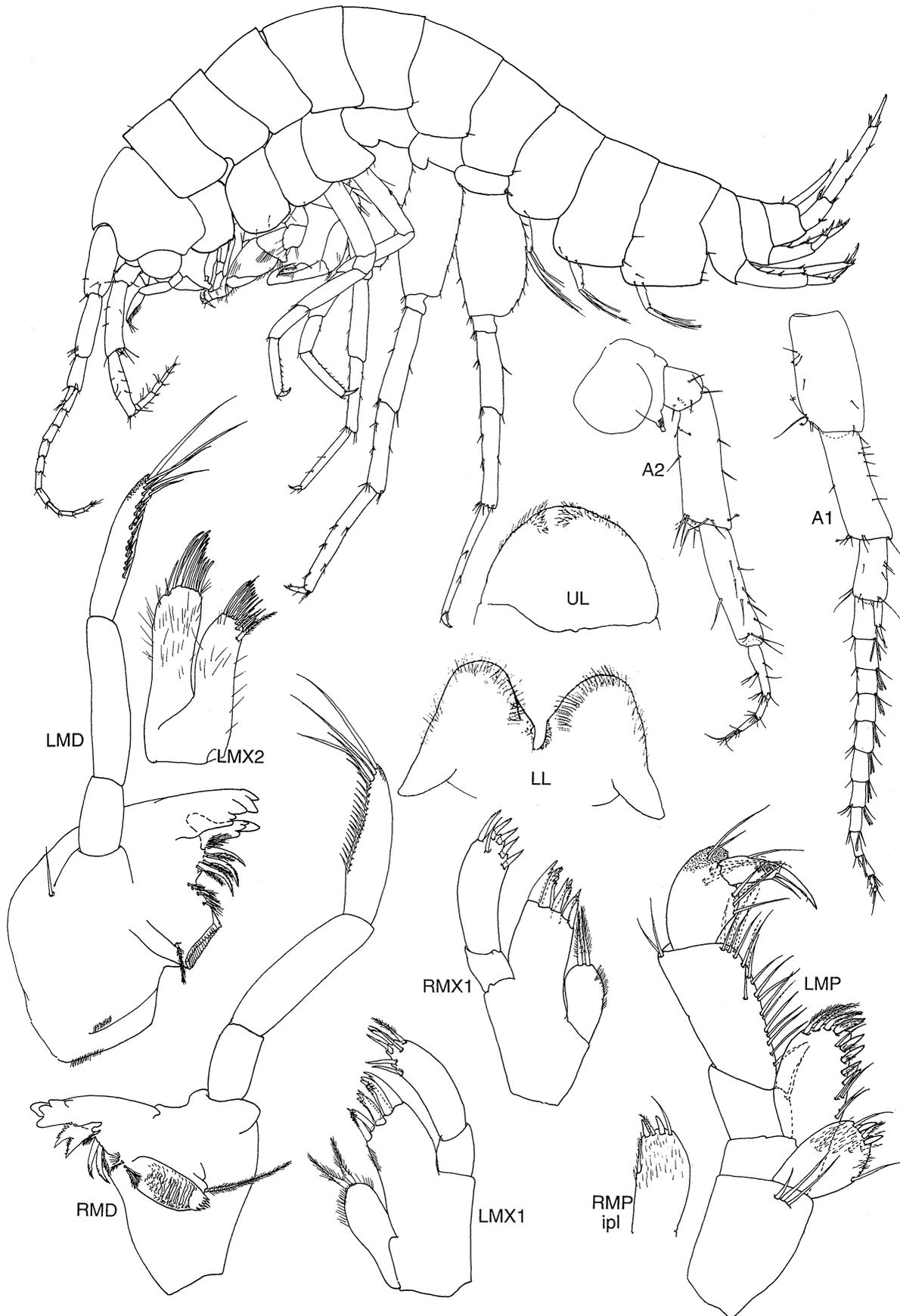


Fig. 10. *Neocrypta robinae* n.sp. holotype male 6 mm; body, antennae, mouthparts.

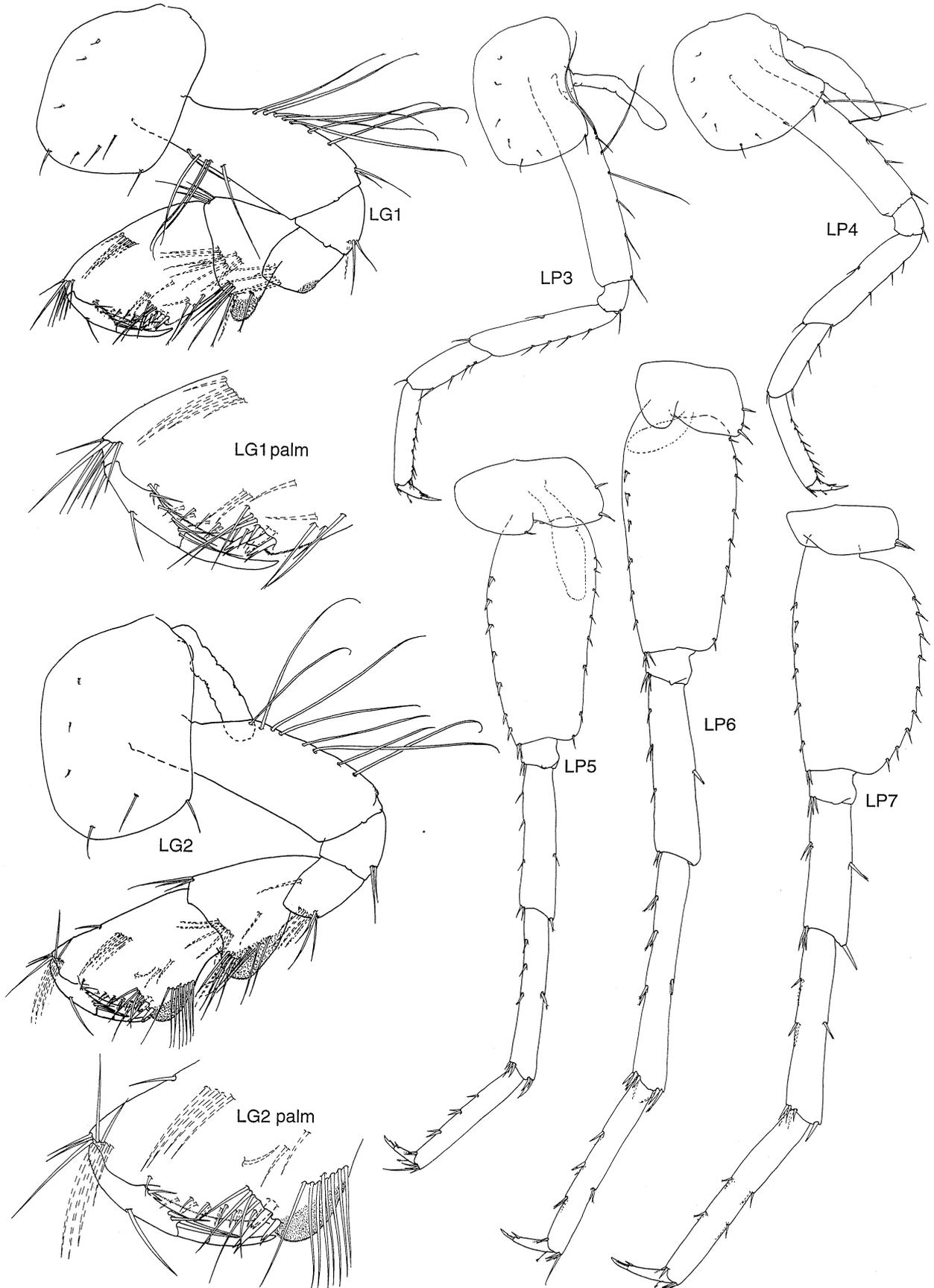


Fig. 11. *Neocrypta robinae* n.sp. holotype male 6 mm; legs.

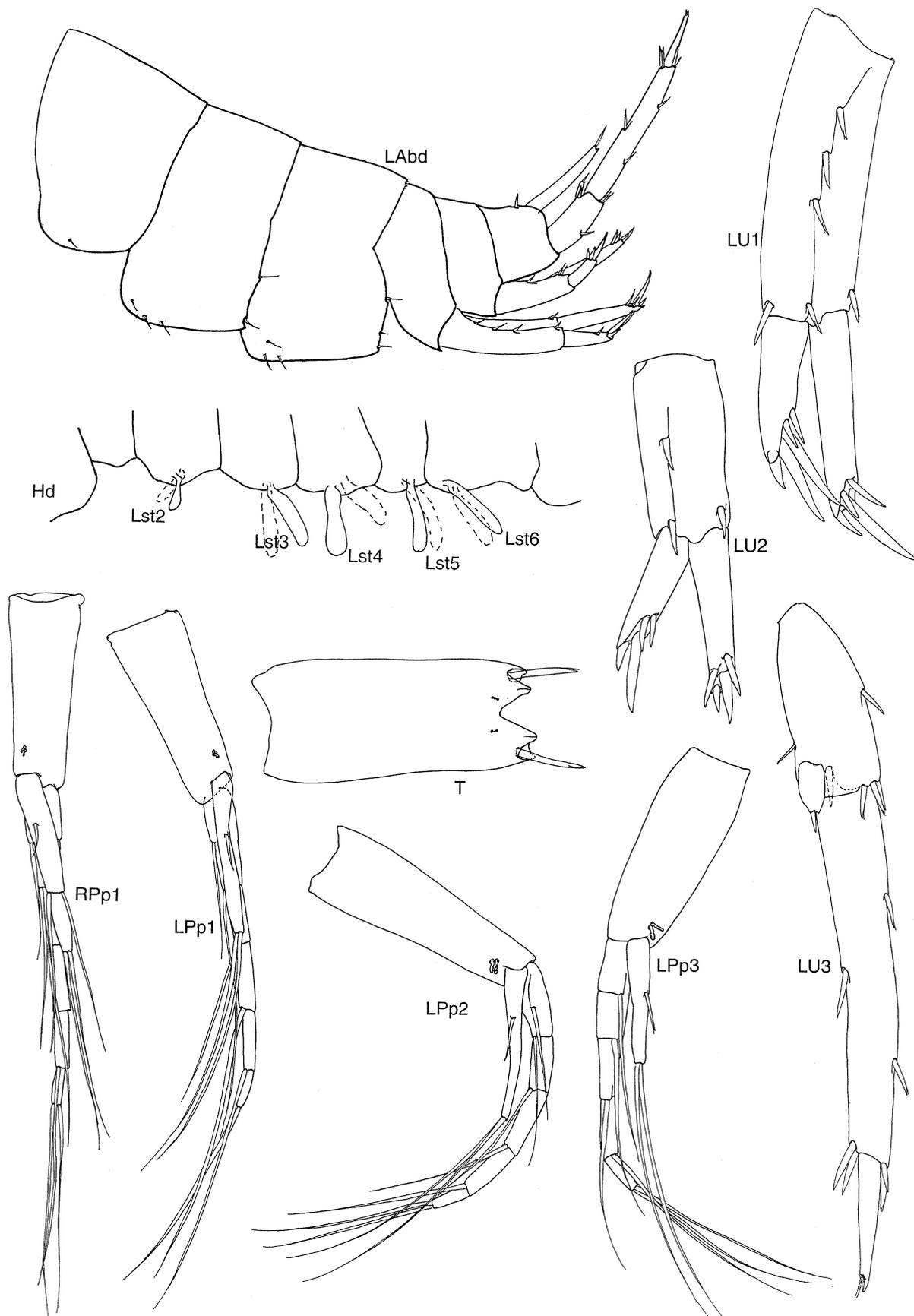


Fig. 12. *Neocrypta robinae* n.sp. holotype male 6 mm; abdomen, gills, pleopods, uropods, telson.

palmar corner robust setae; robust setae along the palm moderately crowded; dactyl with accessory spinules and a small recumbent robust seta on the inner margin, reaching beyond the palmar corner. Second gnathopod: slightly larger than gnathopod 1; article 2 with a small posterior rugose hump, articles 3 and 4 without; carpal lobe broader than gnathopod 1; propodus with distinct posterior rugose lobe, palmar corner with one medial, two lateral robust setae, the palm moderately crowded with robust setae; dactyl with a small proximal recumbent robust seta and accessory setules on the inner margin, reaching to palmar corner robust setae; coxa sparsely setulose apically, bearing a small sac like gill. *Peraeopods* (Fig. 11): coxae 3 and 4 with sparse, weak apical setae; coxa 4 weakly emarginate; peraeopods 3 and 4 subequal, longer than gnathopod 2, articles 3 and 4 weakly spinose posteriorly, propodi with evenly spaced single posterior robust setae; peraeopods 5–7 similar, leg six longest, five and seven subequal, coxae with 2-3-2 robust setae on the posterior margins, second articles expanded moderately, sub quadrate to ovate, weakly postventrally lobate, with weak marginal setation; propodi lacking strong setae on the posterior margins except for long subdactylar setae on legs 5 and 6. *Gills* (Fig. 12): coxae 2–6 with sac like gills; sternites 2–6 with paired simple medial gills. *Epimera* (Fig. 12): second epimeron only with a small postventral tooth; posterior margins of E1–2 almost straight, of E3 convex, the posterior margins weakly setulate; first epimeron with a single mid facial robust seta, the second and third with one anterofacial and two mid ventral robust setae. *Pleon* (Fig. 12): pleonites 1 to six without posteromarginal setae or robust setae, six with a single posterodorsal robust seta adjacent the telson. *Pleopods* (Fig. 12): two retinacula each, peduncles all naked; pleopods reduced, right pleopod 1 with two articles on the inner ramus, all other pleopods with one moderately elongate inner article, each with a single medial marginal seta; outer rami with 6-5-5 articles. *Uropods* (Fig. 12): third uropod extending well beyond uropods 1 and 2 in the intact specimen; uropod lengths relative to uropod 1, uropod 2 0.68 \times , uropod 3 1.4 \times ; first uropod peduncle 1.4 \times medial ramus, 2 \times lateral ramus, the outer margin with one slightly sub apical distal robust seta and one ventrodorsal robust seta, dorsal margin with three robust setae, medial margin with one sub apical robust seta, rami of unequal length—medial 1.4 \times lateral—without marginal robust setae, both with four apical robust setae; second uropod peduncle slightly longer than rami—1.5 \times lateral, 1.2 \times medial—with one short dorsolateral robust seta plus a slightly sub apical robust seta, and one subdistal medial robust seta; rami without marginal robust setae, both with four apical robust setae; third uropod peduncle as long as urosomite three, 0.4 \times outer ramus, with one medial and one laterofacial robust seta, three distolateral and one distoventral robust seta; proximal article of outer ramus with one mid-medial and two mediolateral robust setae, two lateral and two distolateral robust setae; distal article length 0.27 \times proximal, with two small apical setules; inner ramus small, 0.1 \times length outer ramus, with one small apical robust seta. *Telson* (Fig. 12): moderately long, 1.6 \times urosomite three, longer than broad, length 2.1 \times width, cleft 12%, apices with a single robust seta set in a notch, single penicillate setules either side at M0.88

Relationship. *Neocrypta robiniae* differs from *N. primaris* in: the short length of its antennae, which also have fewer flagellar articles; lacking C but with greater numbers of D and E setae on the mandibular palp; less rugosity of the first gnathopod, and with greater numbers of palmar robust setae on both gnathopods; second

article of peraeopods 5–7 less posteriorly expanded; outer rami of pleopods with fewer articles; telson cleft less and narrower. *Neocrypta robiniae* differs from *N. simoni* in: first antenna shorter but with a greater number of flagellar articles; second antenna without aesthetascs; mandibular palp bearing many more D and E setae; left first maxilla palp not narrowed; first gnathopod less rugose, both gnathopods with more spinous palms; outer rami of pleopods with more articles; telson less cleft and narrow. *Neocrypta robiniae* differs from *N. georginae* in: second antenna flagellum of less articles, and without aesthetascs; mandibular palp with more D and E setae; first gnathopod less rugose and without facial rugosities; outer rami of the pleopods with more articles; uropods are less spinous; telson not tumid, and longer.

Distribution. Diprotodon Cave, Canomodine, New South Wales, 33°30'S 148°52'E.

Neocrypta moniae n.sp.

Figs 13–16

Etymology. Named for the first daughter of the first author in recognition of her indirect support of amphipod research and contributions in field collections.

Type locality. Bowan Park, New South Wales, Cave BP 13, 31°54'S 148°05'E.

Material examined. HOLOTYPE (Australian Museum P51364) female 6.5 mm; collected by S. Eberhard; 13 March, 1995.

Diagnosis. Lateral cephalic lobes weakly projecting, antennal sinus weak, eyes absent, ratio of lengths of peduncular articles of first antenna 10:11:8, ratio of lengths of mandibular palp articles 8:11:13, article 3 almost linear, with DE setae. The inner plate of the first maxilla with two apical plumose setae, inner plate of the second maxilla with one member of the distomedial slightly sub marginal, coxa 1 tapering apically, articles 2–4 of both gnathopods bearing posterior rugose lobes, three robust setae at the palmar corners, robust setae along the palms sparse on first, moderate on the second gnathopod. Peraeopod 6 longer than 7, legs 5–7 moderately lobate post-ventrally on the second article. Outer ramus of pleopods of moderate length, of 9,8,8 articles, inner rami reduced to one article each, without marginal setae. Epimera without postventral teeth, with facial robust setae on some, margins of rami of uropods 1 and 2 with one row of dorsal robust setae only, the lateral ramus of uropod 1 without dorsal robust setae, inner ramus of third uropod reaching to M0.09 of outer. Telson cleft 16%, bearing mid lateral dorsal spination.

Description of holotype (female). *Body* (Fig. 13): pleon with few dorsal arms, pleonites 1–4 with few setae, pleonite 5 with three lateral robust setae, pleonite 6 with one distolateral robust seta, length 5.5 mm. *Head:* rostrum small, eyes absent. *First antenna* (Fig. 13): long, length 0.7 \times body, 2.4 \times second antenna, the peduncle shorter than the flagellum, ratio of lengths of articles 23:26:19, setae sparse, flagellum of 22 articles, aesthetascs present on articles 6–22, flagellar segments uniform, sparsely setulate; accessory flagellum 2-articulate, reaching to M0.5 of the second article of the primary flagellum. *Second antenna* (Fig. 13): length 0.3 \times body,

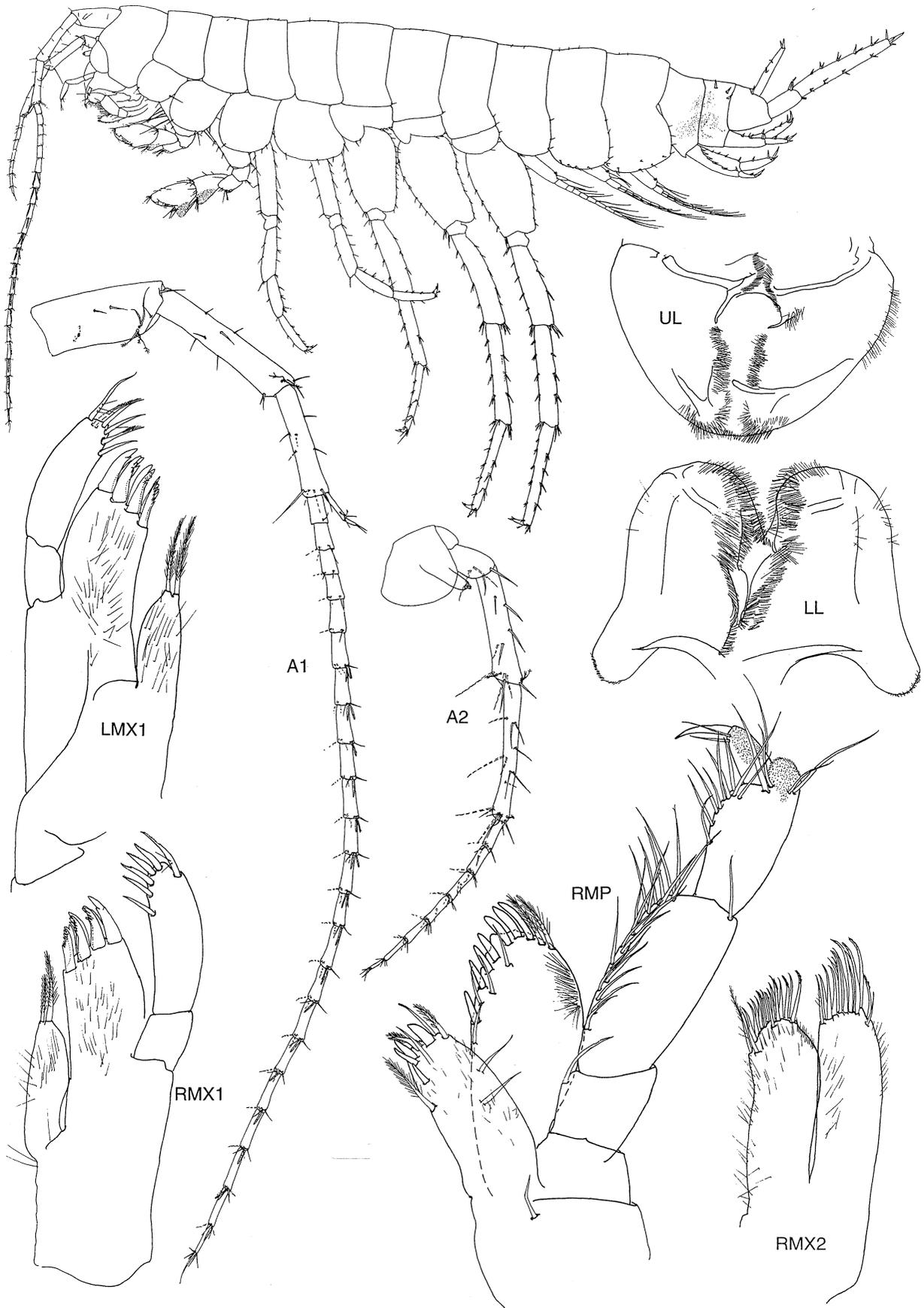


Fig. 13. *Neocrypta moniae* n.sp. holotype female 6.5 mm; whole, antennae, mouthparts.

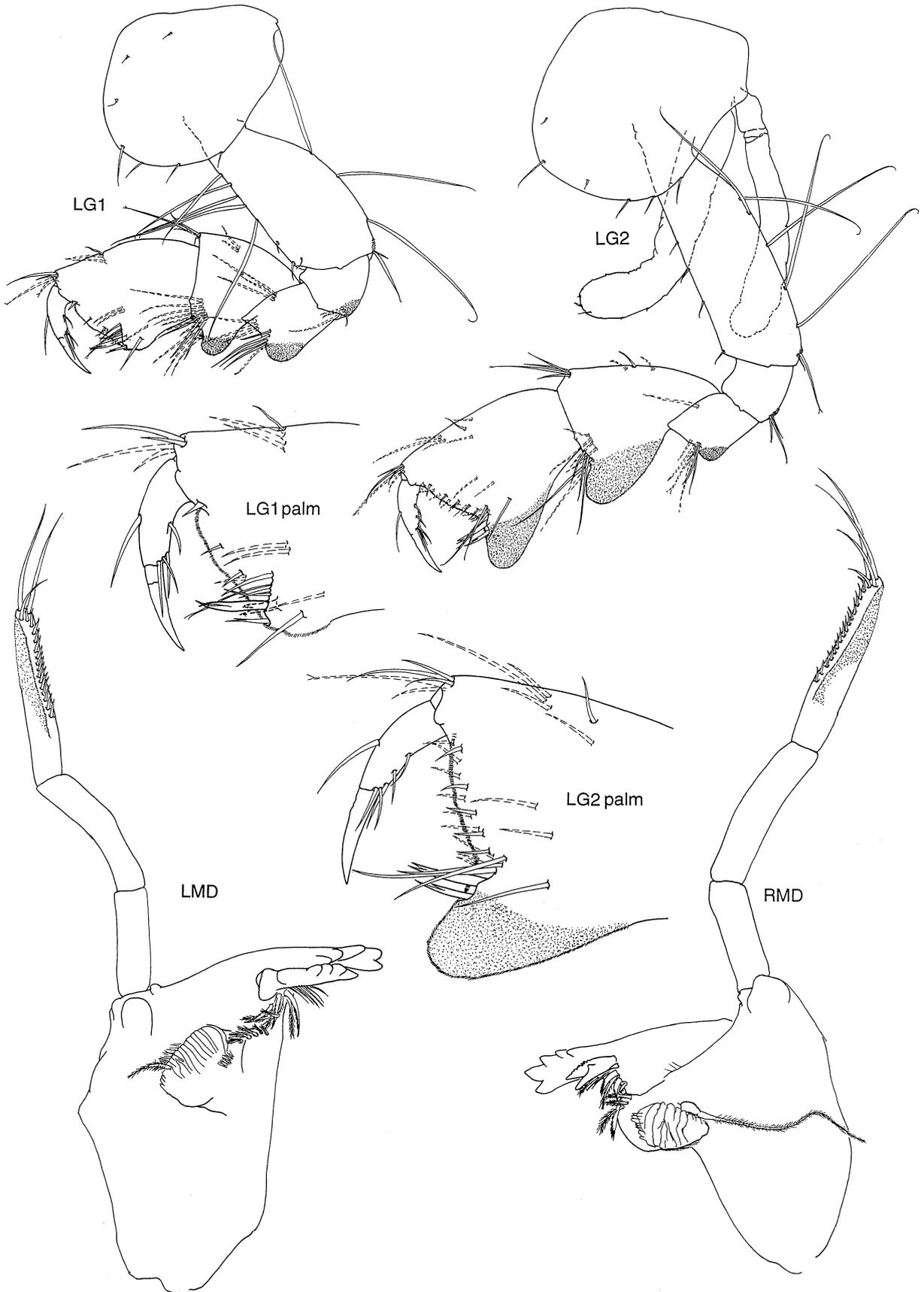


Fig. 14. *Neocrypta moniae* n.sp. holotype female 6.5 mm; mandibles, gnathopods.

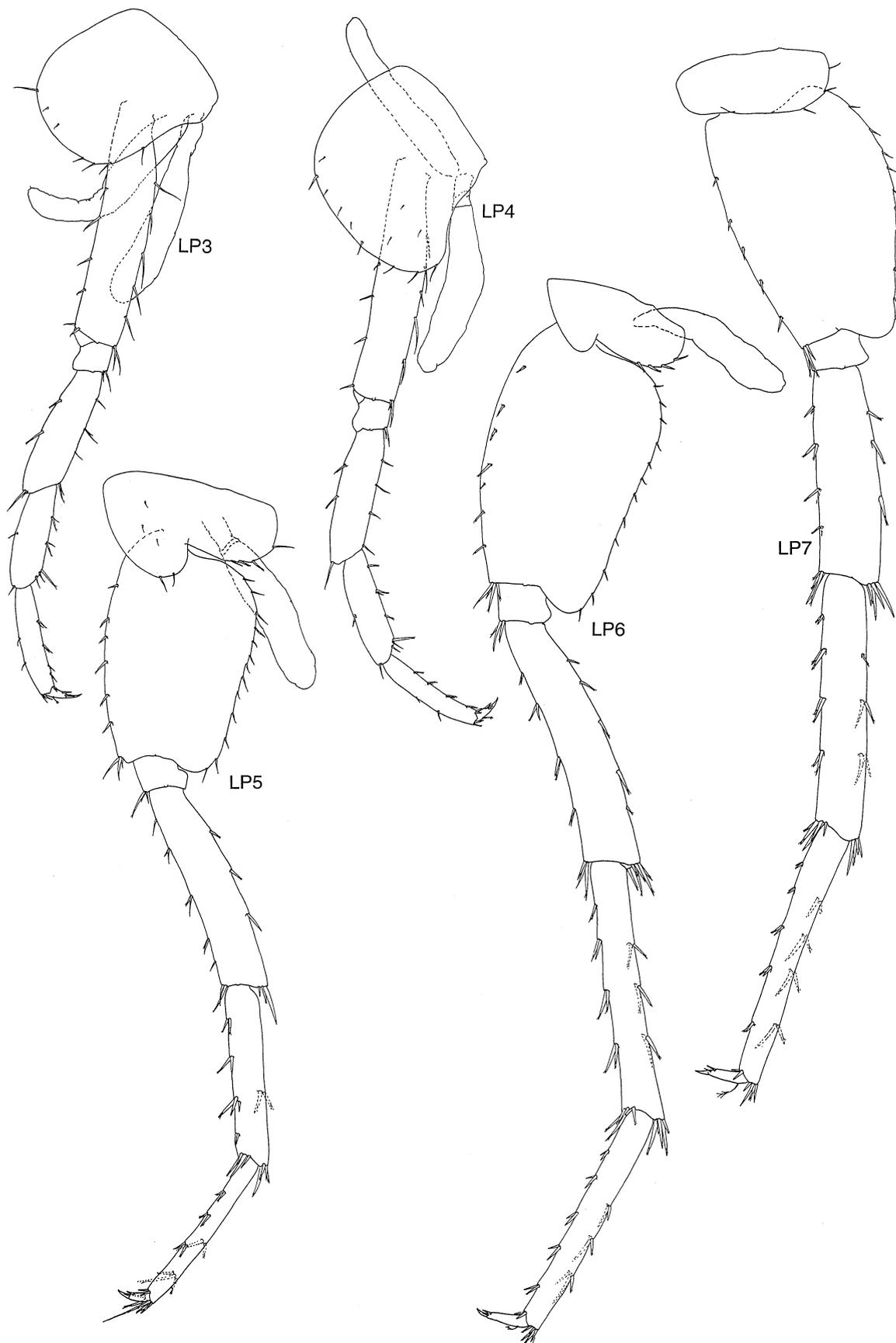


Fig. 15. *Neocrypta moniae* n.sp. holotype female 6.5 mm; peraeopods.

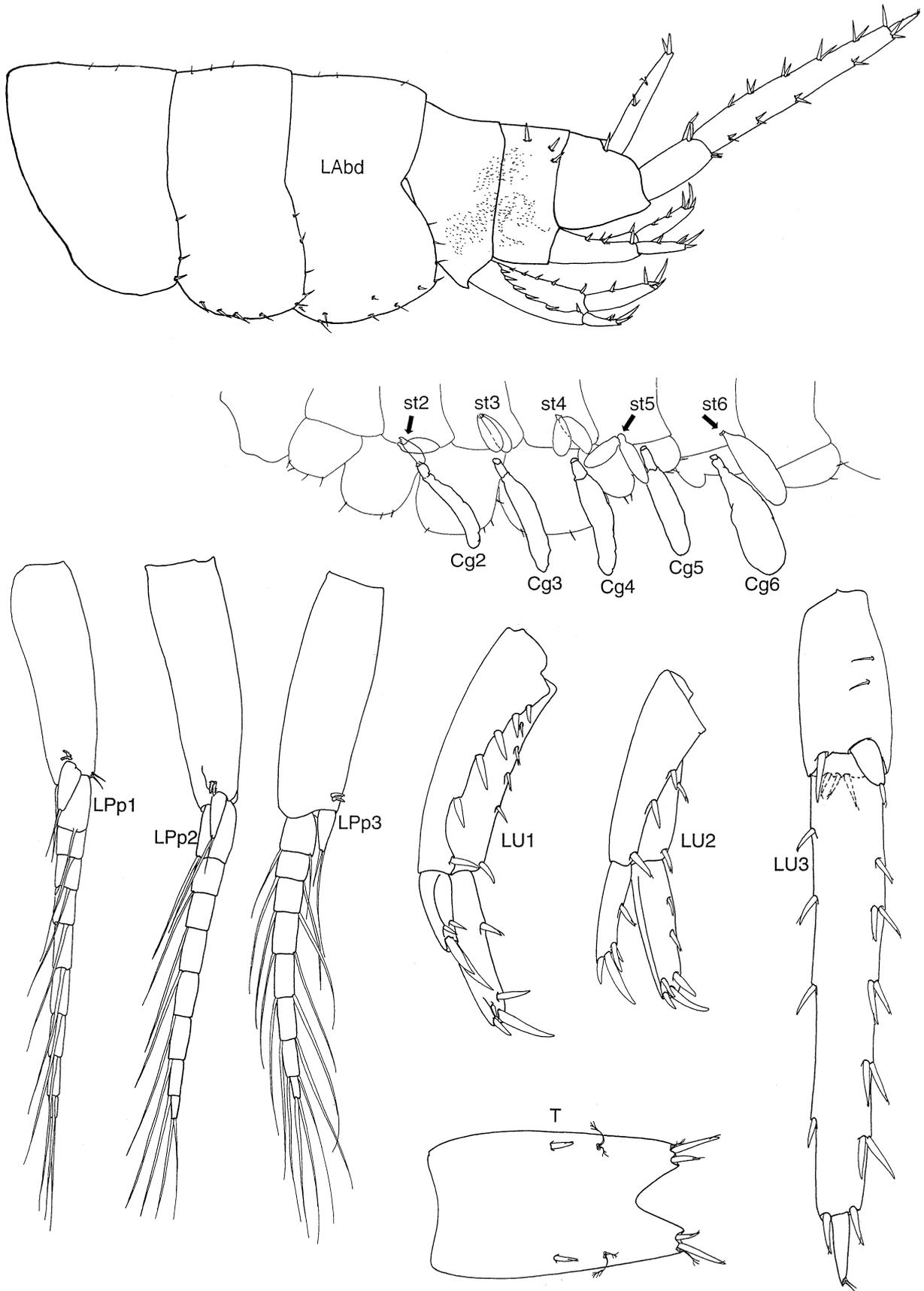


Fig. 16. *Neocrypta moniae* n.sp. holotype female 6.5 mm; abdomen, gills, pleopods, uropods, telson.

peduncle longer than flagellum—1.9×—article 4 slightly shorter than five—21:24—articles 3–5 with moderate ventral setation; flagellum of seven articles, weakly setose ventrally. *Left mandible* (Fig. 14): palp article 3 longer than 2—25:20—linear and distofacially rugose, setae 14D3E; incisor with five teeth, lacinia mobilis four; six slender naked setae basal to the incisor; accessory blades of three rakers and four interraker plumose setae, five brushy setae onto the base of the molar; molar triturative with a short posterior pappose seta. *Right mandible* (Fig. 14): palp article 3 with 15D4E setae, the third article facially rugose; incisor with five teeth; lacinia mobilis bifid, denticulate anteriorly, posteriorly bearing long incisive edge, two slender naked setae and a plumose robust seta basal to the mandible; accessory blades of three rakers, five interraker plumose setae, and a short hooked seta; molar triturative with a long posterior pappose seta. *Maxillae* (Fig. 13). Left first maxilla with two apical and three apicomedial robust setae and one ventrofacial sub apical robust seta; two robust setae naked, the others armed basally or apically with long or short setules; outer plate with seven apically dentate strong robust setae; inner plate two plumose apical setae. Right first maxilla palp article 2 with a row of four stout, mediolateral to distal, apically armed robust setae, one similar apicolateral robust seta and one mediolateral naked robust seta; outer plate with seven denticulate apical robust setae; inner plate with two apical plumose setae. Second maxilla outer plate with two setae on the apicolateral margin; inner plate apicomedial corner with one submarginal thick seta and one plumose seta. *Maxilliped* (Fig. 13): palp article 3 without setae on the inner ventral face, the outer apex with two medial and two lateral setae basal to a strongly produced rugose apical lobe; dactyl with two accessory robust setae basal to the nail, medially rugose; inner plate apex with two thick naked tooth like robust setae, one distal and one apicolateral plumose seta, a slender distal seta, two medial submarginal, and one mid facial setae, with a single naked basal seta; outer plate with a row of six slender naked setae extending from the basomedial face to the mid distal face, a row of seven blunt naked tooth like robust setae from the mid medial margin across the apical face almost to the lateral apex, continuous with a pair of distolateral plumose setae, the distomedial and apical margin broadly scalloped. *Gnathopods* (Fig. 14): coxal plate of the first gnathopod with four short to moderate length apical setae; articles 2–4 with progressively enlarged posterior rugose hump, the fourth forming a strong lobe; carpus short, posteriorly lobate, the lobe rounded, without apical setae and rugose; propodus trapezoidal, slightly longer than wide, the posterior angle rounded, with a small rugose hump, robust setae of the palmar corner one medial and two lateral, the dactylus reaching the corner robust setae, with several accessory spinules along the inner margin, but without a recumbent robust seta. Second gnathopod moderately larger than the first; posterior lobe of the fourth article smaller; carpal lobe larger; propodus with a strong rugose posterior lobe, palmar corner with one medial and two lateral robust setae, dactylus with inner marginal spinules, without recumbent robust seta, reaching robust setae of the palmar corner; coxa bearing slender oostegite and sac like gill, with few short apical setae. *Peraeopods* (Fig. 15): coxa 3 with a sparse apical row of short to moderate setae and single posterior seta; coxa 4 weakly emarginate, with one anteroventral and four postventral setae, several small facial setules and a long oostegite and sac like gill; peraeopods 3 and 4 longer than second gnathopod, subequal, articles 4 and 5 spinous posteriorly, articles 6 with 2-2-1-1 and 2 locking, and 1-2-2-1 and 2 locking robust setae, respectively; peraeopods 5–7 similar; coxae with 4-4-3 robust setae on the ventral margins

of the posterior lobes; second articles expanded posteriorly—5>6=7—and moderately lobate, with short posterior setae; propodi of legs 5 and 6 with long setae basal to the dactyls. *Gills* (Fig. 16): coxae 2–6 with sac like gills; sternites 2–6 with simple gills attached to the mid lateral edge. *Epimera* (Fig. 16): without postventral teeth, posterior margins moderately convex with 3-4-4 setae, and 0-5-6 ventrofacial robust setae. *Pleon* (Fig. 16): pleonites 1–4 with few posterior setae; pleonite 5 with three dorsolateral robust setae, six with a single dorsolateral robust seta basal to the telson, pleonites 4 and 5 bearing areas of tiny facial setules. *Urosomite one* (Fig. 16) at the base of uropod 1 bearing a robust seta like extension. *Pleopods* (Fig. 16): two retinacula each; peduncle of pleopod 1 only with two distal setae at the base of the outer ramus; inner rami reduced to a single article each; outer rami with 9,8,8 articles. *Uropods* (Fig. 16): third uropod extending well beyond first and second uropods in the intact specimen; lengths relative to uropod 1—uropod 2 = 0.8×, uropod 3 = 1.6×; first uropod peduncle length 1.7× medial ramus, 3.1× lateral ramus, the outer margin five short robust setae plus a sub apical distal robust seta, medial margin with four robust setae plus an apical robust seta; rami strongly unequal, the medial 1.8× lateral, with reduced spination, only the medial ramus with a single mid medial, short robust seta; both rami with four apical robust setae: second uropod peduncle length 1.4× medial ramus, 2× lateral ramus, with two plus one sub apical lateral robust setae, and one plus one apicomedial robust setae; rami with two medial robust setae on the medial ramus and one lateral robust seta on the lateral ramus, both rami with four apical robust setae; third uropod peduncle length less than the third urosomite—33:38—and 0.36× the length of the outer ramus, with two small basofacial setae, one ventrodorsal and a row of three distolateral robust setae; the proximal article of the outer ramus with four approximately evenly distributed lateral robust setae, five transverse medial sets of 1-2-2-2-2 robust setae and single distal lateral and medial robust setae; the second article with a small pair of apical setules; the inner ramus length 0.09× outer ramus, with a single apical robust seta. *Telson* (Fig. 16): moderately long, 1.3× urosomite three, length 1.7× width; cleft 16% with a lateral penicillate setule and two robust setae in small notches dorsal on each lobe, a medio facial robust seta on each side at M0.5, and paired dorsolateral penicillate setules at M0.65 on each side.

Relationship. *Neocrypta moniae* differs from *N. primaris* in: denser medial setae on the maxillipedal palp; denser palmar robust setae; less posterior expansion of the second article of peraeopods 5–7; pleopods with fewer articles of the outer ramus; telson less tumid and shorter. *Neocrypta moniae* differs from *N. robiniae* in: longer antennae with more articles; less D and E setae on the mandibular palp; left first maxilla palp broad; maxillipedal palp second article with dense medial setae; greater posterior expansion of the second article of peraeopods 5–7; outer rami of pleopods with more articles; uropods 1 and 2 more spinous; telson more cleft and broader. *Neocrypta moniae* differs from *N. simoni* in: antennal flagellum longer and with more articles; aesthetascs never paired; mandibular palp with many more D setae; left first maxilla palp not narrowed; maxillipedal palp second article with denser medial setation; article 2 of peraeopods 5–7 more expanded posteriorly; outer rami of pleopods with greater numbers of articles; uropods more spinous; telson less cleft, less tumid and more

slender. *Neocrypta moniae* differs from *N. georginae* in: flagellum of first antenna longer, both antennae with more flagellar articles; mandibular palp with more D setae, less E setae; setae of medial margin of maxillipedal palp denser; first gnathopod less rugose; article 2 of peraeopods 5–7 more expanded; pleopod outer rami with more articles; first and second uropods more spinous; telson more cleft, less tumid, more slender.

Distribution. Cave BP13, Bowan Park, New South Wales, 31°54'S 148°05'E.

Neocrypta georginae n.sp.

Figs 17–20

Etymology. Named for the second daughter of the first author in recognition of her indirect support of amphipod studies and assistance in field work.

Type locality. From a pool in the dark zone, Apple Tree Cave, Copperhania, Abercrombie, New South Wales; Cave A 79, 33°55'S 149°22'E.

Material examined. HOLOTYPE (Australian Museum P51365) female “b” 5.5 mm, ALLOTYPE (Australian Museum P51366) male “a” 5 mm, five other small specimens in the type series; collected by S. Eberhard; 16 June, 1995.

Diagnosis. Lateral cephalic lobes moderately projecting, antennal sinus weak, ratio of lengths of peduncles of first antenna 10:10:7, ratio of lengths of mandibular palp articles 8:13:14 to 8:14:15, article 3 weakly falcate, setae DE. Inner plate of first maxillae with two and three apical plumose setae, inner plate of second maxilla without sub marginal medial seta. Coxa 1 apically tapered, articles 2–6 of both gnathopods with posterior rugose projections, three robust setae at corners of palms, length of peraeopod 6 equal to seven, articles 2 of peraeopods 5–7 moderately to weakly lobate. Rami of pleopods reduced, inner rami each of one article without marginal setae. Epimera without postventral teeth and ventrofacial robust setae, spination of the rami of the first and second uropods reduced to a single robust seta for each pair, inner ramus of the third uropod 0.11× length of outer ramus. Telson cleft 11% with only a single mid lateral robust seta on one side.

Description of holotype (female). *Body* (Fig. 17): pereion with few armaments, pleonites 1–4 with sparse short dorsal setae, pleonite 5 with a distal transverse row of three dorsal to dorsolateral robust setae, six with a single mid dorsal robust seta; length 5.5 mm. *Head*: rostrum small, eyes absent. *First antenna* (Fig. 17): moderately long, 0.42× body, 1.7× second, peduncle shorter than flagellum—71: 116,—relative lengths of articles 10:11:7, flagellum of 12 articles, segments uniform, sparsely setulate, aesthetascs present on articles 2–11; accessory flagellum 2-articulate, reaching to M0.3 of the second article of the primary flagellum. *Second antenna* (Fig. 17): length 0.23× body, peduncle longer than flagellum—73:40—article 4 shorter than five—22:26—articles 3–5 with moderate ventral setation; flagellum of six articles, weakly setose ventrally, article 6 with a small apical aesthetasc. *Left mandible* (Fig. 18): palp article 3 subequal to two, ratio of lengths 8:14:15, weakly falcate medially and distally rugose, setae 8D4E, first and second articles naked; incisor with five teeth; lacinia mobilis five teeth and four long basal setules;

accessory blades of three chisel robust setae and two plumose robust setae, several fine setules basal to the molar; molar trititative with a short pappose posterior seta. *Right mandible* (Fig. 18): palp article 3 slightly longer than three, ratio of lengths 8:13:14, medially rugose, setae 8D4E, first and second articles naked; incisor with five teeth; lacinia mobilis bifid, denticulate, basally setose; accessory blades two chisel robust setae and two plumose robust setae, two brushy setae basal to molar; molar trititative with a long posterior pappose seta. *Maxillae* (Fig. 17): palp of left first maxilla with five thin apical robust setae and one medial sub apical robust seta; outer plate with seven denticulate strong robust setae; inner plate with two plumose apical setae; right first maxilla with three apical and one medial sub apical thick robust setae, one facial and one ventral simple seta, a long distofacial strong naked seta and distolateral slender robust seta; outer plate with seven denticulate strong robust setae; inner plate with three apical plumose setae; second maxilla with long curved terminal setae, inner distal margin without a submarginal seta. *Maxilliped* (Fig. 17): palp article 3 without ranks of fine setae on the inner basal face, with moderate distomedial setation, a pair of ventrofacial setae basal to the dactyl, without lateral setation, the apex strongly produced and rugose, the dactyl facially rugose with a pair of accessory spinules basal to the nail; article 2 naked laterally with a medial row of long naked setae, outer plate with a row of basomedial simple setae, a distomedial to apical row of six submarginal to facial tooth like robust setae and two distolateral plumose setae, apex of the inner plate with two moderate naked tooth like robust setae and a brushy seta, distolaterally a slender simple seta, two medio facial slender robust setae and a submarginal disto medial short robust seta. *First gnathopod* (Fig. 18): coxal plate with three moderate distal setae, article 2 with three posterior rugose keel like extensions, article 3 with a small posterior rugose hump, article 4 with a distinct posterior rugose lobe; carpus short with a distinct rugose lobe, rounded and without apical setation; propodus with a small posterior rugose keel and a mid dorsofacial area of rugosity, trapezoidal, longer than wide with two lateral and one facial palmar corner robust setae, palm with moderately crowded simple robust setae, dactyl with accessory inner edge spinules, reaching to the palmar corner. *Second gnathopod* (Fig. 18): slightly larger than first, articles 2–4 with small posterior rugose humps; carpus and propodus with strong rugose lobes; carpus short, lobe larger than on gnathopod 1; propodus with a small mid dorsal area of rugosity, palmar corner marked with two lateral and one medial robust seta, palmar robust setae moderately sparse and simple, dactyl with accessory inner margin setules, reaching beyond palmar corner robust setae; coxa sparsely setose apically, bearing a short slender sac like gill and long narrow oostegite. *Peraeopods* (Fig. 19): coxae 3 and 4 weakly setate apically, coxa 4 very weakly emarginate, both bearing slender sac like gills and long slender oostegites; peraeopods 3 and 4 subequal, longer than gnathopod 2, articles 4 and 5 sparsely spinose posteriorly, articles 6 with 1-1-1-1 and 1-1-1-1-1 posterior setae respectively; peraeopods 5–7 similar, 5 shorter than 6 and 7, coxae with 1-1-0 weak posterior robust setae, articles 2 posteriorly expanded, weakly postventrally lobate, with sparse moderate to weak marginal setae; propodi with few posterior setae, but peraeopods 5 and 6 with long basodactylar seta. *Gills* (Fig. 20): coxae 2–6 bearing slender to moderate sac like gills; sternites 2–6 each with a pair of simple gills attached to the mid medial area of each segment. *Epimera* (Fig. 20): without postventral teeth, posterior margins convex, with few moderate setae, the ventral faces with 1-3-4 facial robust setae. *Pleon* (Fig. 20): pleonites 1–4 with sparse dorsal setae; pleonite 5 with a transverse dorsal row

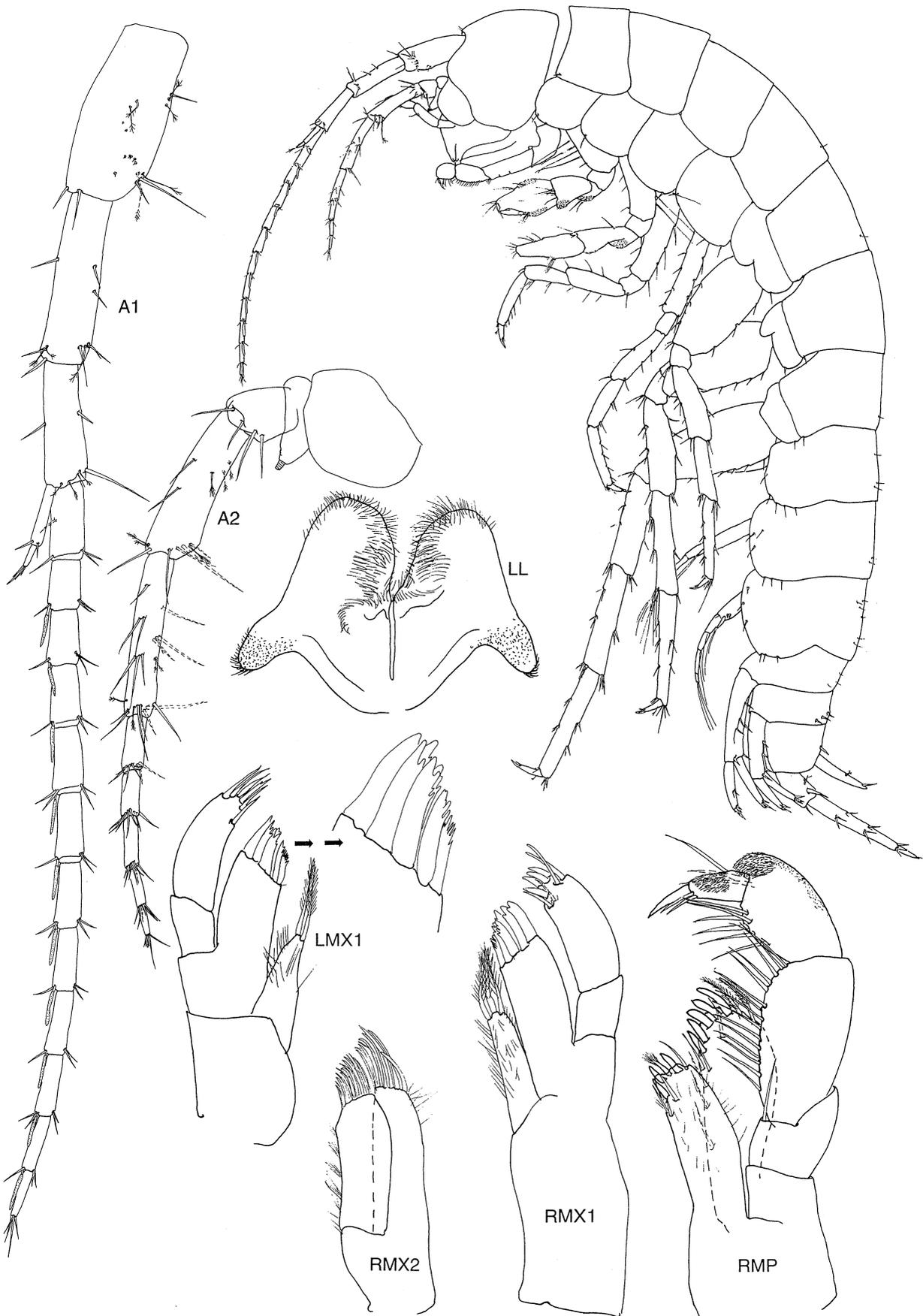


Fig. 17. *Neocrypta georginae* n.sp. holotype female "b" 5.5 mm; whole, antennae, mouthparts.

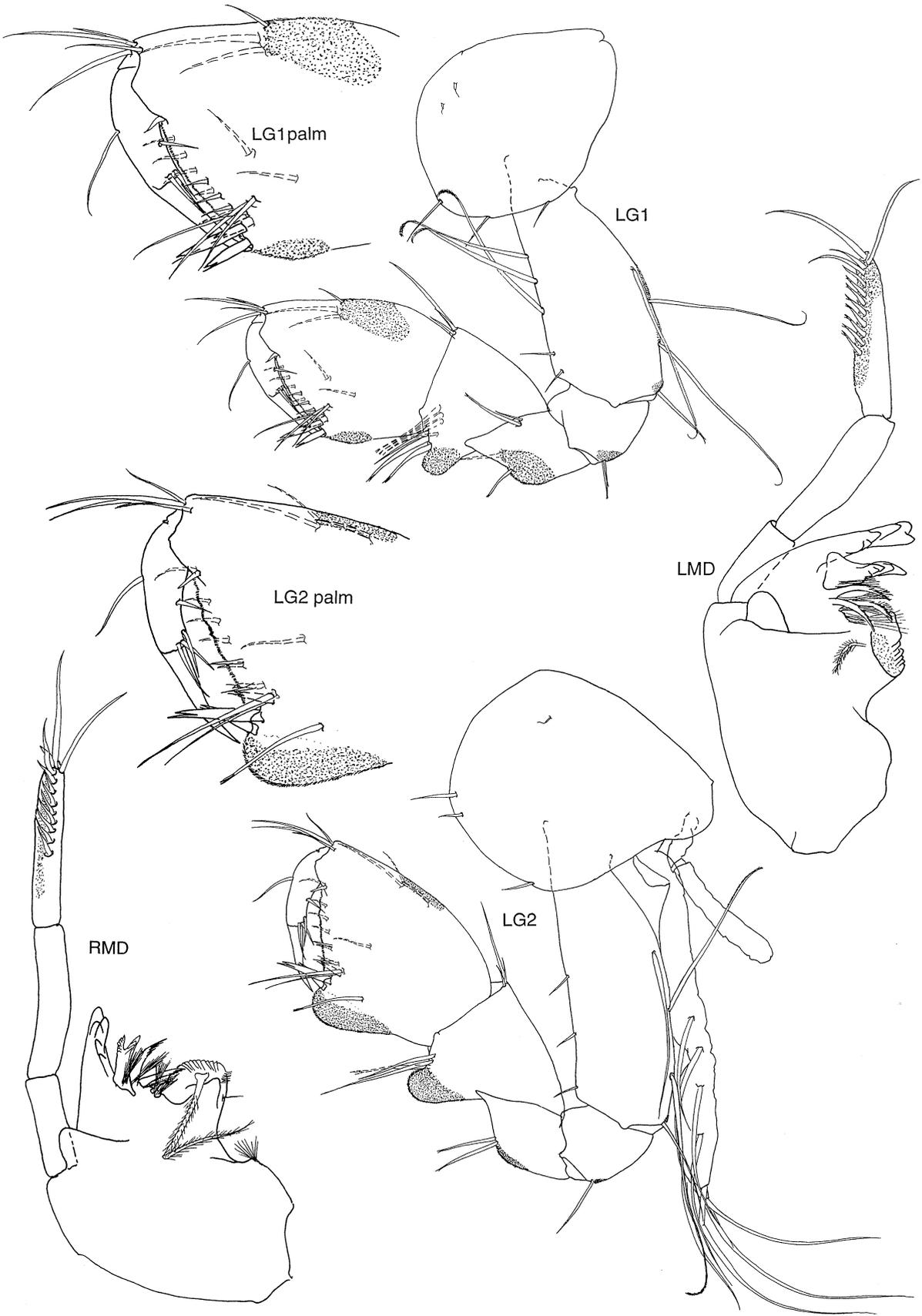


Fig. 18. *Neocrypta georginae* n.sp. holotype female "b" 5.5 mm; mandibles, gnathopods.

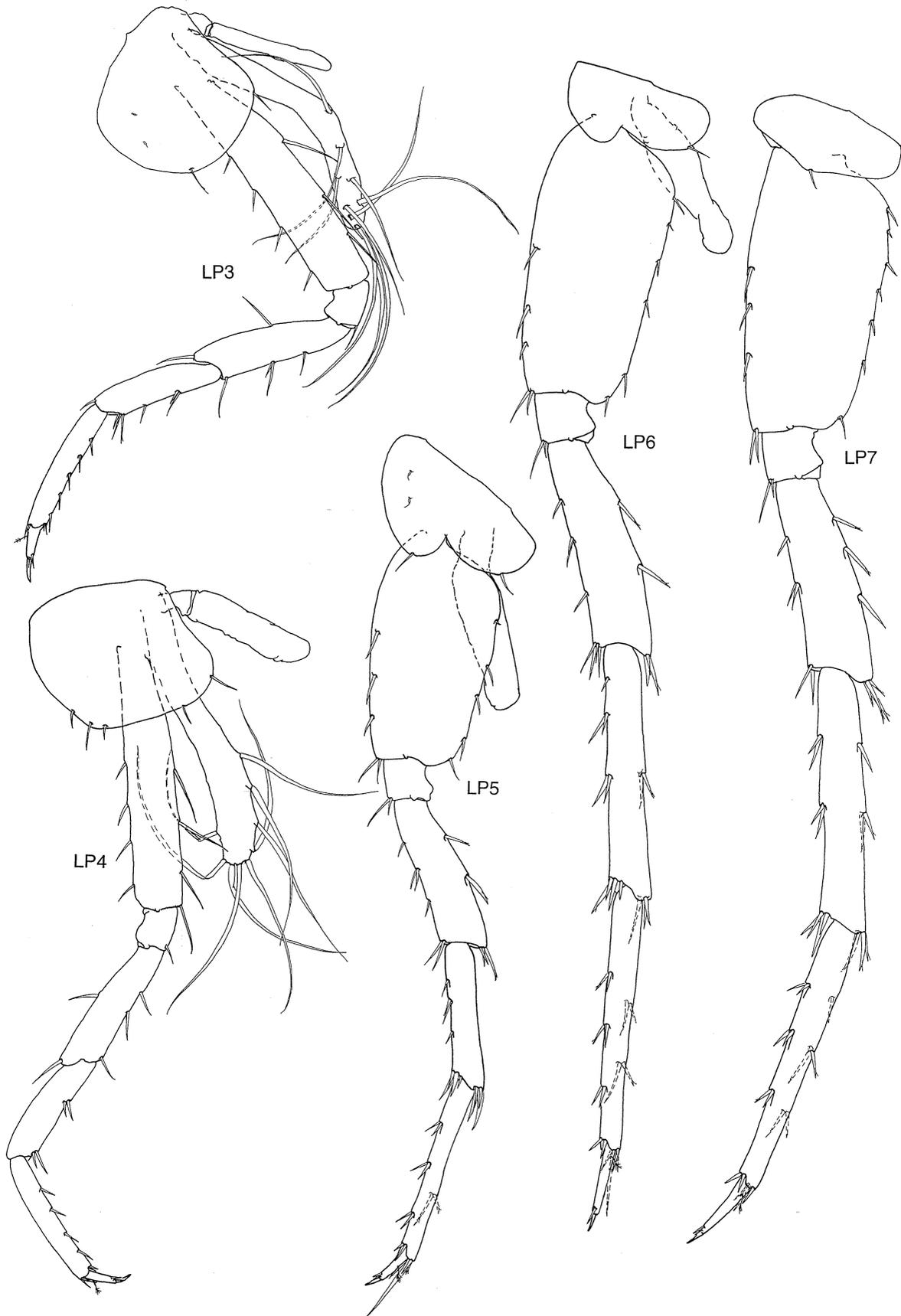


Fig. 19. *Neocrypta georginae* n.sp. holotype female "b" 5.5 mm; peraeopods.

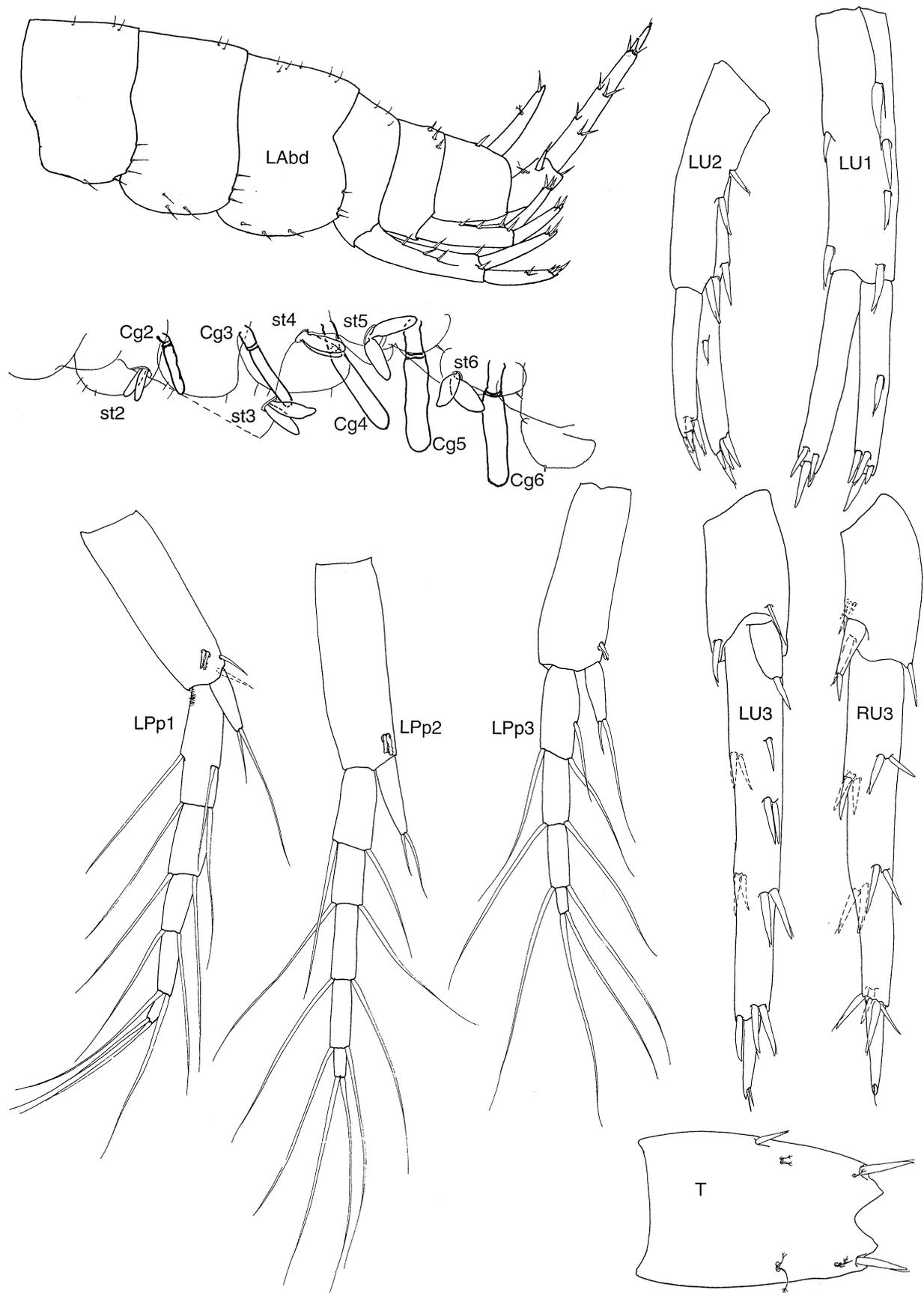


Fig. 20. *Neocrypta georginae* n.sp. holotype female "b" 5.5 mm; abdomen, gills, pleopods, uropods, telson.

of three moderate robust setae; six with a single dorsal robust seta basal to the telson. *Pleopods* (Fig. 20): each with two retinacula; peduncle one with two apicomedial setae, rami strongly reduced, outer rami of 5-5-4 articles, inner rami each of one article, without marginal setae. *Uropods* (Fig. 20): uropod 3 extending beyond 1 and 2 in the intact specimen; lengths relative to uropod 1, uropod 2 0.8×, uropod 3 1.3×; uropod 1 peduncle length 1.3× medial ramus, 1.4× lateral ramus, outer margin with three dorsal robust setae and one subdistal robust seta, inner margin with one dorsal robust seta and one subdistal robust seta; rami of subequal length, inner ramus without marginal robust setae and four apical robust setae, outer ramus with one lateral marginal robust seta and four apical robust setae; second uropod peduncle length 1.2× medial ramus, 1.5× lateral ramus; outer margin with two dorsal robust setae and one subdistal robust seta, inner margin with only a sub apical robust seta; inner ramus with one lateral robust seta and four apical robust setae, outer ramus without marginal robust setae and with four terminal robust setae; uropod 3 peduncle length almost as long as urosomite three, 0.29× outer ramus, the left uropod without facial robust setae on the peduncle, with a moderate dorsal robust seta and a simple seta basal to the inner ramus; outer ramus with transverse rows of 2-2 lateral and 1-2-2 medial robust setae, and one distolateral and two distomedial robust setae basal to the distal article; distal article with two small apical setules; inner ramus 0.11× length of outer ramus, with a single apical robust seta; right third uropod with three small ventrofacial setae, a moderate robust seta adjacent the base of the inner ramus, and one distodorsal robust seta; outer ramus with transverse rows of 2-2 lateral and 3-2 medial robust setae and paired distolateral and distomedial robust setae basal to the distal article; distal article with one small apical seta; inner ramus with a single apical robust seta. *Telson* (Fig. 20): moderately long, as long as urosomite three, length 1.5× width; cleft 11%; apices with one robust seta, the right side with a single penicillate setule, the left with two; a single laterodorsal robust seta on the right side only, at M0.5; paired lateral penicillate setules at M0.6 on either side.

Description of allotype (male "a"). *Body*: length 5 mm. *First antenna*: peduncle sparsely setulate, relative lengths of articles 10:9:7; accessory flagellum of two articles reaching to M0.3 of the second article of the primary flagellum; primary flagellum of 12 articles, all but articles 1 and 12 bearing single aesthetascs. *Second antenna*: peduncle longer than flagellum, relative lengths of articles 4 and 5 27:24; flagellum of four articles, the first relatively long, the last bearing a small apical aesthetasc. *Left mandible*: palp relative lengths of articles 8:13:14, third article rugose, setae 10D3E; incisor with five teeth, lacinia mobilis with four teeth and four fine basal robust setae; accessory blades of two robust setae and two plumose setae, with one large bent brushy seta onto the base of the mandible; mandible triturative, with a short posterior pappose seta. *Right mandible*: palp ratio of lengths of articles 8:14:15, article 2 with one mediiodistal seta, setae of third article 8D4E; incisor with five teeth, lacinia mobilis bifid with fine basal and facial setae, accessory blades of two robust setae and two plumose setae; two brushy setae onto the base of the molar; molar triturative with a long posterior pappose seta. *Left first maxilla*: inner plate with two plumose apical setae; outer plate with seven denticulate robust setae; palp with three slender apical robust setae, two distofacial slender setae and two mediiodistal slender robust setae. *Right first maxilla*: inner plate with two plumose apical setae; outer plate with seven denticulate robust setae; palp article 2 with a mediiodistal to apicolateral row of five moderately broad robust setae, the

most lateral armed with setules, and a single distofacial broad naked seta. *Second maxilla*: similar to female except for the presence of two mediiodistal plumose setae. *Maxilliped*: inner plate with two broad naked and one moderate plumose apical robust seta, one apicolateral long curved robust seta, one distomedial plumose seta and two distofacial stout robust setae. *Pleopods*: peduncle of each with two retinacula and one mediiodistal seta; inner rami of each one article only; outer rami of 6, 5, 4 articles respectively. *Uropod one*: without a basal robust seta on urosomite one; peduncle with three dorsolateral, one apicolateral, one dorsomedial and one apicomedial robust seta; rami with one lateral robust seta each and four apical robust setae. *Uropod 2*: peduncle with two dorsolateral and one apicolateral and apicomedial robust seta; rami without marginal robust setae, each with four apical robust setae. *Uropod 3*: relative lengths of articles; peduncle 28, inner ramus 8, outer ramus proximal article 62, distal article 15; peduncle bearing single lateral and medial distal robust setae and three small dorsofacial setae; inner ramus with one apical robust seta; outer ramus proximal article with transverse rows of 2-2 plus one distal lateral robust setae and 2-2 plus two distal medial robust setae; distal article with two small apical setules. *Telson*: moderately long, length approximately equal to urosomite three; cleft about 11%; lobes slightly tumid basally; one apical robust seta on either lobe; a pair of lateral penicillate setules at M0.6 on either side.

Relationship. *Neocrypta georginae* differs from *N. primaria* in: antennae short, with less flagellar articles; second antenna with an apical aesthetasc; mandibular palp bears less D setae, but more E setae; first gnathopod bearing facial rugosities; posterior expansion of second article of peraeopods 5-7 slight; pleopod outer rami with fewer articles; telson cleft 11%.

Distribution. Apple Tree Cave, cave A79, Copperhania, Abercrombie, New South Wales, 33°55'S 149°22'E.

Neocrypta annae n.sp.

Figs 21-24

Etymology. Named for the wife of the second author in recognition of her years of indirect support of amphipod studies.

Type locality. Cave BP-6, Bowan Park, New South Wales, 31°54'S 148°05'E.

Material examined. HOLOTYPE (Australian Museum P51367) male 4.5 mm; collected by S. Eberhard; 13 March, 1995.

Diagnosis. Lateral cephalic lobes weak, antennal sinus weak, ratio of lengths of peduncular articles of first antenna 10:11:7, ratio of lengths of mandibular palp articles 8:11:13 to 8:14:17, the third palp article weakly falcate, bearing DE setae, the inner plate of the first maxilla with two apical plumose setae, inner plate of the second maxilla with submarginal medial setae. Coxa 1 weakly tapering, second article of gnathopod 1 and second and third articles of gnathopod 2 without posterior rugose lobe, three robust setae at the palmar corners, robust setae along the palms sparse, peraeopod 6 longer than seven, the second articles of legs 5-7 moderately lobate post-ventrally. Rami of pleopods reduced, inner rami of one article only, without marginal setae, epimera without postventral teeth, second and third epimera with ventrofacial robust setae,

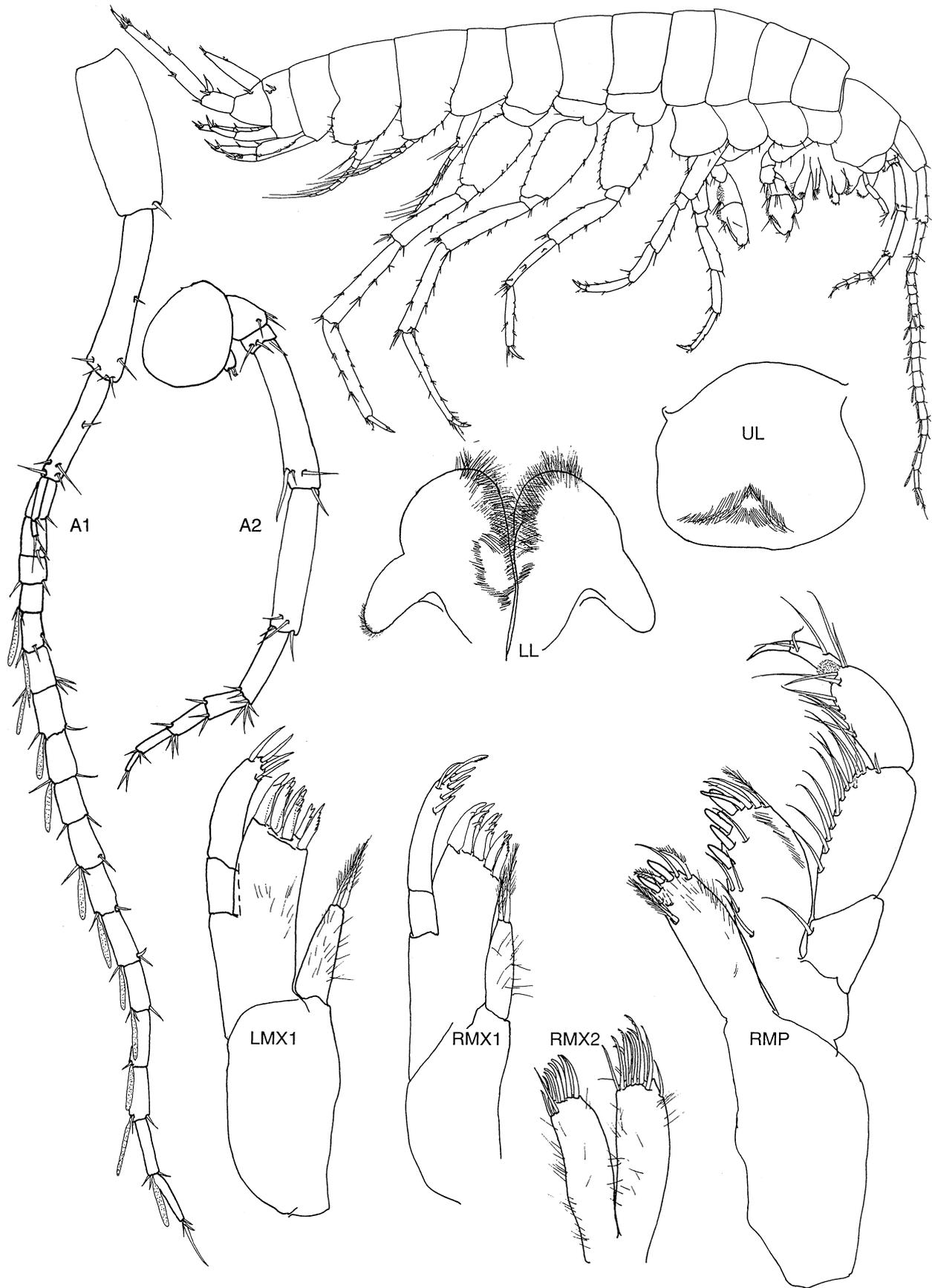


Fig. 21. *Neocrypta annae* n.sp. holotype male 4.5 mm; whole, antennae, mouthparts.

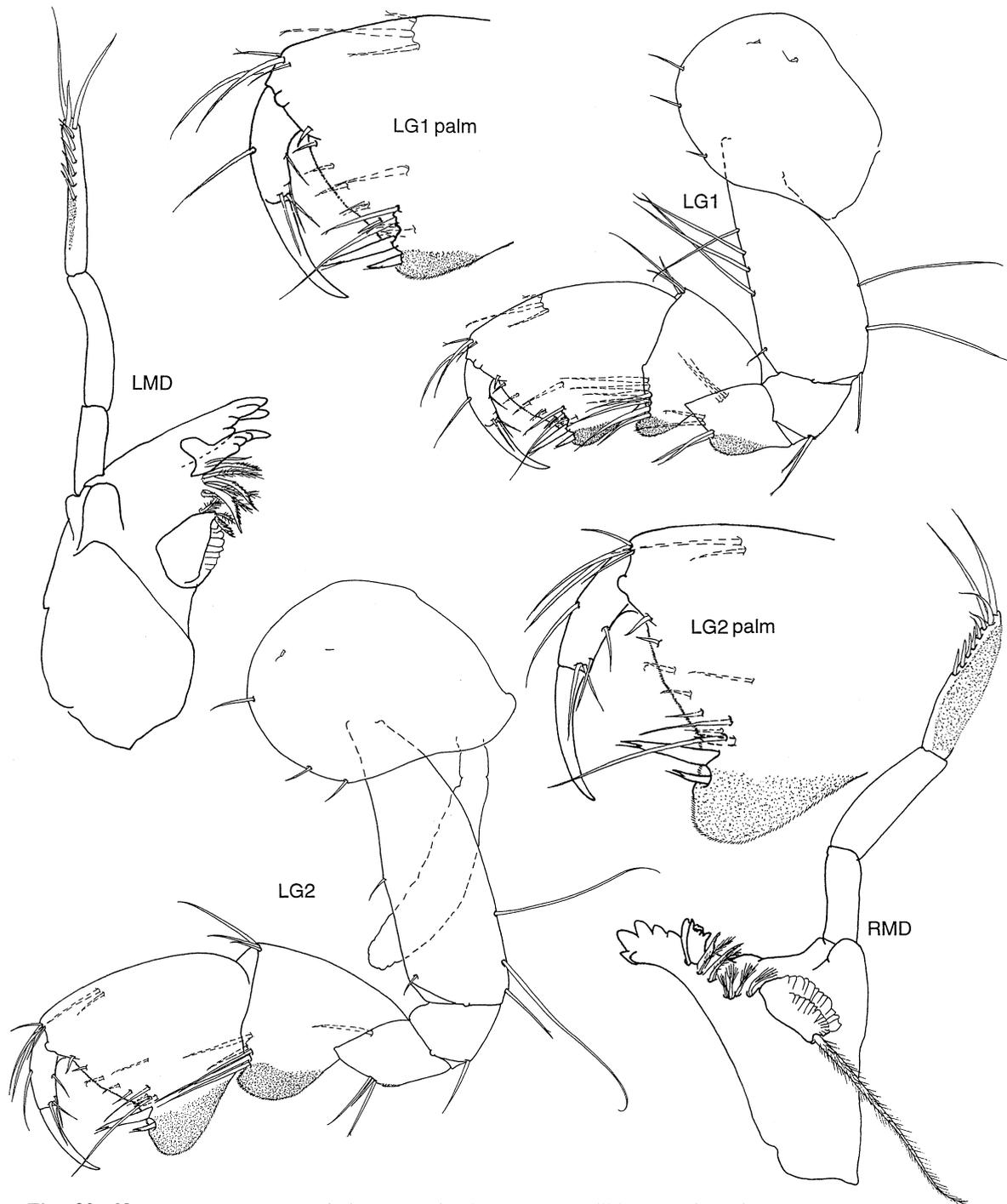


Fig. 22. *Neocrypta annae* n.sp. holotype male 4.5 mm; mandibles, gnathopods.

rami of uropods 1 and 2 with one or no dorsal robust seta rows, the inner ramus of uropod 3 $0.09\times$ length of outer ramus. Telson cleft 20%, with mid lateral spination

Description of holotype (male). *Body* (Fig. 21): pleon with few dorsal arms, pleonites 1–4 with few setae, pleonite 5 with two distolateral robust setae, pleonite 6 with one mid dorsolateral robust seta basal to the telson, length 4.5 mm. *Head*: rostrum small, eyes absent. *First antenna* (Fig. 21): length $0.56\times$ body, $2.1\times$ second antenna, peduncle shorter than flagellum; ratio of lengths of peduncular articles 25:27:18,

with sparse setae; flagellum of seventeen articles, uniform and sparsely setulate, aesthetascs present on articles 4–17; accessory flagellum 2-articulate, extending to M0.5 of the second primary flagellum article. *Second antenna* (Fig. 21): length: $0.27\times$ body; the peduncle much longer than flagellum—68:35—articles 4 and 5 subequal in length, articles 3–5 with moderate ventral setation; flagellum of five articles, weakly setose ventrally, aesthetascs absent. *Left mandible* (Fig. 22): palp article 3 $1.2\times$ article 2, weakly falcate, with setae 6D3E, articles 1 and 2 naked; incisor with five teeth; lacinia mobilis with four; three chisel robust seta accessory blades with three

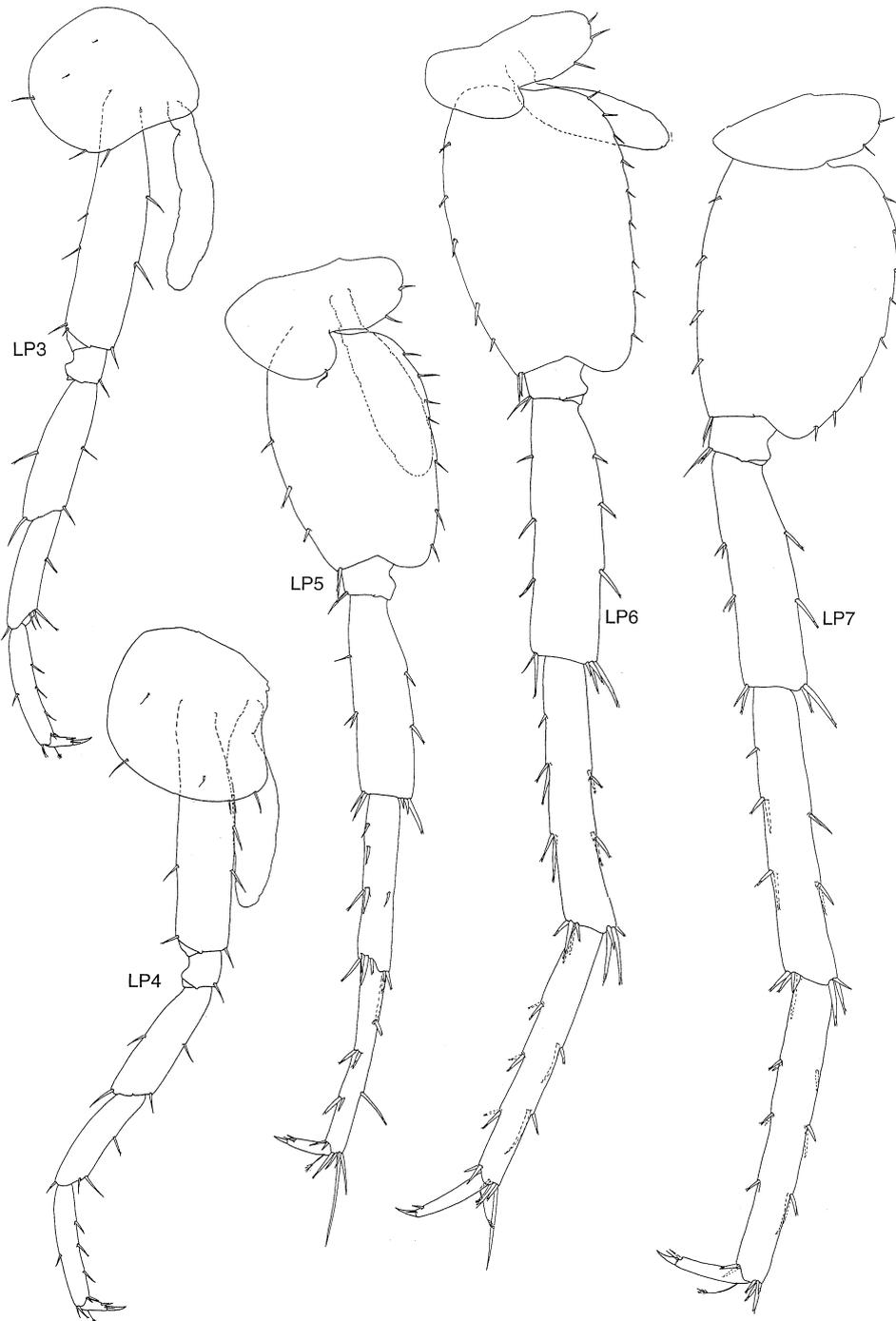


Fig. 23. *Neocrypta annae* n.sp. holotype male 4.5 mm; peraeopods.

interraker plumose setae and one naked robust seta at the base of the incisor, two brushy setae leading to the molar; molar triturative with a short anterior raker blade, no pappose seta. *Right mandible* (Fig. 22): palp with setae 6D3E; incisor with six teeth; lacinia mobilis bifid, denticulate; accessory blades of two chisel robust setae and two plumose setae, four brushy setae basal to the molar; molar triturative with a long posterior pappose seta. *Maxillae* (Fig. 21). Left first maxilla: palp with three thin medio distal to apical robust setae and one similar laterodistal robust seta; outer plate with seven

denticulate strong apical robust setae; inner plate with two apical plumose setae. Right first maxilla: palp with a mediolateral row of four robust setae and two distolateral long robust setae, the distal with apical armaments; outer plate with seven denticulate robust setae, the inner plate with two plumose apical setae. Second maxilla: both plates with long curved apical setae; outer plate distolateral margin with a single small seta; inner plate with two medio distal submarginal slender setae. *Maxilliped* (Fig. 21): palp article 2 moderately setose medially, article 3 with two slender setae basal to the

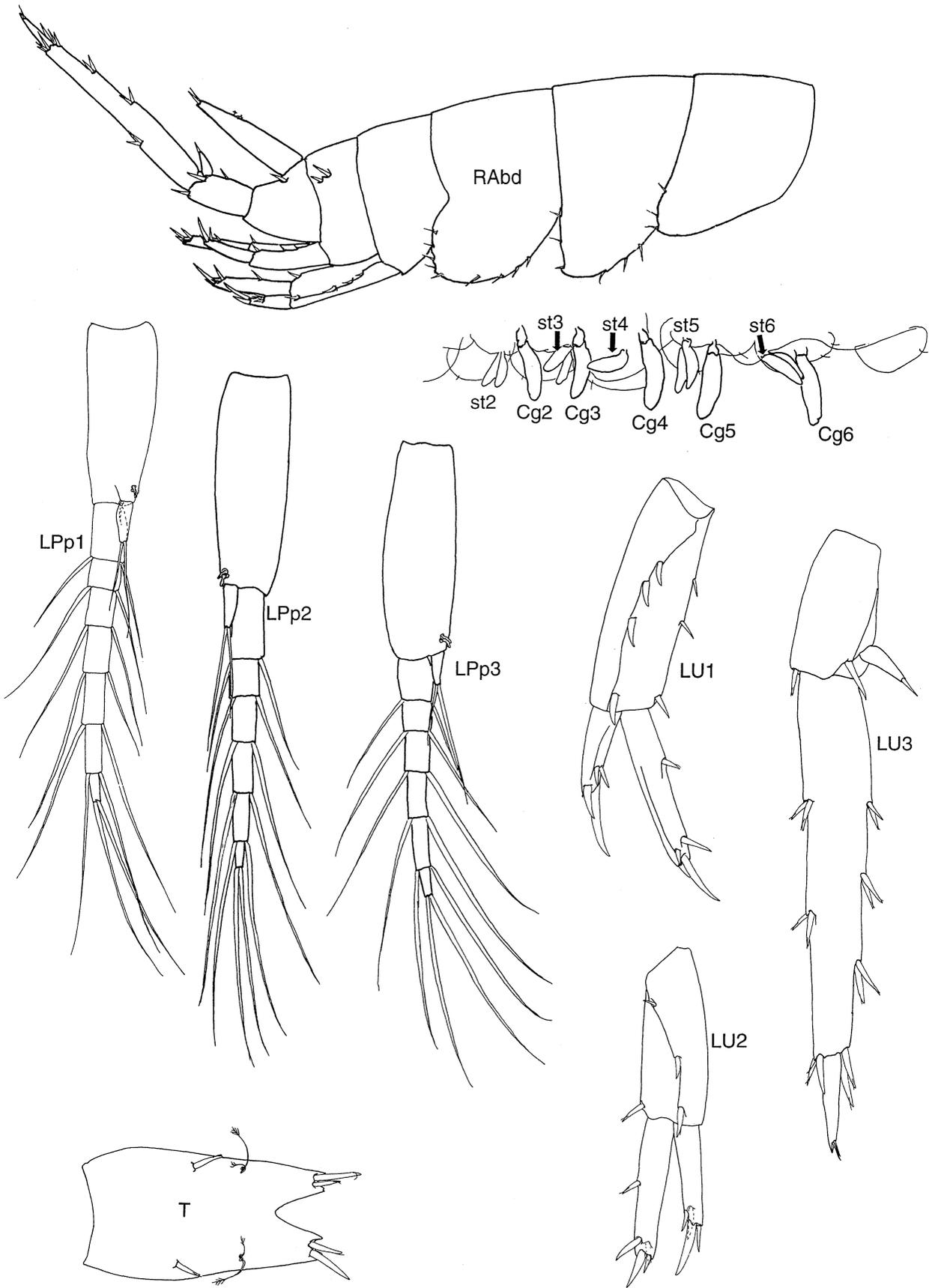


Fig. 24. *Neocrypta annae* n.sp. holotype male 4.5 mm; abdomen, gills, pleopods, uropods, telson.

dactyl, a row of five mediobasal setae, two accessory spinules adjacent the nail, the apex moderately lobate and rugose; inner plate apex with two thick naked robust setae, two plumose and one long naked setae a disto medial plumose seta and two ventrofacial naked setae; outer plate bearing a distolateral plumose robust seta, three slender setae, one naked tooth like robust seta continuous with a row of stout naked sub marginal medial robust setae and a basal row of four slender robust setae. *First gnathopod* (Fig. 22): coxal plate with a row of three moderate length apical setae, article 2 without posterior rugose extension, article 3 with a small postdistal rugose lobe, articles 4–6 with substantial posterior rugose lobes; carpus short, without apical setae on the posterior lobe; propodus trapezoidal, wider than long, posterior rugose lobe keel-like, few, simple palmar robust setae, palmar corner marked by one medial and two lateral robust setae, dactylus with two inner accessory setae and stiff spinules at the inner nail articulation; dactylus reaching slightly beyond the palmar corner robust setae. *Second gnathopod* (Fig. 22): slightly larger than the first; coxa sparsely setose apically, bearing a slender sac like gill; articles 2 and 3 without posterior rugosities; article 4 with only a small mid marginal posterior rugose extension; carpus and propodus strongly lobate; palmar corner with one medial and two lateral stout robust setae, robust setae of palm sparse; dactyl with inner accessory setae, reaching to palmar corner robust setae. *Peraeopods* (Fig. 23): coxae 3 and 4 with three weak apical setae only; coxa 4 weakly emarginate, with a few small facial setules; peraeopods 3 and 4 subequal, slightly longer than the second gnathopod, articles 4 and 5 spinose posteriorly, articles 6 with posterior robust setae 1-1-1 and 1-1-1; peraeopods 5–7 similar, coxae with 2-3-2 weak to moderate posterior robust setae, articles 2 expanded, ovate—P5<6<7—post-ventrally moderately lobate, with small marginal setae, posterior margins of propodi lacking long setae except for long subdactylar setae on legs 5 and 6, dactyls without additional accessory spinules. *Gills* (Fig. 24): coxae 2–6 with sac like gills; sternites 2–6 with paired medial simple gills. *Epimera* (Fig. 24): without postventral teeth; posterior margins of E1 convex, E2 straight, E3 broadly convex, with 3-3-4 posterior setae; ventrofacial robust setae = 0-3-5. *Pleon*: pleonites 1–4 naked, five with two distolateral robust setae, pleonite 6 with one mid lateral robust seta basal to the telson. *Pleopods* (Fig. 24): each with two retinacula, peduncles otherwise naked except for a single small seta basal to the inner ramus of the first pleopod; rami diverse, both reduced, inner rami reduced to a single article only, without marginal setation, outer rami each of six articles. *Uropods* (Fig. 24): third uropod strongly elongate, extending well beyond first and second uropods in the intact specimen; uropod lengths relative to the first uropod 2 0.8×, uropod 3 1.7×. First uropod: peduncle length 1.3× medial, 2.3× lateral rami; apicodistal robust seta of outer margin slightly subapical, with a row of three short dorsal robust setae; medial margin with two robust setae plus the apical robust seta; rami unequal, medial 1.8× lateral, only the medial ramus with a single medial short robust seta, both rami with four terminal robust setae. Second uropod: peduncle longer than rami, 1.2× medial, 1.7× lateral ramus, with two short dorsolateral robust setae plus a distal subapical robust seta; rami unequal, medial ramus 1.4× lateral, only the medial ramus with a single medial robust seta, both rami with four apical robust setae. Third uropod: long, peduncle length 0.9× length of urosomite one, 0.3× length of outer ramus, bearing single distolateral and disto medial robust setae; outer ramus proximal article without setae, with two trans-lateral rows of 2-2 robust setae, three trans-medial rows of 2-2-2 robust setae, three distolateral and two distomedial robust setae, second article short, 0.2× length

of the first, with two small apical setules; inner ramus short, 0.09× length of the outer ramus, with a single apical robust seta. *Telson* (Fig. 24): moderately long, 2× urosomite three, 1.8× longer than broad, cleft 20%, apices with one long and one short robust seta, single dorsolateral robust setae at M0.4 on either side and a pair of lateral penicillate setules at M0.6 on either side.

Relationship. *Neocrypta annae* differs from *N. primaris* in: first and second antennae shorter with fewer articles; mandibular palp without C setae, less D and E setae; palp of right first maxilla narrow; first gnathopod more rugose; second article of peraeopods 5–7 less expanded posteriorly; outer rami of pleopods with fewer articles; uropods 1 and 2 with fewer robust setae; telson more deeply cleft, less tumid and narrower. *Neocrypta annae* differs from *N. moniae* in: first and second antennae with less flagellar articles, shorter; mandibular palp with few D setae; palp of right first maxilla narrow; medial margin of article 2 of maxillipedal palp less setose; first gnathopod with little rugosity; outer rami of pleopods with fewer articles; uropods 1 and 2 with fewer robust setae; telson more deeply cleft. *Neocrypta annae* differs from *N. robinae* in: first antenna longer, with more flagellar articles; second antenna longer, but with the same number of articles; mandibular palp bearing fewer D and E setae; palp of right first maxilla narrow; first gnathopod bearing moderate rugosities; second article of peraeopods 5–7 more expanded; telson cleft much more deeply, and broader. *Neocrypta annae* differs from *N. simoni* in: flagellum of first antenna longer and with more articles; second antenna without aesthetascs; mandibular palp with more D setae; right rather than left first maxilla palp narrow; first gnathopod more rugose; outer rami of pleopods of more articles; telson less tumid. *Neocrypta annae* differs from *N. georginae* in: first antenna longer and with a greater number of articles; second antenna with less articles and without apical aesthetasc; mandibular palp with less D setae; palp of right maxilla narrow; first gnathopod without facial rugosities; second article of peraeopods 5–7 more expanded posteriorly; first and second uropods less spinous; telson more deeply cleft, less tumid and more slender.

Distribution. Cave BP6, Bowan Park, New South Wales, 31°54'S 148°05'E.

Neocrypta simoni n.sp.

Figs 25–28

Etymology. Named for the first son of the second author in acknowledgment of his indirect contributions to the study of amphipods.

Type locality. Paradox Cave (Cave J-48), Jenolan, New South Wales, 33°49'S 150°02'E.

Material examined. HOLOTYPE (Australian Museum P51368) female “a” 4 mm, ALLOTYPE (Australian Museum P51369) male “b” 3 mm; collected 9 March, 1993 by S. Eberhard.

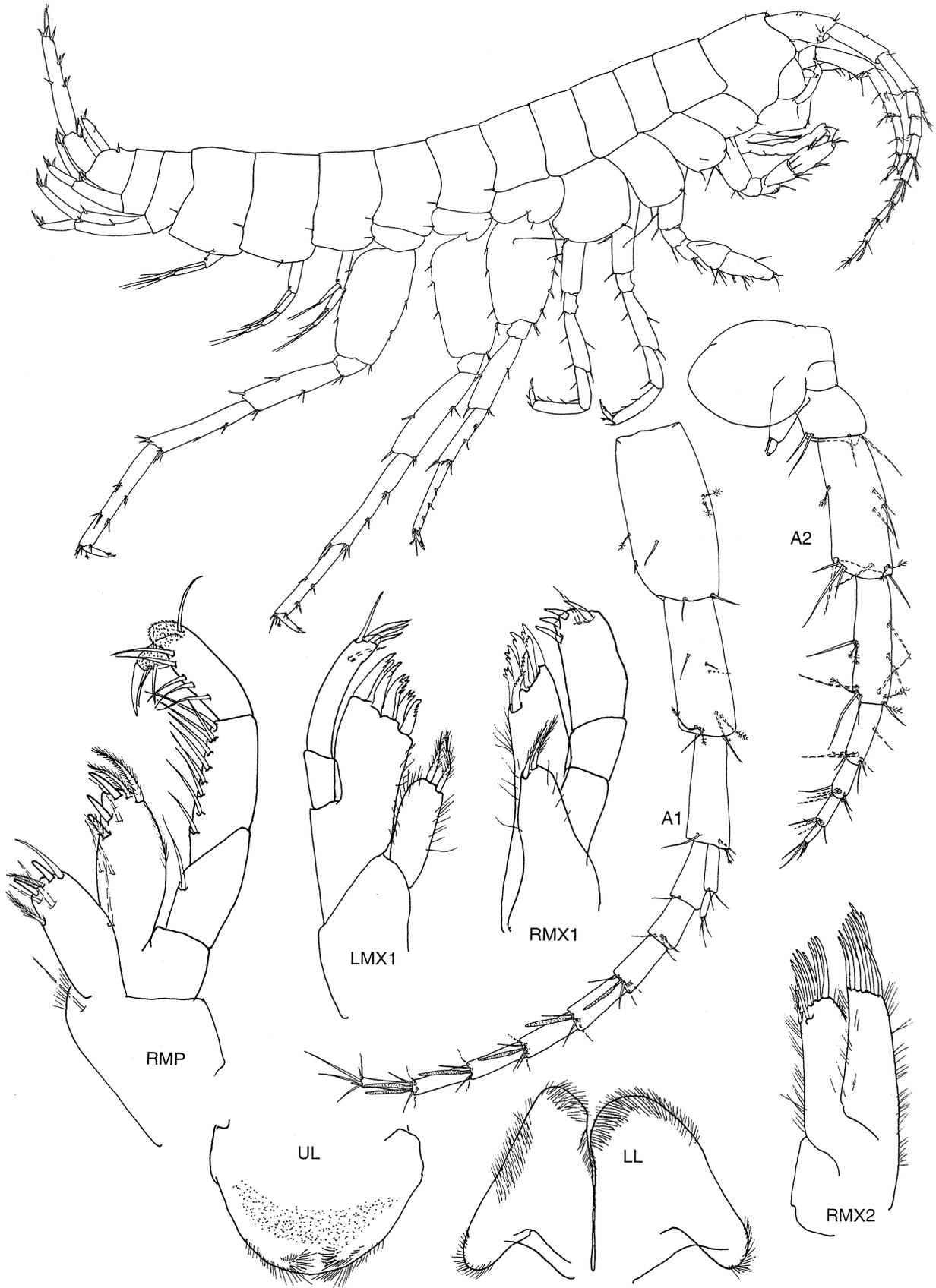


Fig. 25. *Neocrypta simoni* n.sp. holotype female "a" 4.0 mm; whole, antennae, mouthparts.

Diagnosis. Lateral cephalic lobes moderately projecting, antennal sinus moderate, ratio of lengths of peduncular articles of first antenna 10:8:5, ratio of lengths of mandibular palp articles 8:12:10 to 8:13:12, third article linear, setae DE. Inner plate of first maxilla with two plumose apical setae, inner plate of second maxilla with one mediobasal seta submarginal. Coxa 1 tapering apically, articles 2–4 of both gnathopods with posterior rugose lobe, robust setae of the palmar corner 3–2, palmar robust setae short and sparse, peraeopod 6 subequal to seven, second article of peraeopods 5–7 weakly postventrally lobate. Rami of both pleopods strongly reduced, inner rami of one article only, without marginal setation. Epimera without postventral teeth, rami of pleopods 1 and 2 without dorsal robust seta rows, inner ramus of third uropod 0.13× length of outer ramus. Telson cleft 20%, without mid lateral spination.

Description of holotype (female “a”). *Body* (Fig. 25): pereon and pleon without dorsal armaments except for a single small dorsolateral robust seta on pleonite 6 basal to the telson; length 4 mm. *Head*: rostrum small, eyes absent. *First antenna* (Fig. 25): moderate length, 0.56× body, 1.5× second antenna, peduncle shorter than flagellum, ratio of lengths of articles 10:8:5, setae sparse; flagellum of eight articles, segments uniform, sparsely setulate, bearing single aesthetascs on articles 3–6 and a pair on article 7; accessory flagellum of two articles reaching to M0.2 of article 2 of the primary flagellum. *Second antenna* (Fig. 25): length 0.4× body, peduncle much longer than flagellum—80:30—articles 4 and 5 subequal in length—27:24—articles 3–5 with moderate ventral setation; flagellum 4-articulate, weakly setose bearing a single small apical aesthetasc on article 4. *Left mandible* (Fig. 26): palp article 3 shorter than 2—23:26—linear, with 3D4E setae, distolaterally rugose, articles 1 and 2 naked; incisor with six teeth; lacinia mobilis four teeth; accessory blades of three chisel robust setae and two plumose robust setae; molar triturative with a short posterior pappose seta. *Right mandible* (Fig. 26): palp article 3 setae 3D4E, distolaterally rugose; incisor with five teeth; lacinia mobilis bifid, denticulate; no accessory robust setae, but three very short setae onto the base of the molar; molar bearing a hooked brushy basal seta and long posterior pappose seta. *Maxillae* (Fig. 25): palp of left first maxilla slender, bearing four thin apical robust setae and a ventrofacial seta, outer plate with seven denticulate robust setae, inner plate with two apical plumose setae; right first maxilla palp broad, with four thick mediobasal to apical robust setae and one ventrofacial seta; outer plate with seven strong denticulate robust setae, inner plate with two plumose apical setae; second maxillae: both plates with long curved apical setae; inner plate bearing one subdistal medial plumose seta and one simple disto facial submarginal seta. *Maxilliped* (Fig. 25): palp article 3 without thin basomedial setae, with two facial setae basal to the dactyl, and a single distolateral seta at the base of the strongly produced rugose apex; dactyl facially rugose, with two accessory setules on the inner distal margin; inner plate apex with two thick tooth like robust setae, one pappose robust seta and a long lateral seta, inner margin with one plumose seta, ventrodorsal face with two simple setae; outer plate with three naked basofacial setae, medial submarginal pappose and naked robust setae, a ventrofacial long seta, one naked and two long pappose robust setae apically. *First gnathopod* (Fig. 26): coxal plate with two marginal and one ventrofacial setae; articles 2 and 3 with small posterior rugose lobes; articles 4 and 5 with strong posterior rugose lobes; article 6 with a small area of posterior rugosity; carpus short, rugose lobe rounded, without apical setae; propodus trapezoidal, longer

than wide, the posterior angle subquadrate, palmar corner robust setae two lateral and one medial, palm with moderate numbers of simple setae, dactyl with recumbent inner tooth like robust seta, and reaching to the palmar corner. *Second gnathopod* (Fig. 26): slightly larger than the first; articles 2–4 all with posterior rugosities; article 4 posteriorly lobate, but less so than on the first gnathopod; carpal lobe larger than on the first; posterior proposal margin strongly lobate and rugose; palmar corner marked with one medial and one lateral robust seta; dactyl with an inner accessory setule, and reaching beyond the robust setae of the palmar corner; coxa sparsely setose apically with a sac like gill and slender oostegite. *Peraeopods* (Fig. 27): coxae 3 and 4 with sparse apical setation, coxa 4 moderately emarginate, both bearing slender sac like gill and oostegite; peraeopods 3 and 4 subequal, longer than gnathopod 2, articles 3 and 4 weakly setose and spinose, both propodi with the posterior robust seta formula 1-1-1-1; peraeopods 5–7 similar, coxae each with only a single weak posterior robust seta, article 2 expanded posteriorly, weakly lobate, with few moderate marginal setae, propodi with few posterior setae. *Gills* (Fig. 28): sac like simple gills present on coxae 2–6; sternites 2–6 bearing paired simple nondendritic gills on each segment. *Epimera* (Fig. 28): without post-ventral teeth, posterior margins almost straight, each with a single seta only, and single mid ventrofacial robust setae on epimera two and three. *Pleon* (Fig. 28): pleonites 1–5 naked; six with a single dorsolateral robust seta basal to the telson. *Pleopods* (Fig. 28): each with two retinaculæ; peduncles without setae or robust setae; rami reduced, outer rami each with three articles, the third outer ramus with a single additional distal seta on the first article; inner rami of one article each, without marginal setae. *Uropods* (Fig. 28): uropod 3 strongly extended, well beyond uropods 1 and 2 in the intact specimen; uropod lengths relative to uropod 1: uropod 2 0.78×, uropod 3 1.3×. First uropod: peduncle length 1.3× medial, and 1.5× lateral ramus, outer margin with a row of two short dorsal robust setae plus a sub apical distal robust seta, medial margin with a sub apical robust seta only; both rami without marginal robust setae, each with four apical robust setae. Second uropod: peduncle 1.3× medial, 1.5× lateral ramus, outer and inner margins with one sub apical distal robust seta; rami without marginal robust setae, each with four apical robust setae. Third uropod: peduncle length 0.35× outer ramus, as long as urosomite three with one small facial seta, a mediobasal robust seta adjacent the base of the inner ramus, and distolateral robust seta; outer ramus proximal article with two transverse medial rows of two robust setae each, two transverse lateral rows of one and two robust setae, and two medial and one lateral distal robust setae basal to the distal article; distal article length 0.26× proximal, with two fine apical setules; inner ramus small, 0.13× outer ramus with a single apical robust seta. *Telson* (Fig. 28): moderately long, longer than urosomite three, length 1.3× width; cleft 20%; apices each with a single robust seta set in a small notch, and a single lateral penicillate setule; without other dorsal spination or setation except for a pair of penicillate setules on either side at M0.49.

Description of allotype (male “b”). *Body*: length 3.5 mm. *First antenna*: primary flagellum of eight articles, aesthetascs present on articles 3–8, those on articles 3 and 4 paired; accessory flagellum of two articles, reaching to M0.4 of the second article of the primary flagellum. *Second antenna*: flagellum of four articles, the fourth with a small apical aesthetasc. *Mandibles*: similar to female. *Gnathopods*: similar to female. *Peraeopods*: leg three second article lacking one long posterior seta, similarly article 5 with one less posterior

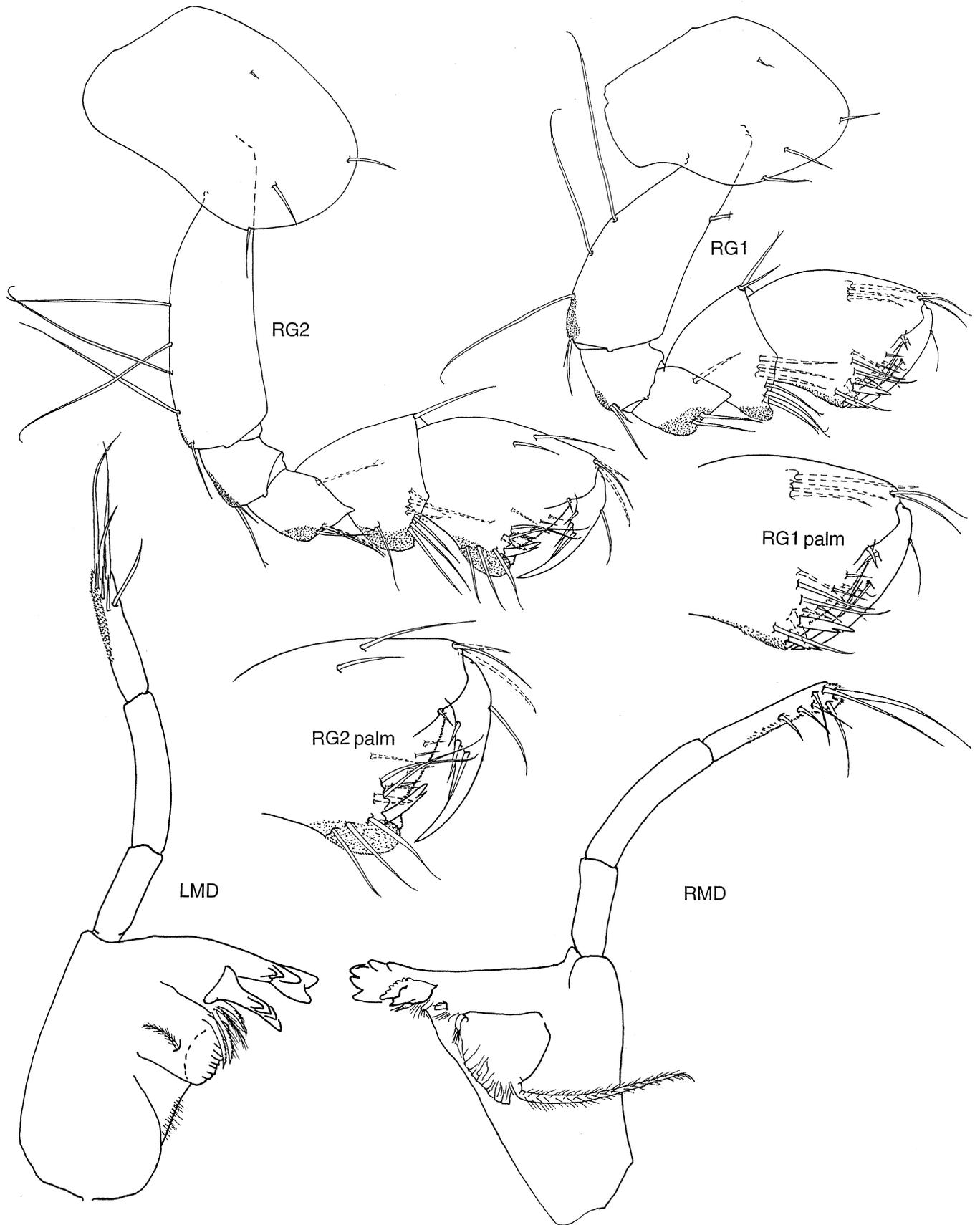


Fig. 26. *Neocrypta simoni* n.sp. holotype female "a" 4.0 mm; mandibles, gnathopods.

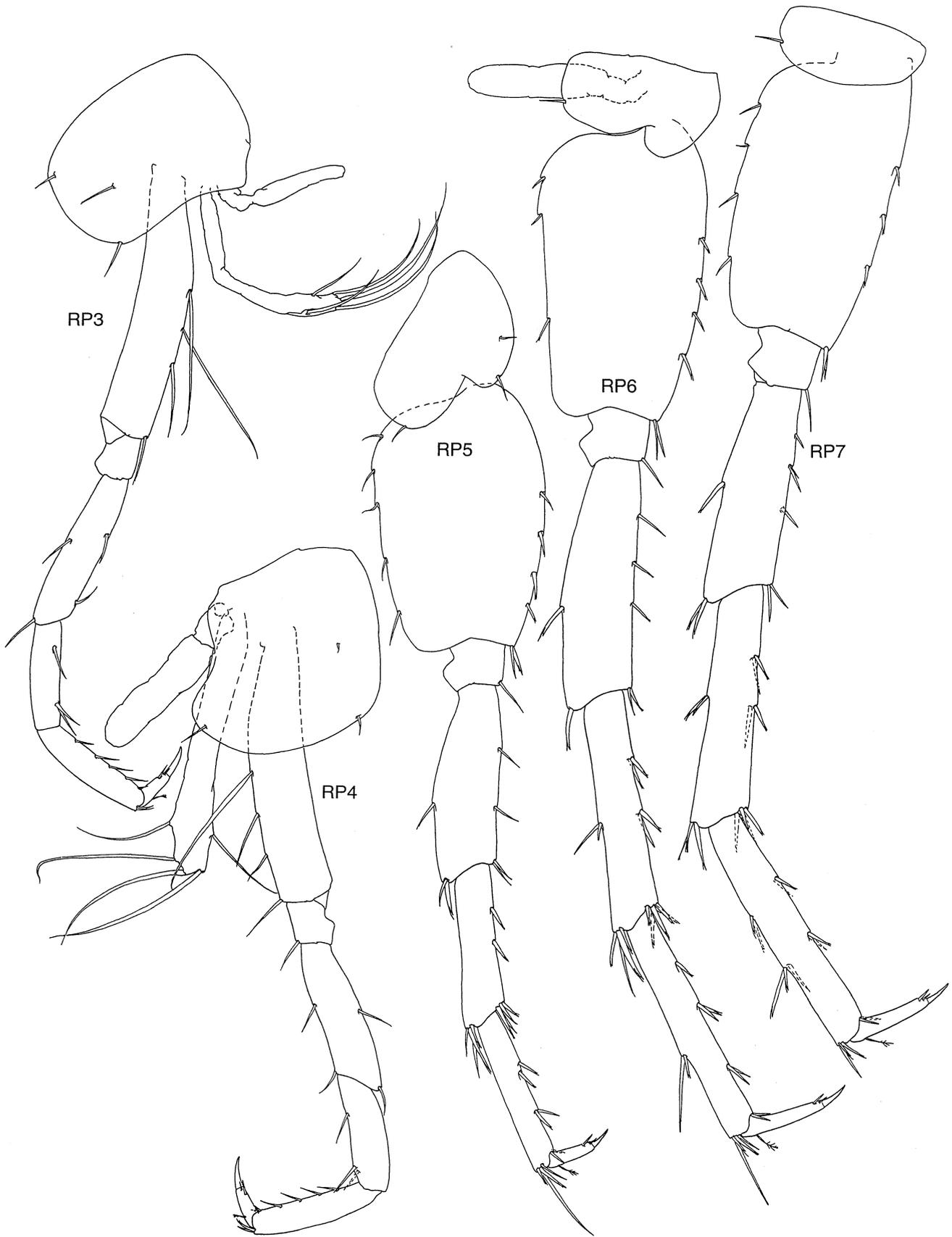


Fig. 27. *Neocrypta simoni* n.sp. holotype female "a" 4.0 mm; peraeopods.

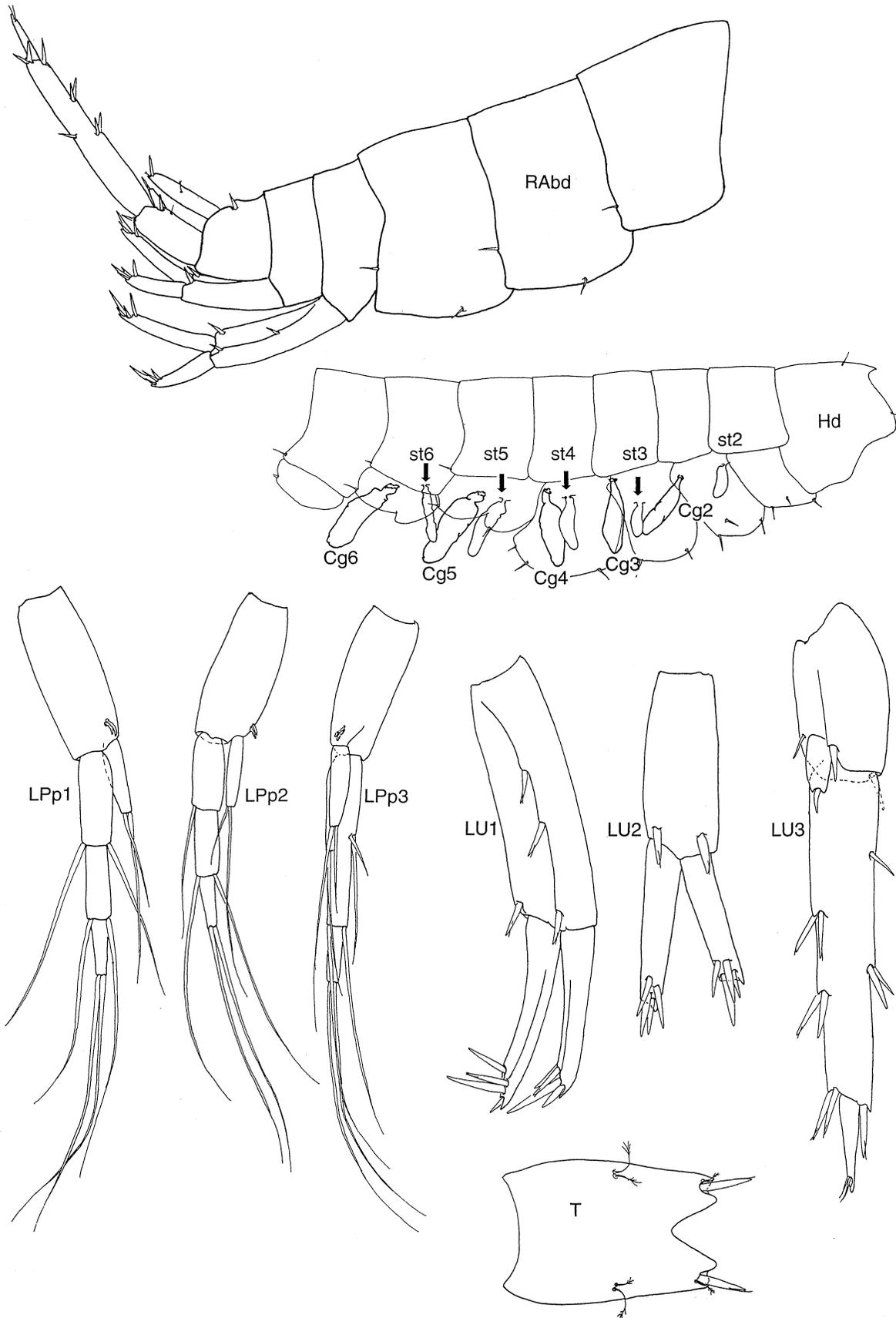


Fig. 28. *Neocrypta simoni* n.sp. holotype female "a" 4.0 mm; abdomen, gills, pleopods, uropods, telson.

seta; other peraeopods also less setose than female. *Pleopods*: similar to female, peduncles each with two retinacula, outer rami with 3-3-2 articles, inner rami each with one article. *Uropods*: first uropod peduncle with one lateral robust seta only; second uropod similarly naked; third uropod peduncle similar to female, outer ramus proximal article with only one lateral robust seta. *Telson*: similar to female.

Relationship. *Neocrypta simoni* differs from *N. primus* in: antennae shorter with few flagellar articles; second antenna bearing apical aesthetasc; mandibular palp with less D setae; left first maxilla palp narrow; article 2 of peraeopods 5-7 less broadly expanded; outer rami of pleopods with fewer articles; uropods 1 and 2 with fewer robust setae; telson cleft more deeply. *Neocrypta simoni* differs from *N. georginae* in: first antenna longest but with fewer articles, some aesthetascs paired; second antenna shorter, with aesthetasc on last article; mandibular palp with fewer D setae; palp of left first maxilla narrow; first gnathopod without facial rugosities; outer rami of pleopods with fewer articles; uropods less spinous; telson cleft more deeply.

Distribution. Paradox Cave (J48), Jenolan, New South Wales, 33°49'S 150°02'E.

Wombeyanus n.gen.

Etymology. Name refers to the type locality: Wombeyan Cave, New South Wales.

Type species. *Wombeyanus botulosus* n.sp.

Diagnosis. Pleonites with weak dorsal arms, rostrum small, lateral cephalic lobes weakly projecting, antennal sinus weak, without eyes. First antenna elongate, longer than the second, the ratio of peduncular articles 10:8:5, the accessory flagellum 2-articulate, calceoli present. The flagellum of the second antenna shorter than the peduncle, with prominent calceoli present. The ratio of lengths of articles of the mandibular palp equals 8:20:20 on the left mandible, 8:15:16 on the right, the second article poorly setose, the third weakly falcate, setae of the third article are BCDE. The labium lacks inner lobes. Inner plates of the maxillae are not setose medially, the first maxilla inner plate ovatotriangular with two apical plumose setae, the outer plate with seven terminal robust setae, the palps asymmetric. The second maxilla lacks an oblique row of facial setae but the two most medial setae of the inner plate are slightly sub marginal. The third article of the maxillipedal palp bears an extended rugose apical lobe. Coxae 1-4 moderately elongate, sparsely setose ventrally, coxae 1-3 without posterior robust setae, coxa 1 weakly tapering apically, coxa 4 moderately emarginate, coxae 5-7 much shorter than coxa 4. Gnathopods small, without sexual dimorphism, carpi short, with a strong posterior rugose lobe, articles 2-4 also bearing rugosities on the post-distal corner, palms transverse to slightly oblique, rugose post-distally, palmar robust setae not bifid nor dense nor bearing triggers, robust setae at palmar corner three or four. Peraeopods 3 and 4 with robust seta sets on the posterior of article 6 evenly spaced, peraeopods 5-7 moderately elongate, six longer than seven, article 2 of peraeopods 5-7 broadly expanded, least on six, ovate, and post-ventrally lobate, articles 4 with few setae, except for an elongate basodactylar seta on peraeopod 5, the anterior margins of article 6 with 5-6-5 robust seta

sets as well as locking robust setae. Dactyls of peraeopods with one marginal and one facial setule. Gills present on coxae 2-6, absent from coxa 7. Sternal gills present on segments 2-6, simple sausage like, attached to the antero- or mid-lateral edge of each segment. Pleopods similar; each with two retinaculae, without accessory retinaculae; the rami subequal, medial setae of the inner ramus of each bifid. Epimera without posterior teeth; ventrofacial robust setae present on epimera two and three; the posterior margins with few setae. Robust setae of uropods 1 and 2 all short. Peduncles of uropods 1 and 2 with a single robust seta on the apico medial corner, the rami extending unequally, margins with few robust setae or setae, basofacial arms of the first uropod absent, the third uropod strongly extended, parviramous, the peduncle relatively short, robust setae of the outer ramus arranged in multiples in lateral and medial rows, the outer ramus with two articles, the second short, medial setae absent from the first article, without plumose setae, the inner ramus very short, with two apical robust setae. The telson short, cleft about 46%, the lobes not laterally tumid, with only apical spination, and a pair of lateral penicillate setules at M0.75

Additional description. Upper lip uniform, rounded but weakly asymmetrical below, mandible accessory blades (rakers) with interraker plumose setae, few additional penicillate setae beyond rakers riding onto the base of the molar, with two bent basal molarial ragged setae. The lower lip uniform, the inner lobes absent. Both plates of the second maxilla with long apical setae. Maxilla inner plates and the lateral margins of the second maxilla moderately pubescent. Maxillipedal inner plate with a distal row of a few plumose setae, three blunt naked robust setae, reduced medial row of plumose setae, the outer plate with a few distal plumose setae, continuous with a mediobasal row of blunt naked tooth like robust setae, palp articles 2 and 3 poorly setose laterally, well setose medially, article 3 with several long robust setae near the base of the dactyl. Dactyls of gnathopods without a recumbent inner tooth like robust seta, with stiff spinules or setules at the inner nail articulation, and without additional spinules along the inner dactylar margin. Gnathopod 1 without an enlarged rastellate seta on the fourth article. Pleopods similar, the peduncles with few or no setae, and rami extending subequally. Urosomite one at the base of the first uropod with a moderate ventrodistal robust seta.

Sexual attributes. Oostegites moderately broad, calceoli absent on female antennae. Sexual differences in appendages minor.

Relationship. The genus is most similar to *Neoniphargus*, but differs from that genus in lacking eyes, the first antenna is only moderately longer than the second, the first article of the mandibular palp is relatively longer, there are fewer robust setae at the palmar corners, robust setae along the palm are not dense nor bearing triggers, posterior expansion of the second article is least on peraeopod 6 rather than five, sternal gills are neither dendritic nor bearing lumps, marginal spination of the rami of the first and second uropods is reduced, the telson is cleft 46% rather than 60%, and the lateral penicillate setules are placed more posteriorly, the ventrodistal robust seta on the first urosomite at the base of the first uropod is moderately long rather than short, and in the female is paired on the right side. The genus differs from *Wesniphargus* in the absence of lumps on

sternal gills, presence of rugosities on the propodi of both gnathopods, lack of coxal gill 7, and asymmetry of the palps of the first maxillae. *Wombeyanus* differs from *Tasniphargus* in the absence of long, dense setae or cojoint first articles on the first antenna, as well as absence of dendricity of the sternal gills. *Wombeyanus* differs from *Yulia* in the lack of dense setae on the pleopod peduncles and absence of an elongate spur on the outer ramus of the first uropod of the male, as well as the absence of dendritic sternal gills. *Wombeyanus* differs from *Neocrypta* in the presence of calceoli on the flagellum of the second antenna; the first article of the mandibular palp is relatively short, the second slightly setose, the third bears B and C setae; coxa 4 is moderately rather than weakly emarginate; pleopods are not reduced, inner and outer rami being subequal; telson is short rather than long, and cleft 46% rather than 20% or less.

Wombeyanus botulosus n.sp.

Figs 29–32

Etymology. From Latin *botulosus*, meaning sausage; name refers to the simple, sausage-like sternal gills.

Type locality. Bullio Cave (2W2) part of the Wombeyan Cave system, New South Wales, 34°19'S 149°59'E.

Material examined. HOLOTYPE (Australian Museum P51370) male "x" 7.5 mm, ALLOTYPE (Australian Museum P51371) female "y" 7.5 mm, other in the type series; male 7.5 mm; collected by T. Dennis 5 April, 1986.

Diagnosis. As in the genus.

Description of holotype (male "x"). *Body* (Fig. 29): pleon not armed dorsally, pleonites 1–4 with few setae, pleonites 5 and 6 with one robust seta on each side, length 7.5 mm. *Head*: rostrum small, eyes absent. *First antenna* (Fig. 29): long, 0.55× body length, 1.9× the second antenna; the peduncle length less than the flagellum, the ratio of lengths 10:8:5, setae sparse, the third article bearing a single medial calceolus at M0.7; flagellum of 26 uniform, sparsely setulate articles, calceoli present on articles 2, 4, 5, 7 and 9, and aesthetascs on articles 3–26 excepting articles 8 and 25; accessory flagellum of two articles, extending to M0.7 of the second article of the primary flagellum. *Second antenna* (Fig. 29): length about 0.3× body, peduncle approximately 1.9× the length of the flagellum, peduncular articles 4–5 subequal in length, articles 3–5 bearing moderate ventral setation; flagellum of ten weakly setate articles of which articles 1–7 bear calceoli, the distal three with a single aesthetasc each. *Left mandible* (Fig. 31): palp articles 2 and 3 equal in length, article 2 with four inner marginal setae, article 3 weakly falcate, bearing 2B5C23D3E setae; incisor with five teeth; lacinia mobilis with four teeth and a few fine basofacial setae; three chisel robust seta accessory blades and three interraker plumose setae; molar bearing a moderate posterior pappose seta as well as two brushy and one naked basal setae. *Right mandible* (Fig. 31): palp articles 2 and 3 equal in length, article 2 bearing four medial setae, setae of article 3 2B6C23D3E; incisor bearing five teeth; lacinia mobilis bifid and denticulate with a few medial setules; accessory blades of two blunt chisel robust setae bearing distal rugosities, two bent brushy setae onto the base of the molar; molar barely

tritulative, bearing a long pappose posterior seta, and a few mediobasal setules. *Maxillae* (Fig. 29): left first maxilla; palp article 2 with a row of four apicomедial and apical slender robust setae, three facial robust setae and one plumose distolateral seta, the outer plate nine terminal robust setae most denticulate, and the inner plate two plumose setae; right first maxilla, palp article 2 with five thick apicomедial robust setae, one apicolateral plumose seta, and two sub terminal apicolateral facial setae, the inner plate with two plumose apical setae; second maxilla outer plate apical margin with one small spinule, inner plate apicomедial corner with two weakly submarginal plumose setae and one slender naked seta. *Maxilliped* (Fig. 29): palp article 3 without ranks of thin setae on the inner ventral face, with four elongate apicolateral setae, the apex strongly produced and rugose, the dactylar face and mediofacial area of article 3 also rugose; inner plate with three thick tooth like robust setae, six plumose setae, and a single naked facial sub terminal seta apically, a medial row of three plumose setae, lacking medial ventrofacial robust setae, the peduncle bearing four slender medial setae basal to the inner plate, and one lateral seta; outer plate with two facial and two ventrofacial setae at M0.4 and M0.6 respectively, a row of six submarginal medio distal blunt tooth like robust setae, one plumose one armed and one naked terminal setae, and one naked ventro distal seta. *First gnathopod* (Fig. 30): coxal plate with a sparse row of short apical setae; fourth article bearing a small barely rugose posterior hump; carpus short, strongly lobate, the lobe rounded, without apical setae, and rugose; propodus trapezoidal, slightly longer than wide, the posterior angle with three short medial robust setae and two long, strong lateral robust setae, rounded and thus bearing a small rugose lobe, palm transverse, slightly convex, the dactylus with accessory spinules on the inner margin, and reaching to the palmar corner robust setae. *Second gnathopod* (Fig. 30): slightly larger than the first; the carpal lobe broader; the palmar corner more lobate, with two short medial robust setae and three lateral robust setae, dactylus bearing inner margin accessory spinules, and reaching to the palmar corner robust setae; coxa sparsely setulose apically, bearing a sac like gill. *Peraeopods* (Fig. 31): coxa 3 with a sparse row of short apical setae, coxa 4 moderately emarginate with three anteroventral setae and five posterior setae, peraeopods 3 and 4 subequal in length, longer than the second gnathopod, articles 4 and 5 spinous posteriorly, article 6 of the third leg bearing 2-2-2-2-2 posterior robust setae, and of the fourth leg 1-2-2-2-2 posterior robust setae; peraeopods 5, 6 and 7 similar, the coxae each bearing a weak posterior robust seta, the second articles expanded posteriorly, that of the sixth leg slightly narrower than the other two, ovate, postventrally moderately lobate, with short marginal setae, the posterior margins of the propodi without long setae except at the base of the dactyls, the dactyls a single facial and medial setule and without additional setules. *Gills* (Fig. 32): coxae 2–6 each bearing a single, sac like gill; sternites 2–6 each bearing a single simple, non dendritic gill. *Epimera* (Fig. 32): 1–3 without post-ventral teeth, although the third slightly acuminate; the first epimeron with no ventral robust setae, the second with two—one on the mid-anterior margin and one posterior-, the third with two anteroventral and one mid-ventral slightly facial robust setae, the posterior margins sinuous and with few setae. *Pleon* (Fig. 32): pleonites 1–3, bearing 2-2-3 post-dorsal marginal setae as well as fine marginal teeth; urosomite one without dorsal armaments; urosomites 5 and 6 each bearing a single dorso lateral seta posteriorly. *Pleopods* (Fig. 32): each with two retinacula and no accessory retinacula; peduncles naked except for three small basofacial setules on the first, and two small setae distolateral on the third; first

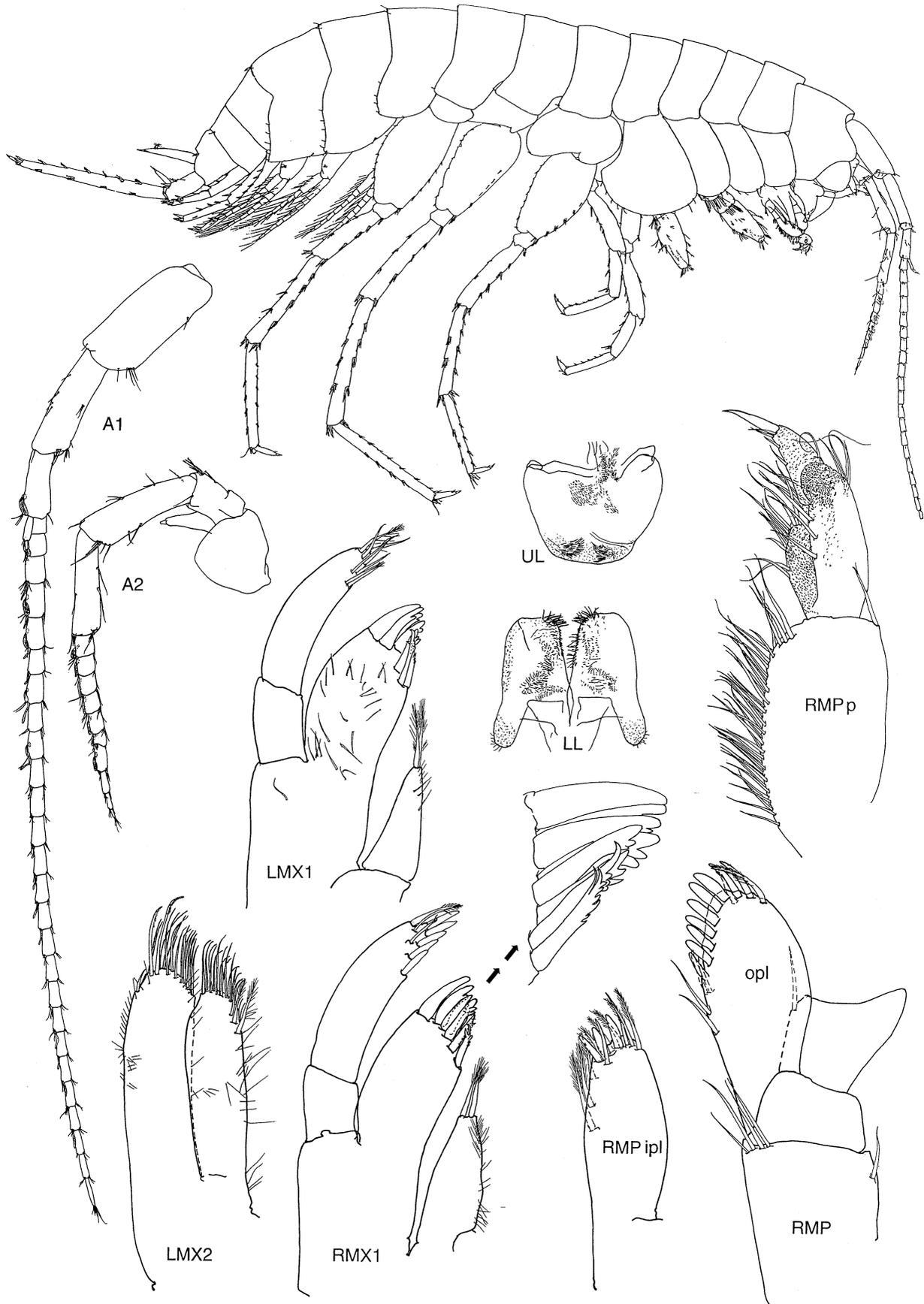


Fig. 29. *Wombeyanus botulosus* n.sp. holotype male "x" 7.5 mm; whole, antennae, mouthparts.

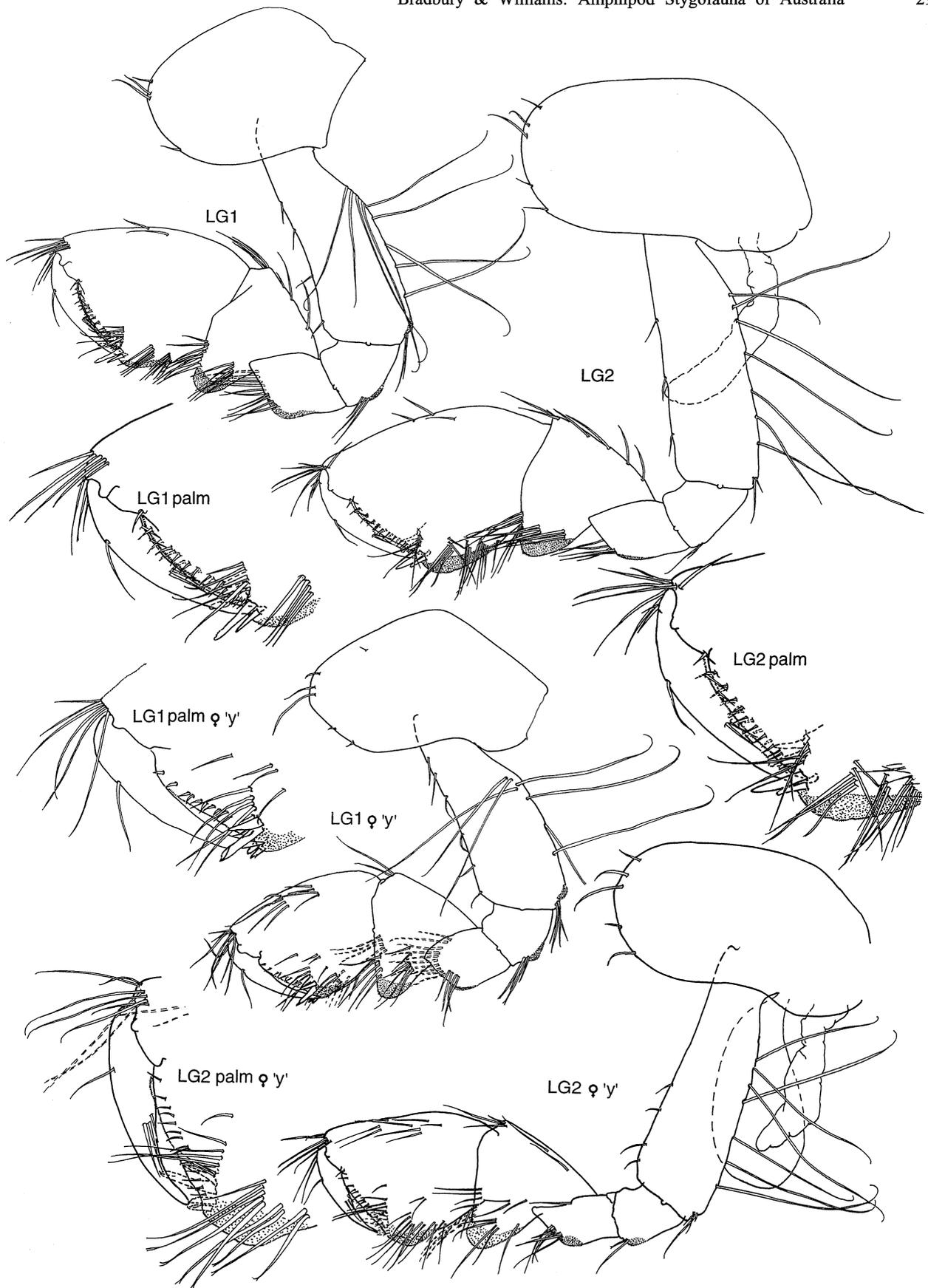


Fig. 30. *Wombeyanus botulosus* n.sp. holotype male "x" 7.5 mm; gnathopods (all drawings except those indicated). Allotype female "y" 7.5 mm gnathopods.

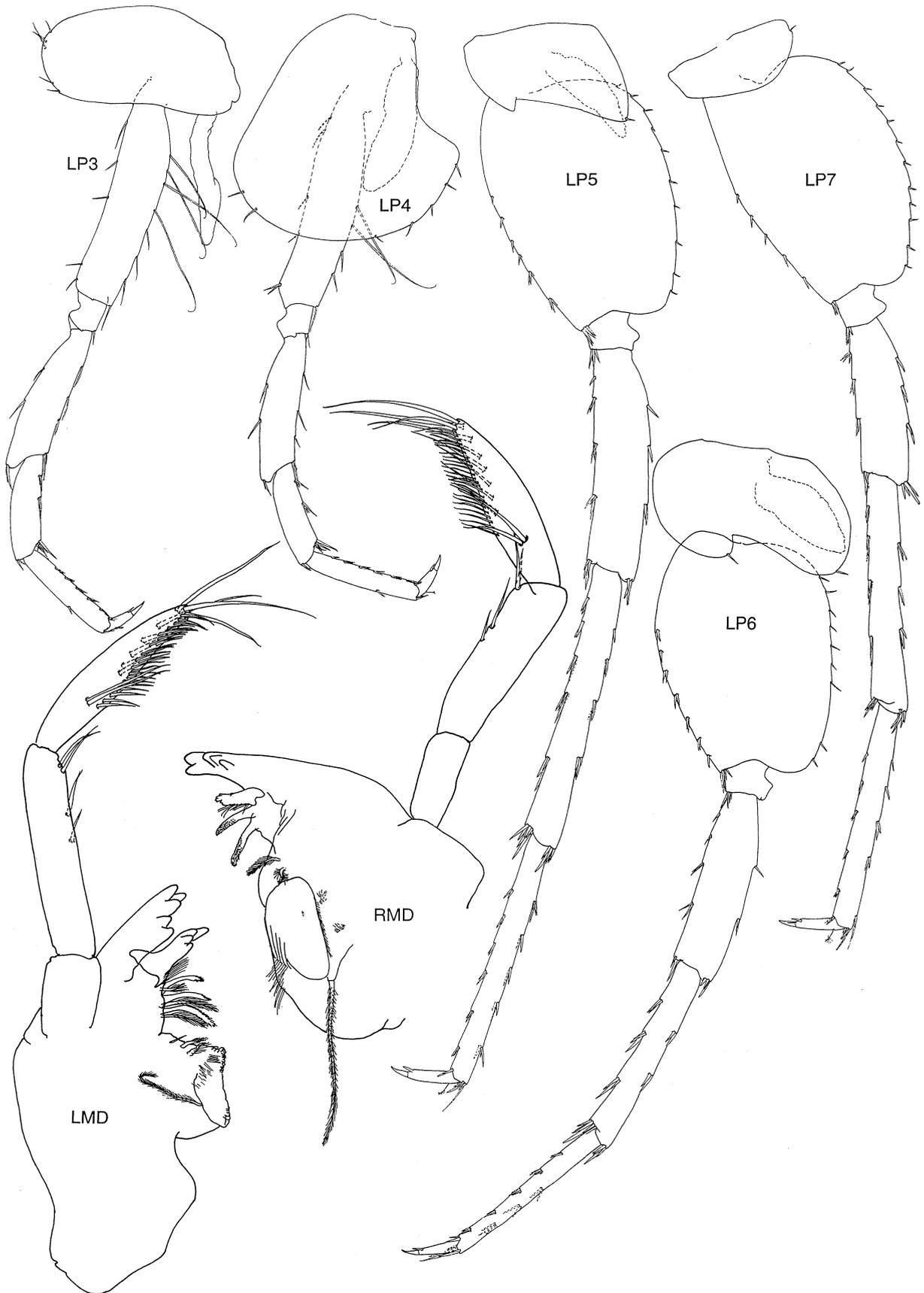


Fig. 31. *Wombeyanus botulosus* n.sp. holotype male "x" 7.5 mm; mandibles, pereopods.

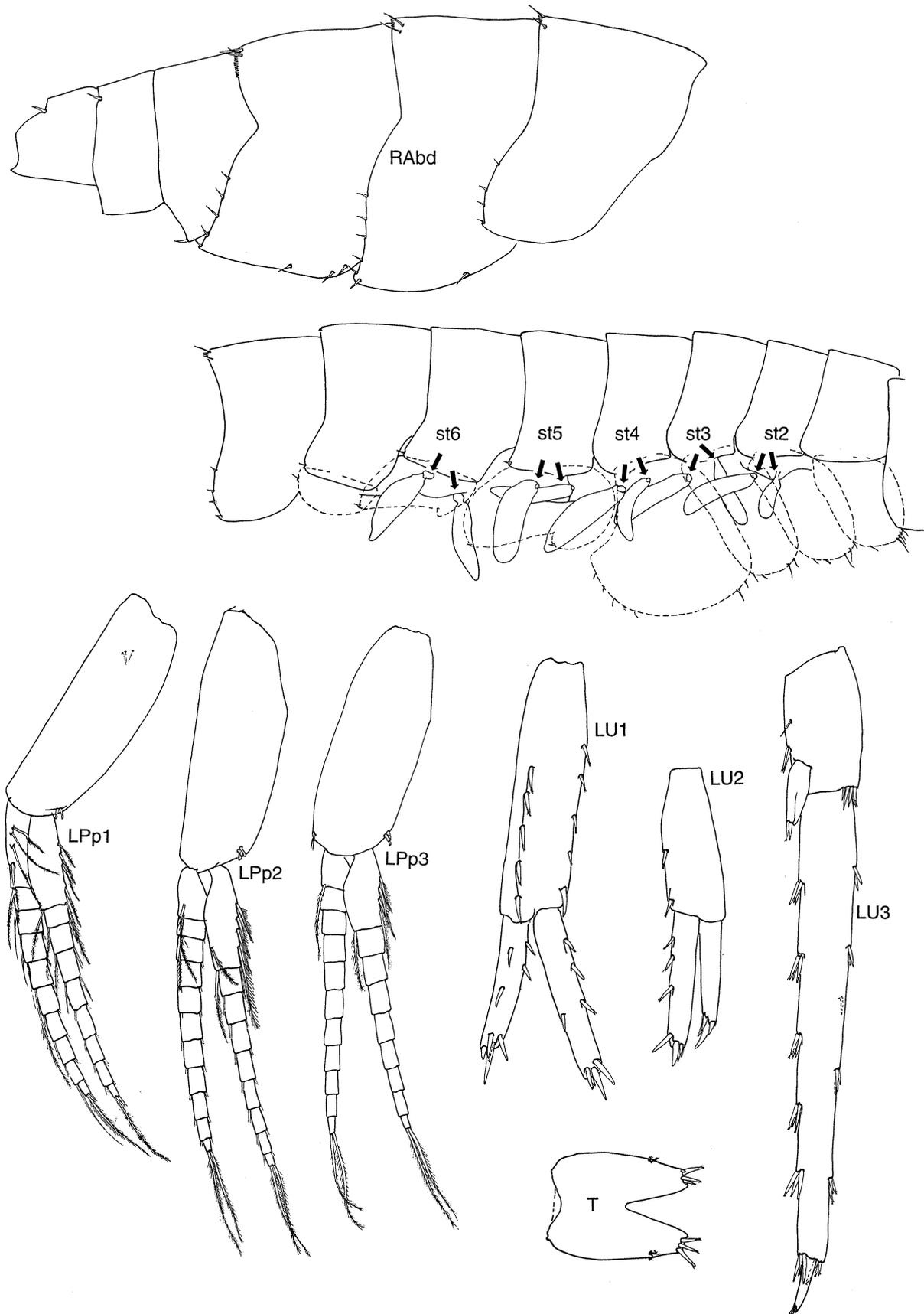


Fig. 32. *Wombeyanus botulosus* n.sp. holotype male "x" 7.5 mm; abdomen, gills, pleopods, uropods, telson.

article of the inner rami of each bearing terminally bifid basomedial setae and an additional ordinary plumose seta, rami of 9-9, 11-9, 11-9 lateral and medial articles respectively. *Uropods* (Fig. 32): third uropod extending well beyond uropods 1 and 2 in the whole animal; uropod lengths relative to uropod 1; uropod 2 0.65×, uropod 3 1.5×; first uropod peduncle length 1.4× medial and 1.8× lateral rami, the lateral margin without an apicodistal robust seta, with a row of five dorsal robust setae, the medial margin bearing five robust setae, rami of unequal length, both with two rows of short marginal robust setae, and four apical robust setae; second uropod peduncle approximately the same length as the medial ramus, with two short dorsolateral robust setae including the apical robust seta, outer ramus slightly shorter than the inner, only the medial ramus with three mediolateral robust setae, both rami with four terminal robust setae; third uropod peduncle as long as urosomite three, 0.5× the length of the outer ramus, bearing one facial and two distomedial robust setae and a distolateral row of five robust setae, the outer ramus of two articles, proximal article with transverse rows of robust setae arranged laterally 2-2-1-3-3 and medially 3-3-3-3-3, without setae, and lateral and medial groups of three terminal robust setae, the distal article short, approximately 0.12× proximal, three fine apical setules, the inner ramus short, 0.27× outer, with two simple apical setae only. *Telson* (Fig. 32): moderate length, approximately equal to the length of the peduncle of the third uropod, length 1.25× width; cleft 46%; apices with three short robust setae in a row, no other robust setae, and a pair of penicillate setules dorsolaterally at M0.75.

Description of allotype (female “y”). *Body*: length 7.5 mm. *First antenna*: peduncle ratio of lengths 10:9:6; primary flagellum of 23 articles, aesthetascs present on articles 4–20. *Second antenna*: peduncle articles 3–5 sparsely setulate, lengths of articles 4 and 5 equal; flagellum of eight articles. *Left mandible*: incisor with four teeth; lacinia mobilis four teeth, and a group of basofacial setae; accessory blades of three chisel robust setae and three plumose setae; two bent brushy setae onto the base of the molar; molar triturative with a moderate posterior pappose seta; palp of three articles, ratio of lengths 8:20:21, article 2 with two medial setae, article 3 with setae 2B3C14D3E. *Right mandible*: incisor with four teeth; lacinia mobilis bifid and facially setose; accessory blades of two rakers and two plumose setae; three bent brushy setae onto the base of the molar; molar triturative, with a long posterior pappose seta; palp ratio of lengths of articles 8:22:23, second article with two medial setae, third article with setae 2B3C14D3E. *Left first maxilla*: palp with three slender apical robust setae, one with setules, two mediolateral and one apicofacial robust setae and two distofacial setae; outer plate with nine denticulate robust setae; inner plate with two apical plumose setae. *Right first maxilla*: palp with one stout setulate apical robust seta, an oblique distal row of five stout articulated robust setae, and a single apico facial slender seta. *First gnathopod* (Fig. 30): coxa with few apical setae; articles 2–4 with small posterior rugose lobes; carpus short with strong posterior rugose lobe; propodus trapezoidal, longer than wide, with small rugose posterior lobe, the rugosities extending to the corner robust setae; palmar corner with two small medial and two lateral robust setae, palm slightly oblique, straight, with few simple robust setae; dactyl with three accessory spinules on the inner margin and stiff spinules at the inner nail articulation. *Second gnathopod* (Fig. 30): coxa with few apical setae, bearing sac like gill and simple oostegite; articles 3 and 4 with small posterior rugose lobes; carpus with strong posterior rugose lobe; propodus with

moderate posterior rugose lobe, palmar corner with two medial and three lateral robust setae, palm slightly convex and oblique, with moderate numbers of simple robust setae, dactylus with three accessory spinules on the inner margin and two stiff spinules at the inner nail articulation, and reaching the palmar corner robust setae. *Peraeopods*: peraeopod 3 similar to male, with few apical coxal setae, coxa bearing a broad oostegite; peraeopod 4 about the same length as three, coxa deeply emarginate, bearing a broad oostegite. *Pleopods*: peduncle of first pleopod naked, lateral ramus with 11 articles, inner with eight; second pleopod rami with ten and nine articles respectively; peduncle of third pleopod with two mid medial and two distolateral setae, rami of ten and eight articles respectively. *Uropods*: first uropod peduncle with three dorsomedial setae including the apical seta and four dorsolateral and one apicolateral setae, the outer ramus with two basomedial and two lateral robust setae, the inner with three medial and one lateral robust setae, each with four apical robust setae; second uropod peduncle with two dorsolateral and one apicolateral robust setae, and one dorsomedial and one apicomedia robust setae, each with four apical robust setae; third uropod parviramous, peduncle with three latero- and two mediolateral robust setae and four setae basal to the inner ramus; inner ramus short with only a single apical robust seta; outer ramus proximal article with transverse lateral robust seta groups 2-2-2-2-3 and three distolateral robust setae, the medial margin with 2-3-2-2-2-2 and five distomedial robust setae, distal article with a pair of small apical spinules, ratio of lengths of articles; peduncle 20, outer ramus proximal article 62, distal 8, inner ramus 10. *Telson*: similar to male, both lobes with two rather than three apical robust setae; lateral penicillate setules at M0.6.

Distribution. Bullio Cave, cave 2W2, Wombeyan Cave system, New South Wales, 34°19'S 149°59'E.

Jasptorus n.gen.

Etymology. Named for the type locality and the lumpy sternal gills; *torus* (Latin) protuberance or bulge.

Type species. *Jasptorus solepti* n.sp.

Diagnosis. Eyes absent; the first antenna long, peduncle article 1 subequal with article 2, calceoli present on peduncle and flagellum; second antenna peduncle longer than flagellum, calceoli present on flagellum. Second article of mandibular palp relatively short and poorly setose, setae of the third article BCDE. Inner plate of the first maxilla with two apical plumose setae, outer plate with nine robust setae, distal robust setae of the right palp articulated not fused. Coxae 1–4 sparsely setose ventrally; robust setae at the corner of the palm of both gnathopods 4 or more, palmar robust setae not crowded or bifid; dactyls of peraeopods without additional facial setules; coxal gill 7 absent, sternal gills on segments 2–6, and lumpy, not fully dendritic. Epimera without postventral teeth or facial robust setae or setae near the ventral margin. First uropod without an elongate robust seta at the apicomedia corner; both rami of first and second uropods with one robust seta row each, the third uropod strongly extended and without plumose setae. Telson of moderate length, cleft about 56%, the lobes moderately tumid, with only apical spination.

Additional description. Accessory blades (rakers) on mandibles with interraker plumose setae; additional penicillate setae

beyond rakers and riding onto base of molar, with ragged bent molarial setae and pappose seta. Lower lip uniform, inner lobes absent. Both plates of maxilla two with long apical setae; inner plate of maxilla one and outer plate of maxilla two covered with pubescence. Maxillipedal inner plate with a distal row of few plumose setae and two blunt naked robust setae, a medial basofacial to mid-facial row of five plumose setae and a pair of blunt naked tooth like robust setae; palp articles 2 and 3 naked laterally, well setose medially, article 3 with two pairs of non-comb robust setae near the base of the dactyl, the apex produced and rugose, the dactyl rugose. Dactyls of gnathopods without recumbent inner tooth like robust seta, with stiff spinules at the inner nail articulation, with additional spinules along the inner dactylar margin. Pleopods similar; peduncles bearing few setae, rami extending equally. Ventrodorsal robust seta on urosomite one at the base of uropod 1 moderate to long.

Relationship. This genus bears lumpy sternal gills, a characteristic of *Wesniphargus* and is closest to that genus among the family. However, *Jasptorus* differs from *Wesniphargus* in: absence of eyes; shorter first peduncular article of the first antenna; sparse rather than moderate setation of the second article of the mandibular palp; asymmetry of the palp of the first maxillae; coxa 1 tapers apically, and the third coxa ovate rather than sub rectangular; propodi of gnathopods expanded apically, bearing posterior rugosities; palmar robust setae lacking triggers; second articles of peraeopods 5–7 moderately or weakly expanded posteriorly; third uropod distinctly parviramous, the outer ramus strongly extended and without medial plumose setae; telson cleft 56% rather than 85% and basally tumid. *Jasptorus* differs from *Tasniphargus* in the absence of eyes and of long dense setae and elongate basal flagellar articles on the first antenna, the presence of calceoli (on both antennae), presence of B and absence of A setae on the third article of the mandibular palp, nine rather than seven robust setae on the outer plate of the first maxilla; absence of triggers on palmar robust setae; coxal gill 6 not significantly reduced, sternal gills not dendritic; epimera without post-ventral teeth; clear asymmetry of rami of uropods 1 and 2; telson slightly tumid laterally. *Jasptorus* differs from *Neoniphargus* in the absence of eyes; sternal gills not dendritic; inner plate of first maxilla not ovate; dactyl of maxillipedal palp rugose as well as apex; palmar robust setae without triggers; corner robust setae of palms four or more rather than six or more; peraeopods elongate and slender; distodorsal robust setae of peduncles of uropods 1 and 2 sub apical; rami of uropods asymmetric, with few marginal robust setae; lobes of telson tumid basally. *Jasptorus* differs from *Yulia* in the absence of eyes; lack of long dense antennal setae; first antenna flagellar articles equal, not fused; C setae present on mandibular palp; inner plate of first maxilla with two rather than four apical setae; coxae poorly setose ventrally; robust setae of palmar corners four rather than eight; palmar robust setae not dense, bifid or with triggers; coxa 7 without gill; sternal gills lumpy rather than dendritic; peduncles of pleopods with no or very few setae; rami of uropods 1 and 2 unequal; third uropod strongly extended; telson moderately tumid.

Jasptorus solepti n.sp.

Figs 33–35

Etymology. Named for the slender form of the body: *soma* body, *leptos* thin.

Type locality. Cave WJ-10, Wee Jasper, New South Wales, 35°07'S 148°41'E.

Material examined. HOLOTYPE (Australian Museum P51372) male "a" 6.5 mm, other specimen in type series; male "b" 5 mm.

Diagnosis. As in the genus.

Description of holotype (male "a"). *Body* (Fig. 33): pleon with few dorsal arms, pleonites 1–4 with few setae, 5 and 6 with one dorsolateral robust seta each, length 6.5 mm. *Head*: rostrum small, eyes absent, lateral cephalic lobes prominent, antennal sinus moderate. *First antenna* (Fig. 33): length 0.8× body, 2.2× the second antenna, the peduncle shorter than the flagellum—64:151—with sparse setae; ratio of lengths of peduncular articles 10:9:6; flagellum of 25 uniform (excepting article 3 which is short), sparsely setulate articles; calceoli present on peduncle article 3 and flagellum articles 1, 2, 6, 8, 10, aesthetascs present on most flagellar articles; accessory flagellum 2-articulate reaching slightly beyond the end of article 1 of the primary flagellum. *Second antenna* (Fig. 33): length 0.36× body; peduncle 1.2× the flagellum, articles 4 and 5 subequal—22:23—and articles 3–5 with moderate ventral setation; flagellum of eight articles, weakly setose ventrally, calceoli present on articles 1–5. *Left mandible* (Fig. 33): palp relative lengths of articles 8:17:21; article 3 longer than 2, weakly falcate, with 1B3C21D5E setae, the second article bearing three inner marginal setae; incisor with four teeth and fine facial setae; lacinia mobilis with two weak teeth and an area of fine basofacial setae; accessory blades of three chisel robust setae and four plumose interraker setae; molar triturative with a long posterior pappose seta. *Right mandible* (Fig. 33): palp relative lengths of articles 8:23:27; third article longer than the second with 1B5C20D4E setae; incisor with four teeth; lacinia mobilis bifid, the anterior arm denticulate, the posterior with three teeth and an area of fine facial setules; two accessory blades (rakers), two plumose inter rakers, and three plumose and three hooked brushy setae onto the base of the molar; molar triturative without a posterior pappose seta. *Maxillae* (Fig. 33). *Left first maxilla*: palp article 2 with four submarginal mediobasal slender robust setae—three terminally armed and one naked—two armed and one naked distofacial robust setae and one distolateral plumose seta; outer plate with nine denticulate terminal robust setae and two short, slender, naked setae at the medio distal corner; inner plate with two apical plumose setae and one small naked medio distal seta. *Right first maxilla*: palp article 2 with five thick mediobasal to apical robust setae articulated to the segment, one apicolateral thin robust seta and one apicolateral rastellate seta; inner plate with two plumose apical setae. *Second maxilla*: outer plate with a small distolateral spinule; inner plate with two mediobasal (almost medial) plumose setae. *Maxilliped* (Fig. 33): palp article 3 with a row of thin setae on the inner margin, outer apex with three slender setae, apex face with two pairs of slender setae, dactyl with two medial and two sub terminal robust setae adjacent the nail, the apex strongly produced and rugose, as is the dactylar face; inner plate with two thick tooth like apical robust setae,

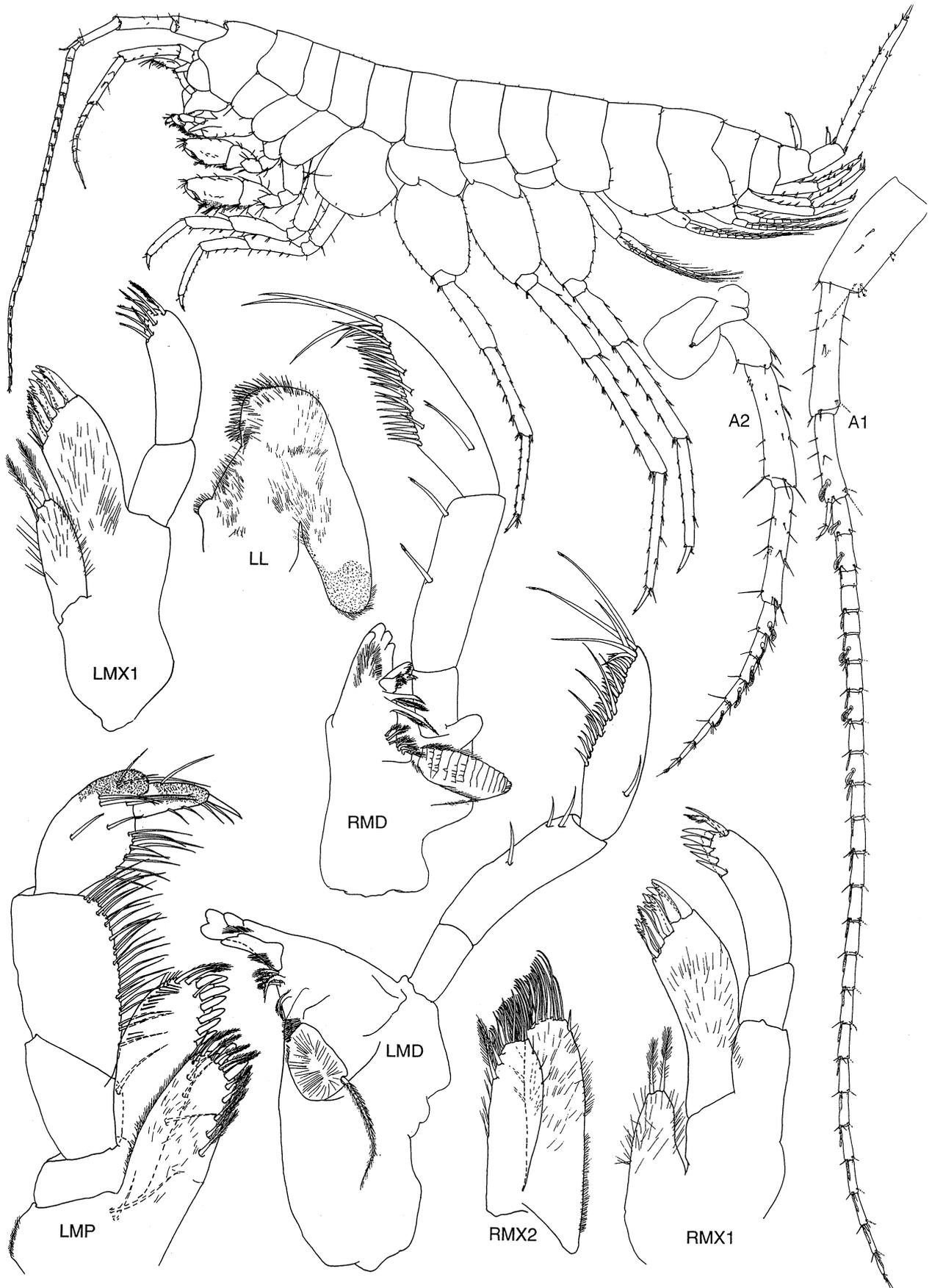


Fig. 33. *Jasptorus solepti* n.sp. holotype male "a" 6.5 mm; whole, antennae, mouthparts.

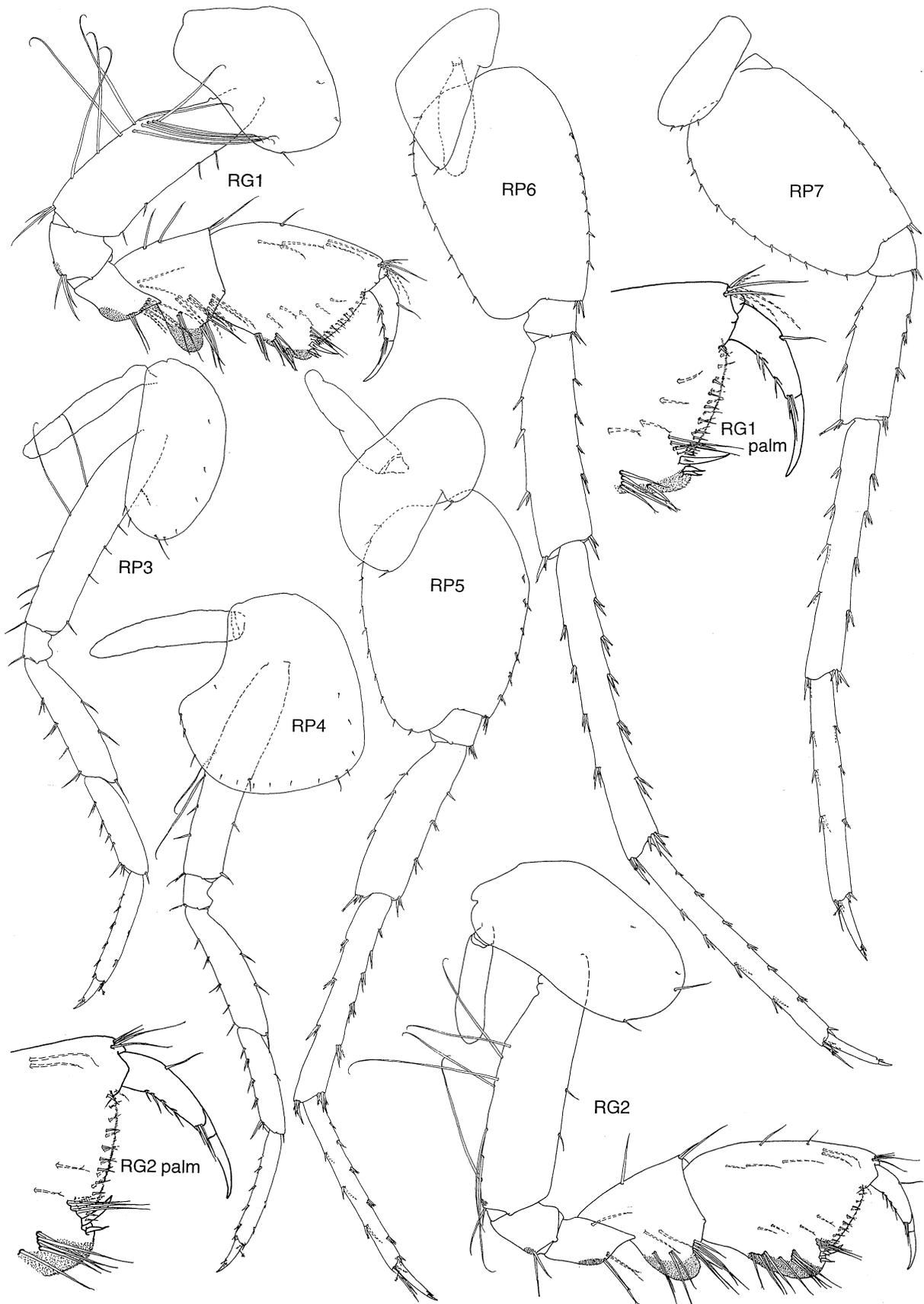


Fig. 34. *Jasptorus solepti* n.sp. holotype male "a" 6.5 mm; legs.

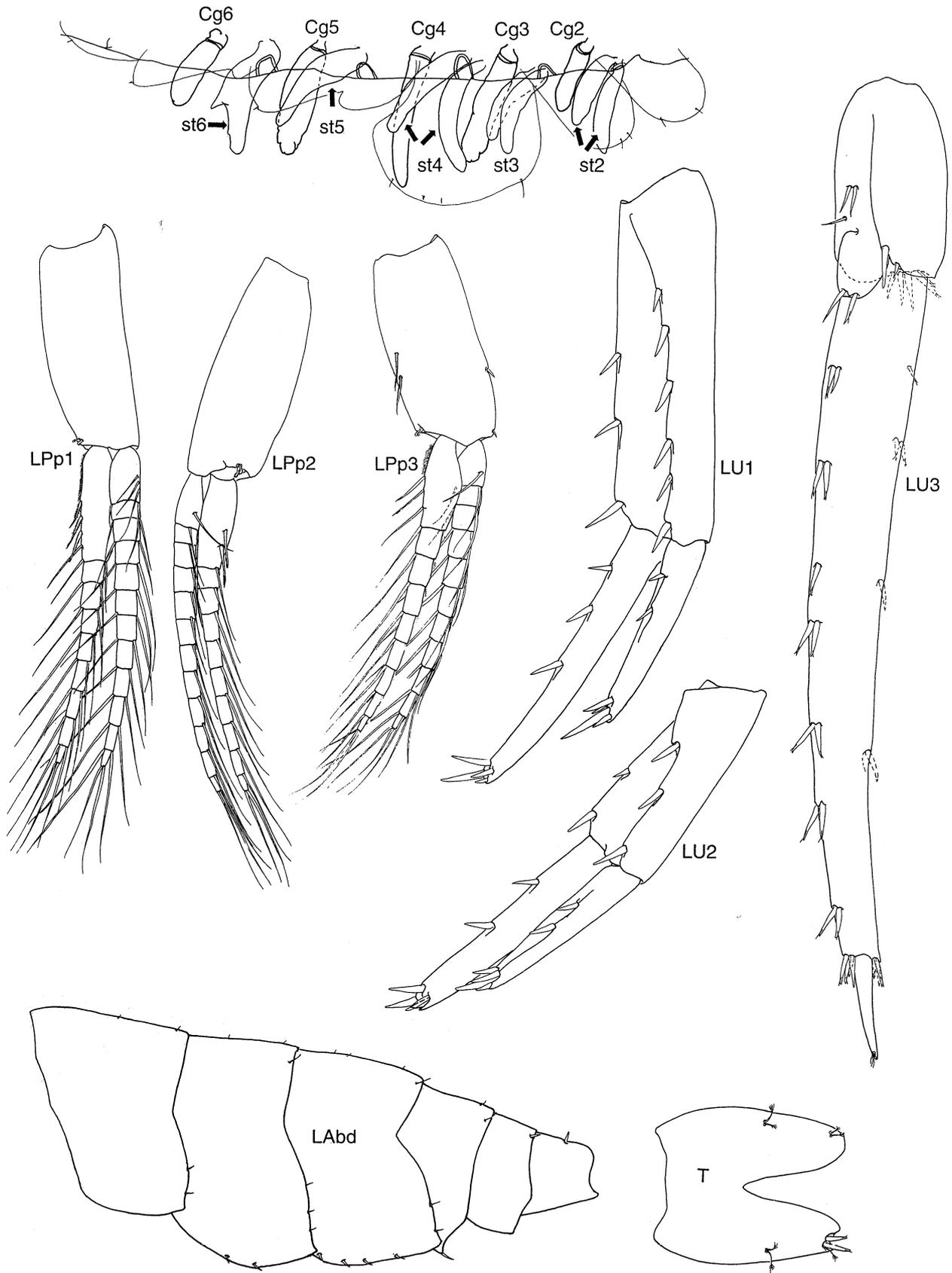


Fig. 35. *Jasptorus solepti* n.sp. holotype male "a" 6.5 mm; abdomen, gills, pleopods, uropods, telson.

several plumose and simple setae, and a row of medial submarginal plumose setae; outer plate with five basomedial slender setae, a row of naked tooth like robust setae medial sub marginal to mid distofacial, two distal plumose setae and a lateral sub marginal row of fine simple setae; peduncle bearing a pair of ventrofacial long setae basal to the inner plate. *First gnathopod* (Fig. 34): coxal plate with a single post-ventral seta only; article 3 with a small posterior rugose hump; article 4 with a moderate rugose hump; carpus short, strongly lobate and rugose, the lobe rounded and without setae; propodus trapezoidal, slightly longer than wide, posterior angle rounded, anteriorly prominent and rugose, the palmar corner marked by one medial and a long and two short lateral robust setae without bifurcations or triggers, the palm slightly oblique and convex, dactylus reaching to the corner robust setae, robust setae along the palm simple, not crowded. *Second gnathopod* (Fig. 34): slightly larger than the first, coxa bearing two apical setae, and a sac like gill; rugose carpal lobe larger than the first; rugose lobes of articles 2-4 smaller; posterior rugose lobe of the propodus more expanded than on the first gnathopod, the palmar corner marked by long and short lateral and medial robust setae, dactylus not reaching the palmar corner; the palm lined with simple setae. *Peraeopods* (Fig. 34): coxa 3 with few short and long apical setae; coxa 4 deeply emarginate with three anteroventral setae, one ventrofacial posterior seta, and several facial setules; peraeopods 3 and 4 subequal, longer than the second gnathopod, articles 4 and 5 posteriorly spinose, articles 6 with 2-2-2-2-2 and 1-2-2-2-2 robust setae respectively; peraeopods 5-7 similar, coxae with 1-1-3 robust setae on the ventral margins of the posterior lobes, the second article of each moderately expanded posteriorly (P5>P6>P7), with short sparse marginal setae and a moderate postero ventral lobe, posterior margins of propodi lacking long setae except for basodactylar setae, dactyls without accessory setules apart from the usual one medial and facial setules. *Gills* (Fig. 35): coxae 2-6 bearing simple sac like gills, coxa 7 without gill; sternites 2-6 each with a pair of lumpy, incipiently dendritic gills attached to the anterior lateral edge of each segment. *Epimera* (Fig. 35): without postventral teeth, although each slightly acuminate; posterior margins moderately convex, with 2-3-2 setae; with 0-2-4 ventrofacial robust setae. *Urosomite one* (Fig. 35): with a short robust seta at the base of uropod 1. *Pleon* (Fig. 35): pleonites 1-4 with few dorsal armaments; pleonite 5 with a single posterolateral robust seta, pleonite 6 with one mid dorsal robust seta. *Pleopods* (Fig. 35): similar, each with two retinaculæ and no accessory retinaculæ; peduncle of pleopod 3 only with two medial and two facial setae; rami with 12-9, 12-10, 11-9 lateral and medial articles. *Uropods* (Fig. 35): third uropod extending well beyond uropods 1 and 2 in the intact specimen; lengths relative to uropod 1—uropod 2 0.64×, uropod 3 1.54×; first uropod peduncle approximately equal to the third urosomite, length 1.9× lateral ramus, 1.2× medial ramus, the outer margin with a single subapical robust seta and a row of five short robust setae, the inner margin with

a row of two short robust setae and a single distal robust seta; rami of unequal lengths, medial 1.3× lateral, both with a single row of dorsal robust setae—the lateral ramus with two lateral setae, the medial ramus with three medial setae—and each with four apical robust setae; second uropod peduncle 0.9× inner ramus, 1.2× outer ramus, with three short dorsolateral and two short dorsomedial robust setae, the outer ramus shorter than the inner—27:36—both with only one row of short robust setae—lateral ramus with two lateral robust setae and medial ramus with two medial robust setae, each with four apical robust setae; peduncle of the third uropod 0.26× length of outer ramus, as long as urosomite three, with three mediofacial setae, two mediiodistal robust setae basal to the inner ramus, and a distal transverse lateral row of five robust setae; proximal article of the outer ramus with four transverse lateral robust seta rows of 1-2-1-1 robust setae, seven transverse medial rows of 2-2-1-2-2-2-2 robust setae and terminal lateral and medial rows of three and four robust setae basal to the distal article; distal article with three small terminal setules; inner ramus length 0.09× outer, with two apical setae only. *Telson* (Fig. 35): moderate length, equal to urosomite three, the length 1.1× width; cleft 56%; apices with two short setae set in a notch on the left side, no robust setae or notch on the right, but a pair of sub terminal penicillate setules; lobes moderately tumid, with paired dorsolateral penicillate setules at M0.6 on either lobe.

Description of male "b". *Body*: length 5 mm. Similar to male "a", except in the following. *First antenna*: left peduncle third article with mediiodistal calceolus; accessory flagellum of two articles, extending to M0.8 of the second article of the primary flagellum; primary flagellum of 21 articles, with aesthetascs on articles 5-21; right primary flagellum of nineteen articles. *Second antenna*: left flagellum of seven articles with calceoli present on articles 1-4; right flagellum of seven articles, with calceoli on articles 3-5. *Mandibles*: both mandibular palp articles 3 with setae 1B3C11D3E. *Pleopods*: left first pleopod rami with four medial and five lateral articles; right first pleopod with seven and eight articles respectively; second pleopod with 7-8 and 9-7 articles respectively; third pleopod with 6-8 and 6-8 articles respectively. *Uropods*: peduncle of first uropod with three dorsolateral and one apicolateral and two dorsomedial and one apicomedia robust setae; outer ramus with one medial and one lateral robust setae; inner ramus with two medial and one lateral robust setae, both rami with four apical robust setae; peduncle of second uropod bearing one dorsolateral and one apicodorsal, two dorsomedial and one apicomedia robust setae; outer ramus with one each medial and lateral robust setae, inner ramus with two each medial and lateral robust setae. *Epimera*: second epimeron with one rather than two facial robust setae near the ventral margin.

Distribution. Cave WJ10, Wee Jasper, New South Wales, 35°07'S 148°41'E.

Neoniphargus Stebbing, 1899

Neoniphargus Stebbing, 1899: 424.

Unimelita Sayce, 1901: 237–238.

Type species. *Neoniphargus thomsoni* Stebbing, 1899 (= *Niphargus montanus* Thomson, 1893, a homonym).

Relationship. For generic diagnosis, additional description, keys and discussion of relationships see Williams & Barnard (1988: 123–125).

Composition. This genus contains seven species. We here describe a further three species.

Neoniphargus coolemanensis n.sp.

Figs 36–38

Etymology. Named for the type locality.

Type locality. First water trap, Murray Cave (cave CP3), Cooleman Plain, Kosciusko National Park, New South Wales, 35°22'S 149°03'E.

Material examined. HOLOTYPE (Australian Museum P51373) female, 6 mm; collected by S. Eberhard; 20 January, 1994.

Diagnosis (female only): first peduncular article of the first antenna longer than the second; second antenna without calceoli; second article of the mandibular palp longer than the third, and moderately setose, setae of the third article BCDE; palmar corners of gnathopods without special medial robust setae; fourth coxa deeply emarginate, dactyls of peraeopods 3–7 multispinous medially, articles 4–6 of peraeopods 3–7 moderately setose, with elongate basodactylar setae on legs 5–7, anterior margins of sixth article with 1-4-4 transverse robust seta sets (as well as locking robust setae); coxae 5–7 with 1-1-3 weak robust setae on the posterior lobe. Coxae 2–7 bearing gills, the seventh reduced; lumpy to barely dendritic gills present on sternites 2–6. Epimera without facial armaments, or postventral teeth; third uropod extends slightly beyond uropods 1 and 2 in the whole animal; robust setae of uropods 1 and 2 all short; peduncle of uropod 3 0.6× the length of the outer ramus; robust setae of outer ramus arranged in sets of 2-3-3 lateral, 1-2 medial, with no plumose setae; inner ramus bearing one apical robust seta, and no facial setae. Telson cleft about 60%, each lobe bearing three apical robust setae and a dorsal pair of robust setae.

Description of holotype (female). *Body* (Fig. 36): pleon with few setal dorsal armaments, the urosomite three bearing two pairs of dorsal robust setae, pleonites with few dorsal setae, length 6 mm. *Head*: small, eyes small. *First antenna* (Fig. 36): length 0.5× body, 1.4× the second antenna, peduncle less than the length of the flagellum, ratio of lengths of articles 50:33:23, setae sparse, calceoli and aesthetascs absent; accessory flagellum 2-articulate, extending to M0.2 of the second article of the primary flagellum; primary flagellum of nineteen uniform articles with very sparse setation. *Second antenna*: length 0.3× body, peduncle longer than the flagellum—1.5×, articles 4 and 5 subequal, articles 3–5 with moderate ventral setation, flagellum with nine articles, weakly setose ventrally, calceoli absent. *Left mandible* (Fig. 36): palp of three articles, ratio of lengths of articles 10:32:24, article 2 with ten inner

marginal setae, article 3 weakly falcate, with 1B3C11D5E setae; incisor with five teeth; lacinia mobilis with three teeth; accessory blades of three chisel robust setae, three plumose robust setae; molar triturative, bearing a single brushy anterior seta and short posterior pappose seta. *Right mandible* (Fig. 36): palp article 2 with 12 medial setae, article 3 with 2B2C10D5E setae; incisor with five teeth; lacinia mobilis bifid and denticulate; two accessory blades and two inter-raker plumose setae; molar bearing long posterior pappose seta. *Maxillae* (Fig. 36). First maxillae: second article of the palp of the left first maxilla with six thin apical robust setae and two sub terminal facial setae; outer plate with nine robust setae, most denticulate; inner plate with two plumose apical setae; right first maxilla palp article 2 with four thick apicomедial robust setae articulated to the segment, one apicolateral thin robust seta and three thin ventro facial robust setae; outer plate with ten apical denticulate robust setae; inner plate with two plumose apical setae. Second maxilla: both plates with curved apical setae; inner plate with two medial sub apical plumose setae; outer plate with two subdistal naked lateral setae. *Maxilliped* (Fig. 36): palp articles 2 and 3 with ranks of setae on the inner margin and sub marginal face, and a few distolateral setae, apex of article 3 strongly produced and bearing rugosities, dactyl with four accessory spinules on the inner margin, and distofacially rugose; inner plate apex with three thick tooth like robust setae, two plumose setae and a naked seta, a submarginal medial row of five plumose setae, but no ventrofacial robust seta; outer plate with a medial oblique row of moderate to long naked robust setae distofacially, a row of six faciomedial to distomedial naked tooth like robust setae, apically a naked tooth like robust seta and armed tooth like robust seta, two raker setae and one plumose seta, and three slender disto lateral setae. *First gnathopod* (Fig. 37): coxal plate tapering apically, with an apical rows of moderate length setae; articles 2 and 3 each bearing a small rugose posterior lobe; articles 4–6 with strong rugose lobes; carpus shorter than propodus, posterior lobe well developed, rugose, rounded and not setose apically; propodus trapezoidal, slightly longer than wide, bearing paired posterior rugose lobes, corner of the palm with three short medial robust setae and two strong, armed lateral robust setae; palm transverse, slightly convex, with moderate numbers of non-bifid robust setae, dactylus reaching the palmar corner robust setae. *Second gnathopod* (Fig. 37): larger than the first; coxa sparsely setose apically bearing a sack like gill and a broad, naked oostegite; carpal lobe longer and more keel like than the first; propodus with a distinct pair of rugose lobes larger than in the first, palmar corner with three short medial and two long lateral robust setae, dactylus reaching the palmar corner robust setae, palm transverse, slightly convex, bearing moderate numbers of simple robust setae. *Peraeopods* (Fig. 37): coxa 3 with an apical sparse row of moderate length setae; coxa 4 deeply emarginate with three anteroventral setae and four posterior setae; peraeopods 3 and 4 longer than the second gnathopod, subequal in length, articles 4 and 5 spinose posteriorly, articles 6 with robust seta formula 1-1-2-2-3 and 1-1-3-2-3, respectively; peraeopods 5–7 similar, coxae bearing 1-1-3 weak robust setae on the posterior lobe, articles 2 expanded posteriorly (P5<P6<P7), and slightly to moderately lobate postventrally, with short and moderately slender posterior setae, propodus of leg five naked posteriorly, of 6 and 7 with sparse short and long setae, long setae present at the bases of the dactyls of peraeopods 6 and 7; dactyls three to seven each with several accessory setules (2-3-1-4-3) on the inner margin; coxae 2–5 each bearing an oostegite. *Gills* (Fig. 38): coxae 2–7 each with a simple sac



Fig. 36. *Neoniphargus coolemanensis* n.sp. holotype female 6 mm; whole, antenna, mouthparts.

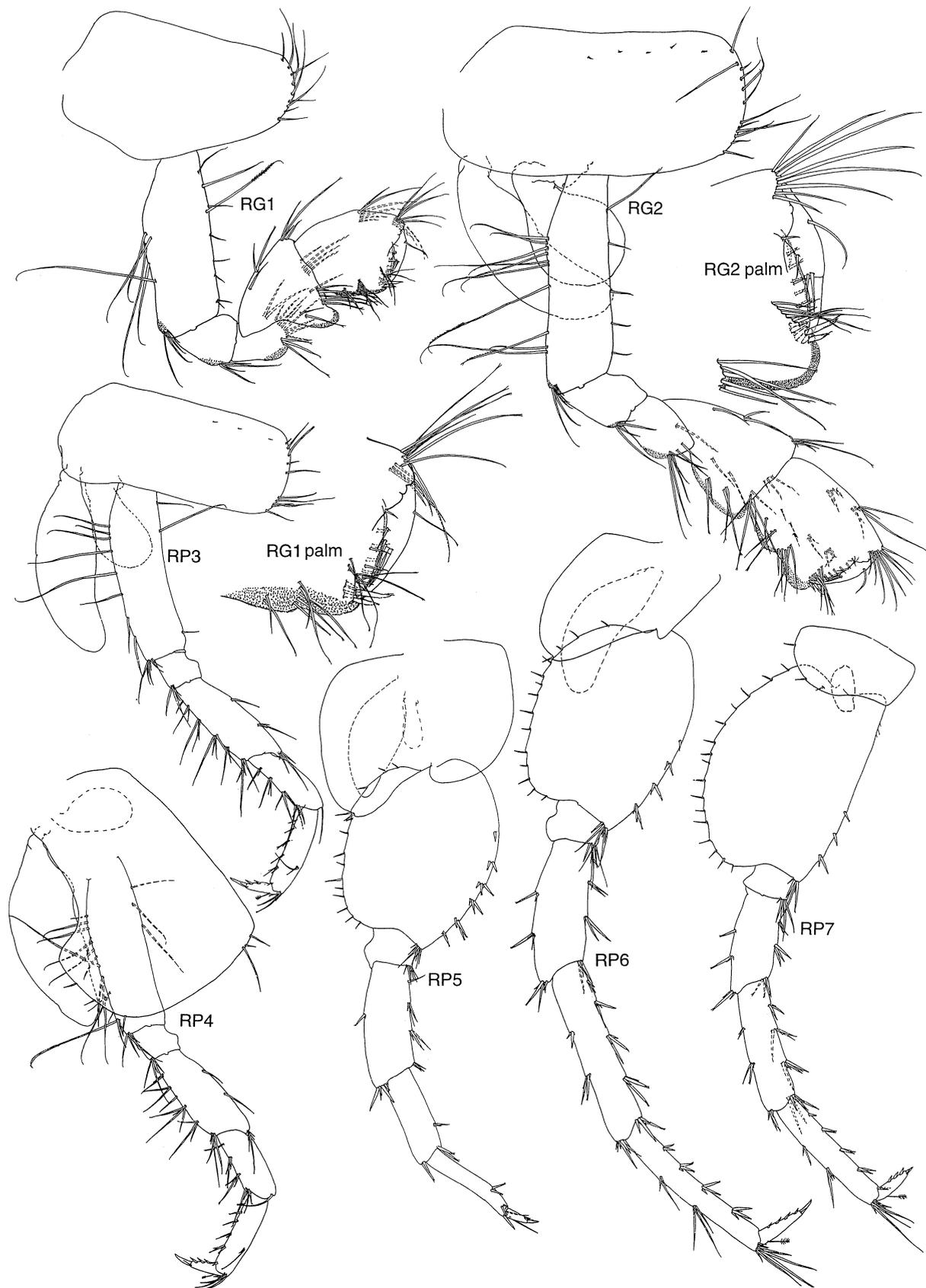


Fig. 37. *Neoniphargus coolemanensis* n.sp. holotype female 6 mm; legs.

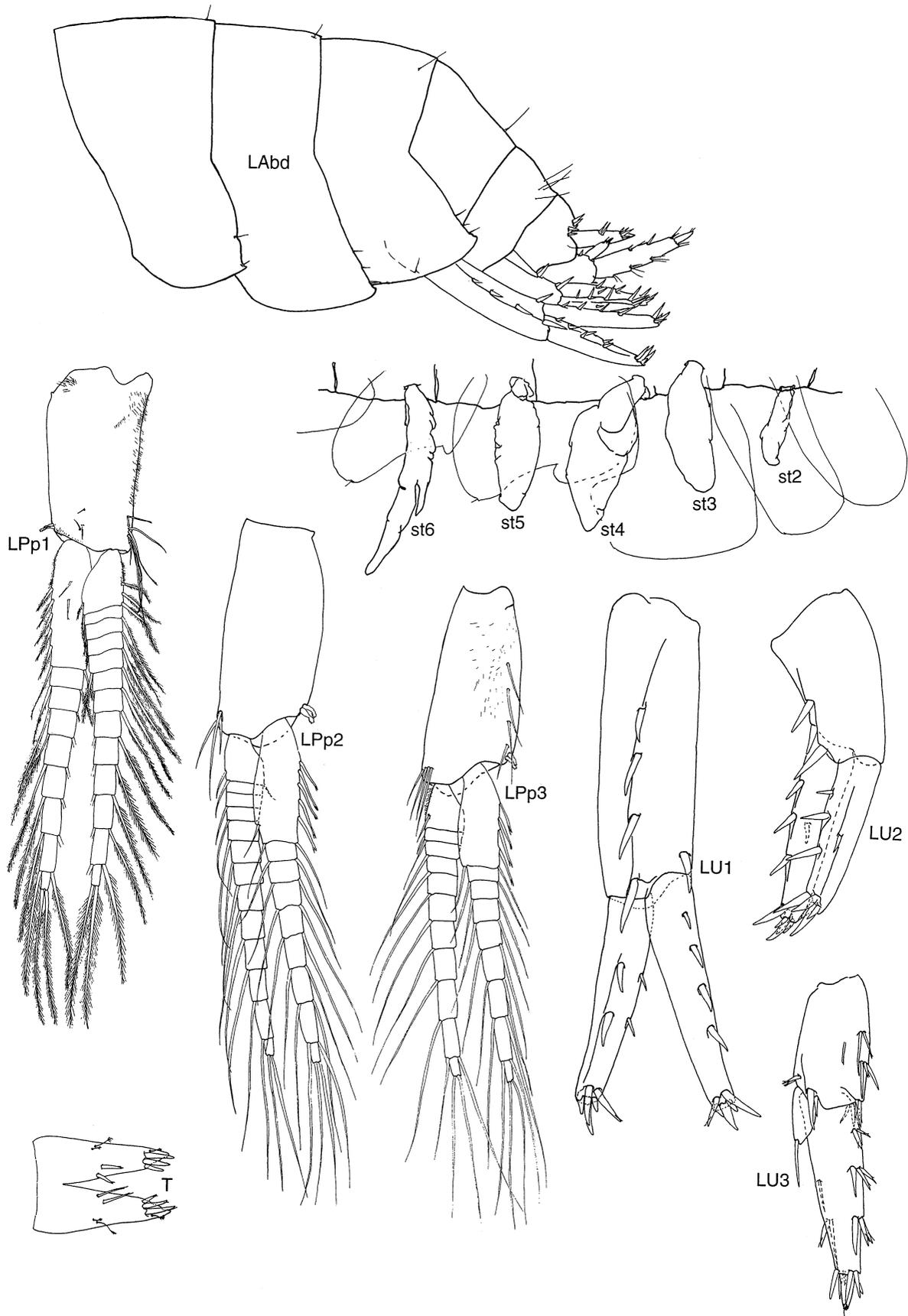


Fig. 38. *Neoniphargus coolemanensis* n.sp. holotype female 6 mm; abdomen, gills, pleopods, uropods, telson.

like gill, that of coxa 7 reduced; sternites 2–6 bearing budded or partially dendritic gills attached on the anterior lateral edge of each. *Epimera* (Fig. 38): without postventral teeth, the posterior margins slightly convex on E1, straight on E2 and concave on E3; all without ventral robust setae; posterior setae sparse—2-3-3. *Pleon* (Fig. 38): pleonites 1–5 with few dorsal setae or robust setae; pleonite 6 bearing a pair of dorsal and a pair of dorsolateral robust setae basal to the telson. *Pleopods* (Fig. 38): with two retinacula each, no accessory retinacula, the peduncles each with several setae; rami of nine medial articles each and 13-13-11 lateral articles respectively. *Uropods* (Fig. 38): third uropod extending slightly beyond the first and second in the whole animal, uropod lengths relative to the first—uropod 2 0.7×, uropod 3 0.6×. First uropod: peduncle length 1.2× the medial ramus, 1.5× lateral ramus, outer margin with one apicodistal robust seta and a row of short dorsal robust setae, medial margin with a single apicodistal robust seta; rami of unequal lengths, lateral ramus shorter and bearing two reduced rows of marginal robust setae the inner row short; and five apical robust setae; medial ramus with only a medial row of four robust setae, and four apical robust setae. Second uropod: peduncle approximately the same length as the rami, with three moderate length to long dorsolateral robust setae (including one apical robust seta); outer ramus slightly shorter than the inner, each with two rows of short marginal robust setae, apices with four and five robust setae respectively. Third uropod: parviramous, peduncle length approximately 0.5× outer ramus, as long as urosomite three, bearing two pairs of medial and two groups of dorsal robust setae, as well as a distal row of five robust setae basal to the outer article; outer ramus proximal article with three lateral transverse robust seta rows of 2-3-3 robust setae and an apical group of three robust setae, as well as two medial rows of 1–2 robust setae and a terminal group of three robust setae; distal article with a single small terminal setule; inner ramus short, 0.27× length of outer ramus, with a single moderately long terminal robust seta. *Telson* (Fig. 38): short, approximately the same length as urosomite three, length 1.4× width; cleft 77%; apices of each lobe with three sub distal robust setae and a single lateral penicillate setule, two dorsal robust setae medially at M0.4 to M0.5, and a submarginal lateral pair of penicillate setae at M0.4; lobes not tumid.

Relationship. This species differs from others of the genus in: ratio of lengths of peduncular articles of the first antenna 10:6.5:5.4, cf. 10:8:5 to 10:11:6, the second article being reduced; length of the first article of mandibular palp reduced, relative lengths being 8:39:30 cf. 8:25:23 to 8:20:24; robust setae at the palmar corner 5 or 6, rather than 6+; robust setae along the palm are not dense; dactyls of peraeopods are multi-spinous, but differ from *Neoniphargus spenceri*; robust setae of the inner rami of first and second uropods are reduced to one row; telson cleft 80% rather than 60%; lateral penicillate setules of the telson are at about M0.5 rather than M0.6; plumose setae are absent between rakers and base of the molar. This species keys to *N. spenceri* in Williams & Barnard (1988), but differs in: the small size of eyes; shorter first antenna; longer accessory flagellum; longer second antenna; mandibular palp second article more setose medially, third article with fewer BC setae and more E setae; second article of first maxilla with nine or ten robust setae, rather than seven; inner plate of maxilliped with three rather than two

apical robust setae, but fewer plumose setae; first gnathopod coxa moderately setose apically, the fourth article with a moderate posterior rugose hump, articles 2 and 3 also with posterior rugosities and small hump, carpus moderately long, almost as long as propodus, propodus with fewer lateral corner robust setae, the palm slightly convex; peraeopods generally less spinous, dactyls bearing 2-3-1-4-3 accessory spinules; sternal gills are not fully dendritic; epimera without postventral teeth; uropod 3 not as strongly extended; telson longer than wide, cleft 77% rather than 56%, fewer dorsal robust setae, lateral penicillate setules more basal. This species differs from *N. secus* in: possessing eyes; the body more robust, and coxal plates longer; accessory flagellum is longer than the first article of the primary flagellum; flagellum of the second antenna is of nine rather than seven articles; the second article of the mandibular palp is more setose medially; coxae 1–3 are moderately setose distally; carpus of the second gnathopod relatively long; dactyls of peraeopods multispinous; coxa 7 bears a small gill; sternal gills are less dendritic; third uropod is only slightly extended beyond uropods 1 and 2; telson is more slender and more deeply cleft and bearing additional dorsal robust setae, the penicillate setules more basal. *Neoniphargus coolemanensis* differs from *N. richardi* in: possessing eyes; the body is less slender; coxal plates larger; flagellum of second antenna longer; second article of mandibular palp bearing more setae; mandibular palp more spinous, the inner plate less pubescent; carpus of second gnathopod relatively longer; dactyls of peraeopods multispinous; coxa 7 with a small gill; sternal gills less dendritic; third uropod shorter; telson slender and not tumid, with dorsal robust setae as well as more apical robust setae.

Distribution. Murray Cave (cave CP3), Cooleman Plain, Kosciusko National Park, New South Wales, 35°22'S 149°03'E.

Neoniphargus secus n.sp.

Figs 39–41

Etymology. From *secus* (Latin); otherwise or different.

Type locality. Gurangah Cave, cave 321, Wombeyan Cave system, New South Wales, 34°19'S 149°59'E.

Material examined. HOLOTYPE (Australian Museum P51374) female "a" 8 mm, PARATYPE (Australian Museum P51375) female "b" 5 mm, three other small females in the type series; collected by S. Eberhard; 17 March, 1993.

Diagnosis. Article 1 of the peduncle of first antenna slightly longer than article 2, calceoli absent from both antennae, mandibular palp article 2 longer than article 3 with very few setae (3R2L ventral, 1L1R dorsal), BCDE setae present on article 3. The fourth coxa moderately emarginate, dactyls of legs three to seven with only one medial and one facial spinules, legs 5–7, articles 4–6 without slender setae except for a few short basodactylar setae, and articles 6 anterior margins with one, five and four robust seta sets respectively, coxae 5–7 with 3-1-2 weak robust setae on the posterior lobe.

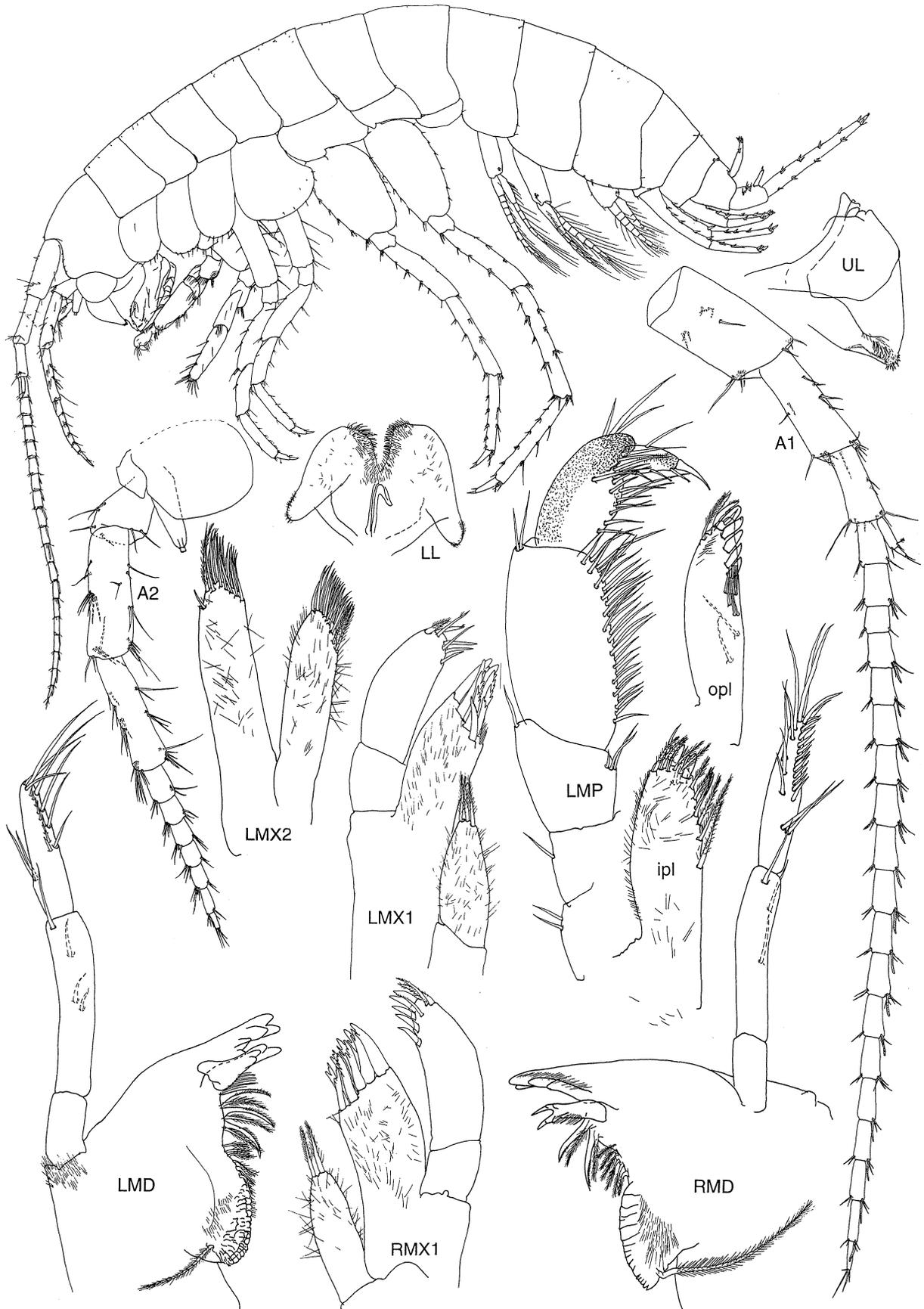


Fig. 39. *Neoniphargus secus* n.sp. holotype female "a" 8 mm; whole, antennae, mouthparts.

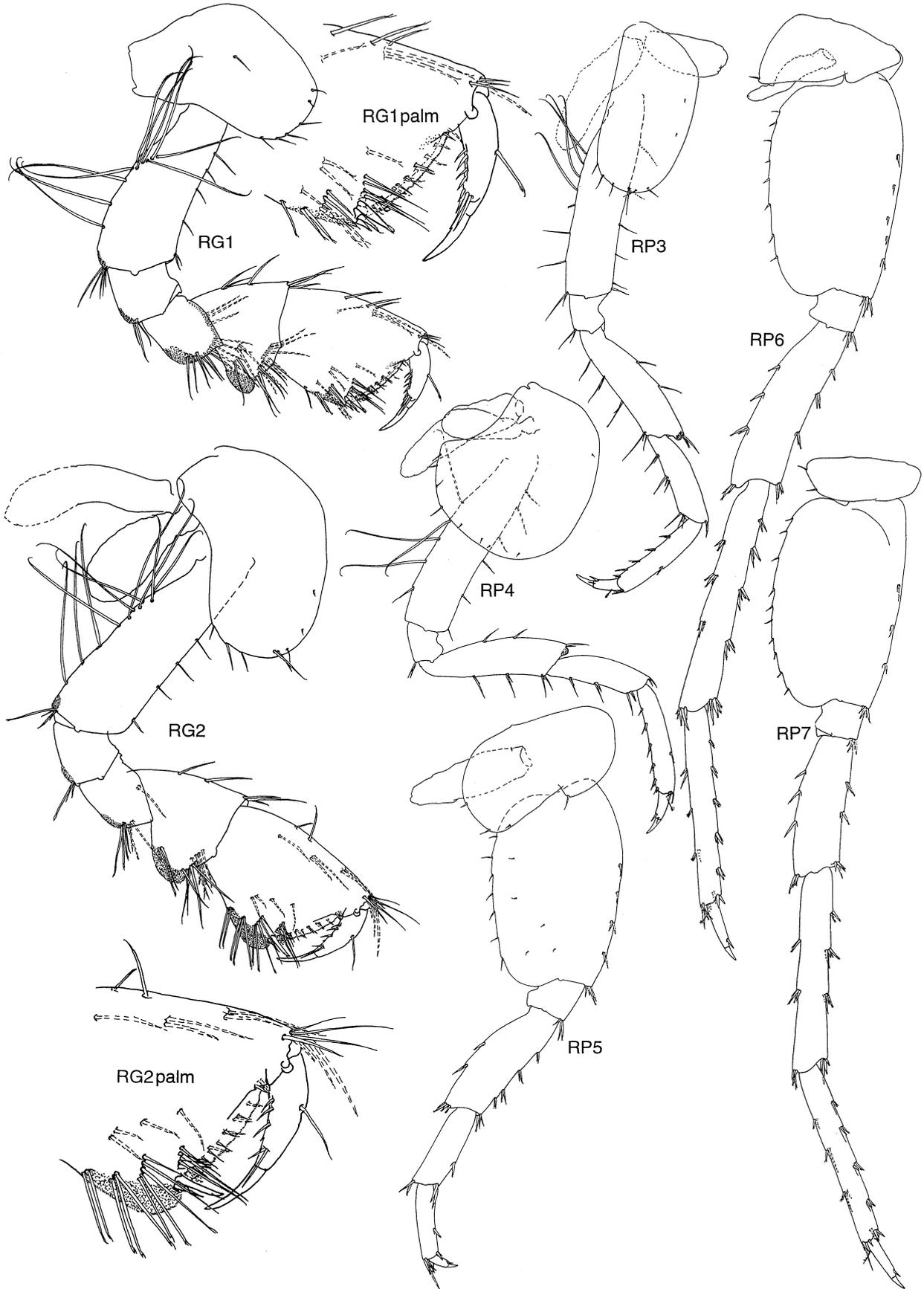


Fig. 40. *Neoniphargus secus* n.sp. holotype female "a" 8 mm; legs.

Gills present on coxae 2–6, and dendritic sternal gills present on sternites 2–6. Epimeron three only bearing ventrofacial robust setae. Uropod 3 extends well beyond uropods 1 and 2 in the intact specimen, all robust setae of uropods 1 and 2 short, the peduncle of uropod 3 0.3× the length of the outer ramus, which bears robust setae arranged in rows both laterally (1-2-2-3) and medially (2-3-2-2), without plumose setae; the inner ramus with a single apical robust seta, lacking other arms. The telson cleft 40%, each lobe bearing three sub apical robust setae only.

Description. *Body* (Fig. 39): pleon not armed dorsally, with few setae, pleonites 5 and 6 bearing no dorsal robust setae, length 8 mm. *Head*: rostrum small, eyes absent. *First antenna* (Fig. 39): length 0.5× body, 2.3× the second, flagellum of nineteen articles, peduncle shorter than the flagellum, ratio of lengths 10:8:6, setae sparse, calceoli absent, aesthetascs present on flagellum articles 2–18, flagellar segments uniform, sparsely setulate; accessory flagellum 2-articulate, equal to article 1 of the primary flagellum. *Second antenna* (Fig. 39): length 0.25× body, peduncle 1.7× the flagellum, articles 4 and 5 subequal, articles 3–5 moderately setate ventrally, flagellum 7-articulate, weakly setulose, without calceoli, but bearing small aesthetascs on flagellar articles 2–6. *Left mandible* (Fig. 39): palp article 3 shorter than article 2, weakly falcate, almost linear, bearing 2B3C9D4E setae, article 2 with two medial and one lateral setae; incisor with five teeth; lacinia mobilis with four teeth; accessory blades of three chisel robust setae with four interraker plumose setae plus five additional plumose setae beyond the rakers onto the base of the molar; molar bearing moderate posterior pappose seta without brushy basal setae. *Right mandible* (Fig. 39): palp with 2B4C12D5E setae; incisor with five teeth; lacinia mobilis bifid and denticulate; accessory blades of two chisel robust setae and two plumose robust setae plus six additional plumose setae onto the base of the molar; molar bearing a long posterior pappose seta. *Maxillae* (Fig. 39): article 2 of the palp of left first maxilla with four thin apicomedial robust setae, two subterminal facial setae and a stout setulate laterodistal robust seta; outer plate with nine mostly denticulate robust setae; inner plate with three apical plumose setae; palp article 3 of the right first maxilla with a mediodistal row of four stout robust setae, two armed slender facial robust setae and one distolateral stout setulate robust seta; the outer plate bearing nine denticulate robust setae, the inner plate two plumose apical setae; both plates of the second maxilla bearing long curved apical setae, outer plate with a single small distolateral seta, inner plate with two medio distal plumose setae. *Maxilliped* (Fig. 39): palp article 3 with moderate numbers of setae on the inner face, a row of six setae at the base of the dactyl, the apex strongly produced, the lateral face of the article, apex and inner distal face of the dactyl all rugose, dactyl with three accessory spinules on the inner edge, the nail naked; inner plate apex with two facial and one ventral stout, naked tooth like robust setae, five facial and two ventral plumose setae and one naked seta, the inner margin with a row of seven plumose and one naked setae; outer plate with three mid-medial rows of 2-1-5 long setae, a distofacial row of five stout naked tooth like robust setae, one plumose and two rastellate laterodistal robust setae in a row and a small naked apical seta. *First gnathopod* (Fig. 40): coxal plate with a sparse apical row of short setae; articles 2, 3 and 4 with small posterior rugose lobes; carpus short, with a large rugose posterior lobe rounded and not setose apically; propodus trapezoidal, longer than wide, with a distinct rugose palmar corner bearing three lateral and one medial robust seta, the palm transverse to slightly oblique, moderately convex, palmar

robust setae simple and not crowded; dactylus reaching the end of the palm, with several accessory spinules along the inner margin, and stiff spinules near the inner nail articulation. *Second gnathopod* (Fig. 40): larger than the first; coxa bearing few apical setae, a sac like gill and broad oostegite; articles 2–4 bearing small posterior rugose lobes; carpal lobe similar to the first gnathopod; palmar corner expanded by presence of a rugose lobe, corner robust setae being two short medial and four lateral, the dactyl reaching the inner edge of the lobe, bearing small recumbent inner tooth like robust seta at M0.6. *Peraeopods* (Fig. 40): coxa 3 with short sparse apical setae; coxa 4 moderately emarginate, with four anteroventral setae, without posterior setae; peraeopod 3 subequal with four, longer than the second gnathopod, articles 4 and 5 spinose posteriorly, articles 6 with 2-2-2-2 and 1-2-2-2-2 robust setae respectively; peraeopods 5–7 similar—five shortest, six longest; coxae 5–7 bearing 1-1-2 setae on the posterior lobe, the second article of each expanded posteriorly, slightly to moderately post-ventrally lobate with short posterior setules, posterior margins of the propodi lacking long setae except for long subdactylar setae; dactyls of legs three to seven with only a single facial spinule and small medial spinule. *Gills* (Fig. 41): simple sac like gills present on coxae 2–6; dendritic gills present on sternites 2–6, attached to the anterior lateral edge of each. *Epimera* (Fig. 41): 1–3 without postventral teeth, posterior margins slightly convex to straight, each with two small setae, posteroventral margin of the third epimeron with three small robust setae. *Pleon* (Fig. 41): pleonites 1–6 with sparse dorsal setation; pleonite 5 with a single distal dorsolateral robust seta. *Pleopods* (Fig. 41): peduncles each with two retinacula, pleopod 1 with a single accessory robust seta; peduncles without setation except pleopod 3 which bears three basomedial and two distolateral setae; rami with 10-7, 9-7 and 10-8 lateral and medial articles respectively. *Uropods* (Fig. 41): third uropod elongate, extending well beyond uropods 1 and 2 in the intact specimen, uropod lengths relative to uropod 1—uropod 2 0.64×, uropod 3 1.16×; first uropod peduncle length 1.5× outer ramus, outer margin with one apicodistal robust seta and a row of four short dorsal robust setae, the inner margin with three short robust setae and a moderate length apical robust seta; rami unequal in length (inner ramus 1.2× outer), the inner ramus with two weakly represented rows of short setae, the outer ramus a lateral row only, both rami with four apical robust setae; second uropod peduncle approximately the same length as the inner ramus, longer than the outer ramus, with two medial and three laterodorsal robust setae; rami each with two poorly represented rows of short marginal robust setae and four apical robust setae; peduncle of the third uropod as long as the third urosomite, 0.3× the length of the outer ramus, bearing four facial setae, two robust setae basal to the inner ramus and a transverse distolateral row of four robust setae; outer ramus proximal article with transverse lateral and transverse medial rows of 1-2-2-3 and 2-3-2-2 robust setae respectively, each side with distal clusters of three robust setae; distal article small, 0.1× proximal, with small apical setules; inner ramus small, 0.16× outer ramus, naked except for a single apical seta. *Urosomite one* (Fig. 41): at the base of uropod 1 bearing a small articulated robust seta. *Telson* (Fig. 41): short, 1.2× as long as broad; cleft 40%; subapices of each lobe bearing three short robust setae, the right lobe with a small additional seta distolaterally; a pair of dorsolateral penicillate setules at M0.6 on either lobe.

Female “b” 5.5 mm and two other small females. Essentially as for female “a”, with minor differences only.

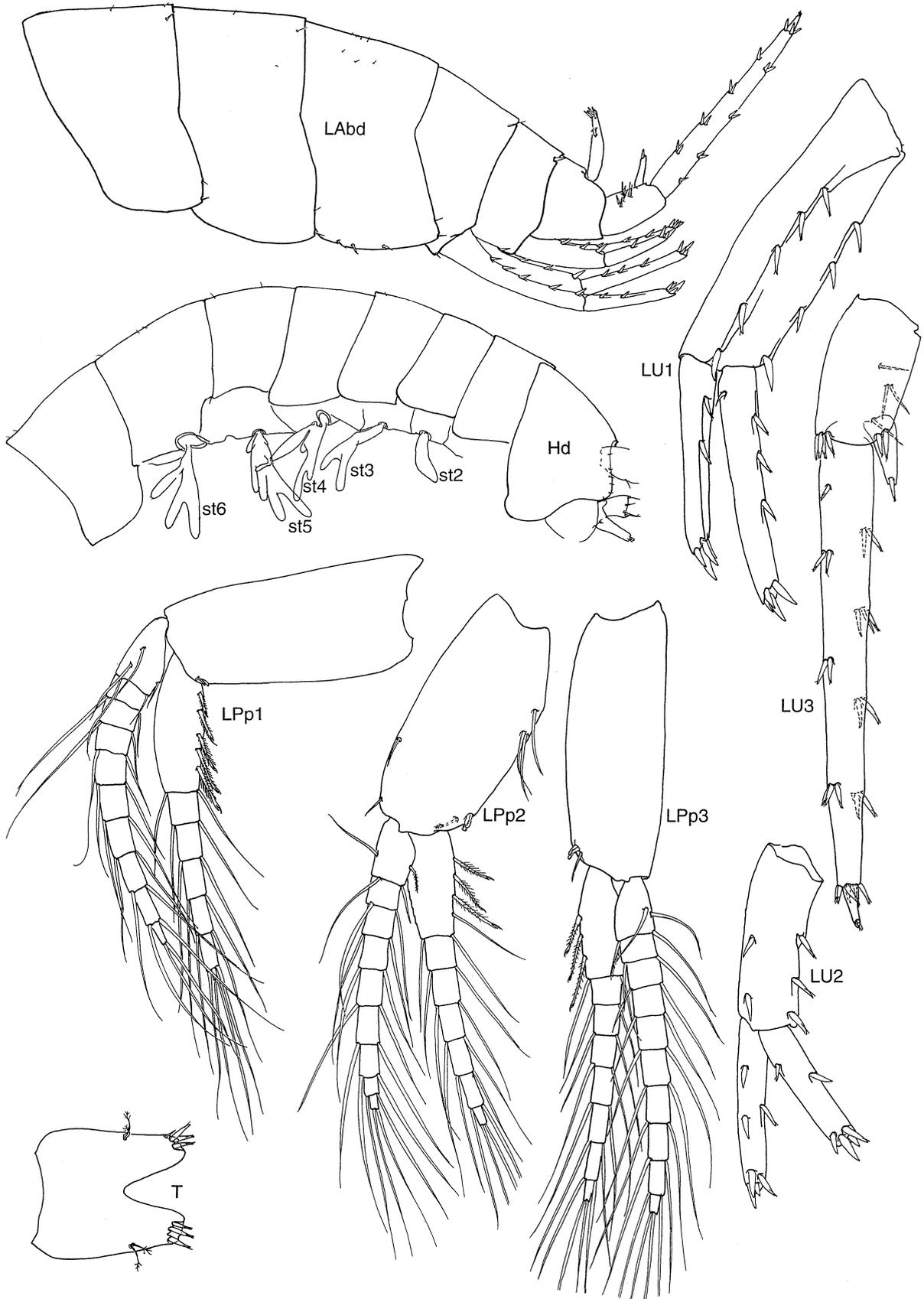


Fig. 41. *Neoniphargus secus* n.sp. holotype female "a" 8 mm; abdomen, gills, pleopods, uropods, telson.

Relationship. This species differs from others of the genus *Neoniphargus* in that eyes are totally absent; the first article of the mandibular palp is relatively longer; palmar corner robust setae are fewer and palmar robust setae less dense and without triggers; no accessory retinaculum is present but the third pleopod bears an accessory seta adjacent the retinacula; the telson is less cleft. *Neoniphargus secus* differs from *N. richardi* in: lower lip without posterior rugosities; mandibular palp with more E setae; first maxilla palps with fewer apical teeth; second maxilla more slender; maxilliped palp article 3 more rugose, outer plate bearing mediofacial comb rows of robust setae, inner plate with fewer naked apical tooth like robust setae and more medial plumose setae; dactyls of gnathopods bearing more inner accessory spinules, second gnathopod dactyl with small recumbent inner tooth like robust seta; peraeopods 3 and 4, article 4 bearing small anterodistal rugose lobe; peraeopod 5 shorter and less spinose; peduncle of pleopod 1 without basolateral pubescence; urosomite one at the base of uropod 1 bearing a small rather than moderate to large articulated robust seta; telson cleft 40% rather than 50%, each lobe bearing three apical robust setae rather than one.

Distribution. Gurangah Cave, cave 321, Wombeyan cave system, New South Wales, 34°19'S 149°59'E.

Neoniphargus richardi n.sp.

Figs 42–45

Etymology. Named for the second son of the second author in recognition of his indirect contribution to amphipod studies.

Type locality. Among tree roots, River Cave Spring (Cave W47) Wombeyan Caves system New South Wales, 34°19'S 149°59'E.

Material examined. HOLOTYPE (Australian Museum P51376) female "a" 6.5 mm, ALLOTYPE (Australian Museum P51377) male "b" 5 mm, in the type series; one other female 6.5 mm, two juveniles 2.5 mm; collected by S. Eberhard; 16 March, 1993.

Diagnosis. Article 1 of the peduncle of first antenna longer than article 2; calceoli present on the second antenna of the male; mandibular palp article 2 longer than article 3, sparsely setose, setae of article 3 BCDE. Palmar corners of both gnathopods without special medial robust setae. Coxa 4 deeply emarginate in both sexes. Dactyls of peraeopods 3–7 with only one facial and one medial setule, legs 5–7 without fine setae except for an elongate basodactylar seta on each propodus, propodi bearing 4-4-1 posterior robust seta sets. Coxae 5–7 with only weak robust setae on the posterior lobe. Coxal gills present on legs 2–6. Epimera two and three with two and three ventro facial robust setae. Uropods with only short robust setae, the third uropod strongly extended posteriorly beyond the first and second in the whole animal, the peduncle 0.5× the length of the outer ramus, the outer ramus bearing robust setae arranged in multiples in several medial and lateral rows, without plumose medial setae, the second article short; the inner ramus with a single apical robust seta and

without facial setae. The telson cleft about 50%, each lobe with single sub apical robust setae and paired lateral penicillate setules at M0.57.

Description of holotype (female "a"). *Body* (Fig. 42): weakly armed dorsally, pleonites 1–4 with few setae, pleonites 5 and 6 with two and three dorsal and dorso lateral strong robust setae, length 6.5 mm. *Head*: rostrum small, eyes absent, lateral cephalic lobes strongly projecting, antennal sinus moderate. *First antenna*: long, 0.5× the length of the body, 1.4× the second antenna, peduncles shorter than the flagellum, article 1 longest, ratio of lengths 30:25:16, calceoli and aesthetascs absent from the female, the accessory flagellum 2-articulate, extending to M0.9 of article 1 of the primary flagellum, primary flagellum of 17 sparsely setose articles—articles 3, 8 and 9 being longer. *Second antenna*: approximately 0.25× body length, peduncle longer than the flagellum—about 1.5×—peduncular articles 4 and 5 subequal, articles 3–5 with moderate ventral setation, the flagellum of nine articles, weakly setose ventrally, calceoli and aesthetascs absent from the female. *Left mandible* (Fig. 42): palp of three articles, the second longest, bearing eight inner marginal setae, the third weakly falcate, bearing 2B3C10D3E setae, rugose lobe on the mandible basal to the palp; incisor with five teeth, lacinia mobilis four teeth, accessory blades of three chisel robust setae and three plumose setae, molar bearing a moderate posterior pappose seta, with three brushy basal setae. *Right mandible* (Fig. 42): palp article 3 setae 2B3C10D3E, basal to the palp a rugose lobe; the incisor with four teeth, the lacinia mobilis bifid, denticulate on one face, four teeth and a cluster of fine basal setules on the other; accessory blades of two chisel robust setae and two plumose setae, with three brushy setae leading to the molar, molar triturative, with a long posterior pappose seta. *Maxillae* (Fig. 42): left first maxilla palp with four thin apical robust setae and two slender sub terminal facial setae, all armed with spinules or setules; outer plate with five denticulate terminal robust setae, and a small distomedial area of setules; inner plate bearing two plumose apical setae; right first maxilla palp second article with a mediolateral row of four naked tooth like robust setae, one distolateral armed robust seta and two slender facial setae; outer plate with five denticulate robust setae and two distomedial thin setae; inner plate bearing two plumose apical setae. Second maxilla: both plates with long curved distal setae; outer plate bearing a lateral sub apical short seta; inner plate with two distal mediofacial armed setae. *Maxilliped* (Fig. 42): palp third article with stout medial and facial setae and a group of three short and two small apicolateral setae, apex strongly produced and rugose, dactyl rugose and bearing three accessory spinules, the nail naked; inner plate with three apical naked tooth like robust setae, several plumose and naked setae and a medial marginal row of four plumose setae; outer plate bearing a distomedial to apical row of five progressively facial robust naked robust setae, an apical group of three slender armed setae, two ventrofacial short setae and a basomedial row of slender setae. *First gnathopod* (Fig. 43): coxal plate with sparse apical setae; articles 2–4 with small posterior rugose lobes; carpus short, strongly lobate, the lobe rounded, rugose, without apical setae; propodus trapezoidal, longer than wide, the posterior angle rounded and rugose, palmar corner bearing two medial and two lateral robust setae, palm transverse, slightly convex, palmar robust setae simple, dactylus with accessory spinules, and reaching to the palmar corner robust setae. *Second gnathopod* (Fig. 43): larger than the first; coxa sparsely setose apically, bearing simple sac like gill and broad long oostegite; articles 2–4 all bearing small posterior areas of rugosity;

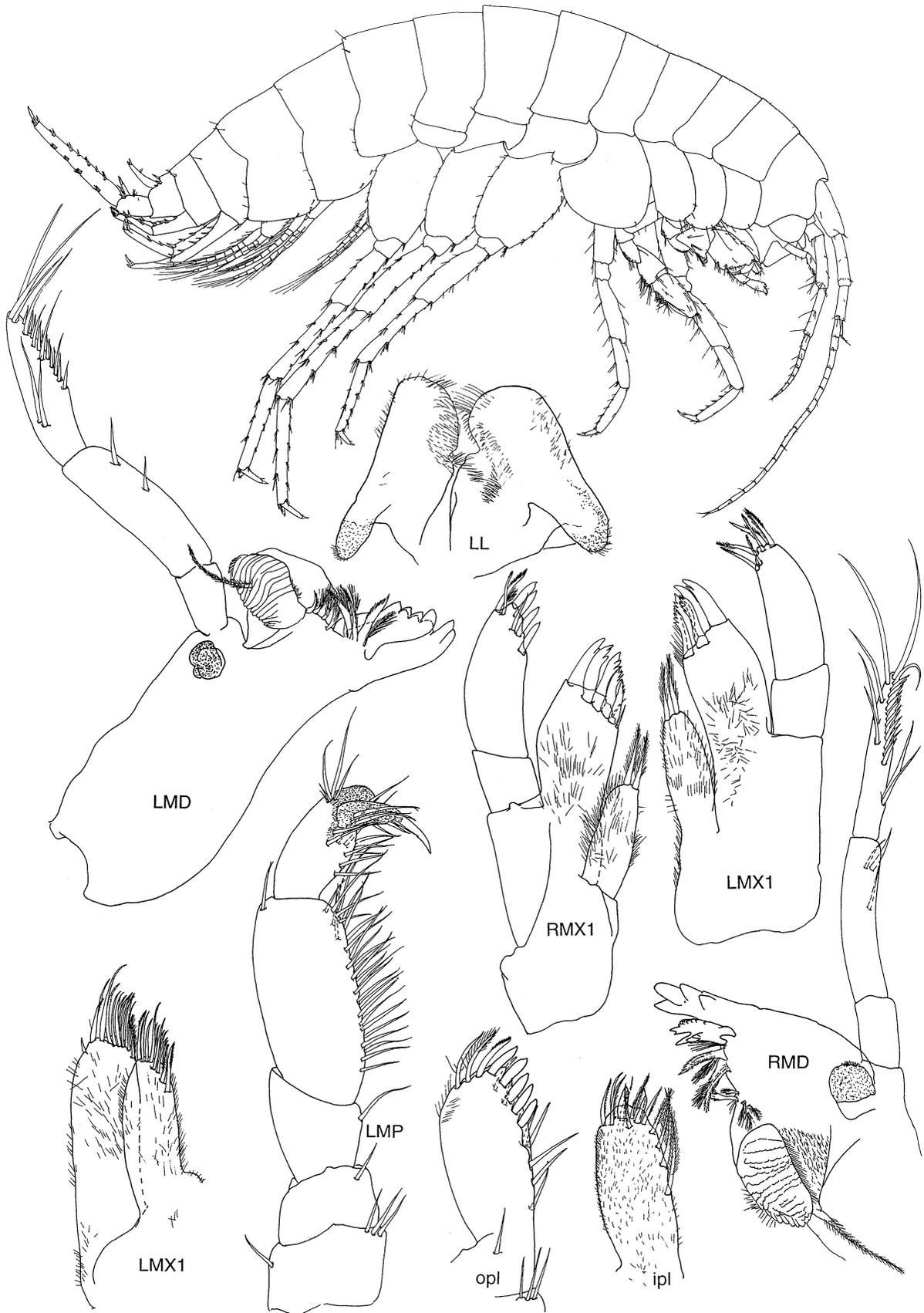


Fig. 42. *Neoniphargus richardi* n.sp. holotype female "a" 6.5 mm; whole, mouthparts.

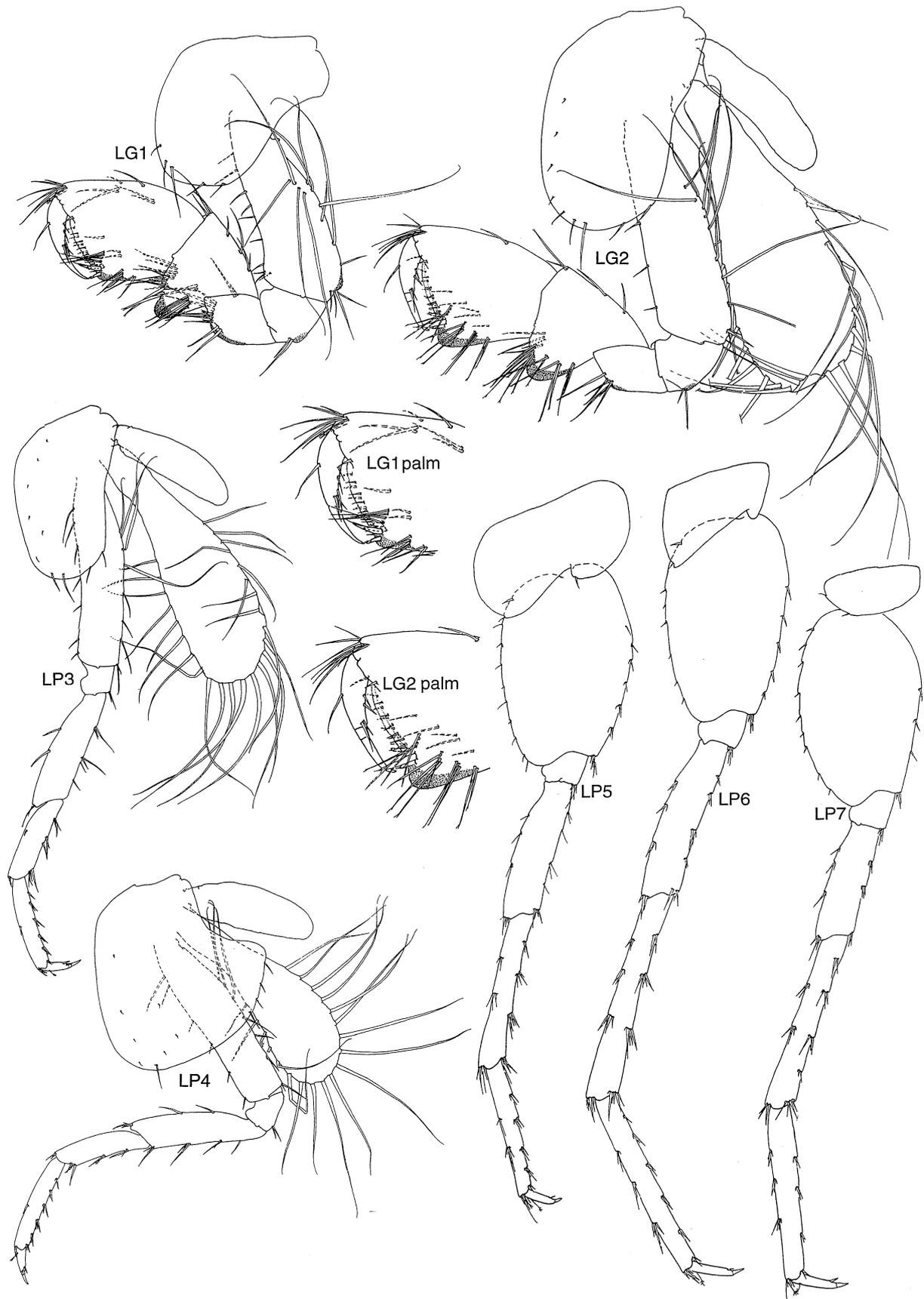


Fig. 43. *Neoniphargus richardi* n.sp. holotype female "a" 6.5 mm; legs.

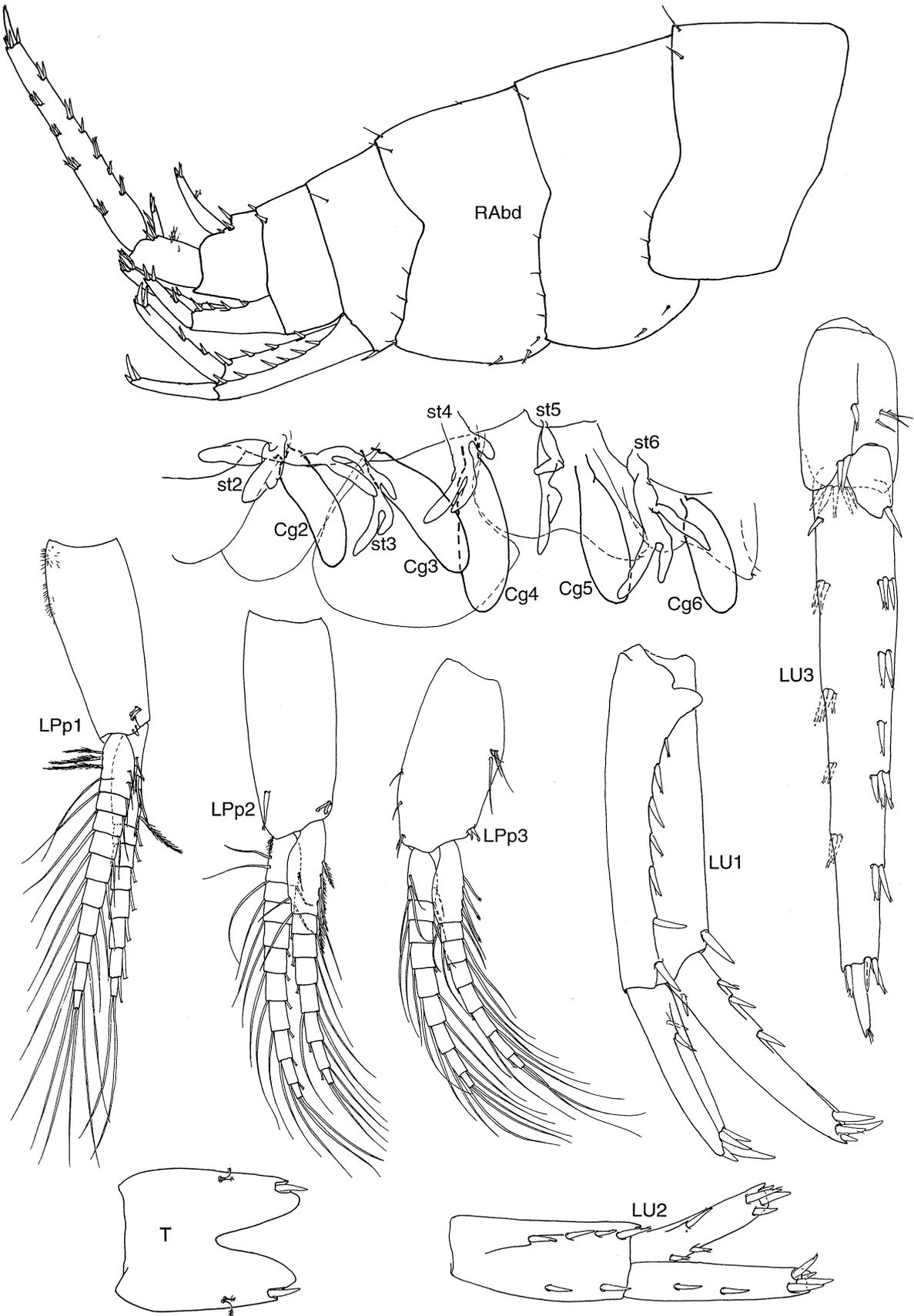


Fig. 44. *Neoniphargus richardi* n.sp. holotype female "a" 6.5 mm; abdomen, gills, pleopods, uropods, telson.

carpal lobe broader but not deeper than of the first gnathopod; propodus posterior corner lobate, larger than for the first gnathopod, rugose, the palmar corner with two lateral and one medial stout robust setae, dactylus reaching palmar corner robust setae. *Peraeopods* (Fig. 43): coxae 3 and 4 with few apical setae, coxa 4 moderately emarginate, both bearing simple sac like gill and broad, long oostegite; peraeopods 3 and 4 subequal in length, longer than the second gnathopod, articles 4 and 5 posteriorly spinose, posterior robust seta formulae of article 6 are 1-2-2-2-2 and 1-2-2-3-2 respectively; peraeopods 5-7 similar, leg six longest, coxae with 1-1-2 posterior weak robust setae, coxa 7 with no gill, articles 2 expanded posteriorly, weakly lobate post-ventrally, with small marginal setae, article 2 of peraeopod 6 slightly narrower; propodi with moderately long basodactylar setae. *Gills* (Fig. 44): coxae 2-6 bearing simple sac like gills; sternites 2-6 with pairs of fleshy, dendritic sternal gills attached to the posterolateral to mid lateral of each segment. *Epimera* (Fig. 44): second epimeron with a small post-ventral tooth, posterior margins of each convex to slightly sinuous bearing few setae, anterior ventro face of epimera two and three bearing two and three small robust setae. *Pleon*: few dorsal armaments; pleonites 5 and 6 with dorsal and dorsolateral robust setae; pleonite 6 bearing an additional robust seta basolateral to the telson. *Pleopods* (Fig. 44): similar, each with two retinacula; peduncle one with three small accessory setules, and short basolateral pubescence; peduncle two with a single distolateral strong seta; peduncle three with four lateral and four mid medial setae; rami of 10-8, 10-8, 9-8 articles respectively. *Uropods* (Fig. 44). Third uropod extending well beyond uropods 1 and 2 in the intact specimen; uropod lengths relative to uropod 1—uropod 2 0.7 \times , uropod 3 1.3 \times . First uropod: peduncle length 2.3 \times medial ramus, 2.9 \times lateral, lateral margin with a distal, subapical robust seta, and a dorsomarginal row of six short to moderate length robust setae, the mediodorsal face with a single subapical robust seta; rami unequal, outer ramus with one medial and one lateral robust seta and four apical robust setae; inner ramus with one basolateral robust seta, three medial robust setae and four apical robust setae. Second uropod: shorter than the first, peduncle bearing three dorsolateral and one subdistal short robust setae, and two medial robust setae; inner ramus longer than outer, with two medial robust setae and four apical robust setae; outer ramus with two medial, one lateral, and four apical robust setae. Third uropod: parviramous, peduncle length 0.3 \times length of the outer ramus, as long as urosomite three, bearing three dorsofacial robust setae, one mid medial and two medial robust setae basal to the inner ramus, and a distolateral row of five robust setae; outer ramus proximal article with four trans-lateral robust seta rows of 3-4-2-3 robust setae and five trans medial robust seta rows of 3-2-1-3-2 robust setae, two medial and three lateral distal robust setae basal to the second article; distal article bearing three small apical setules; inner ramus short, 0.13 \times outer ramus, with a single apical seta. Urosomite one at the base of uropod 1 bearing a moderate to large articulated robust seta. *Telson* (Fig. 44): short, about the same length as urosomite three, slightly longer than broad; cleft 50%; with a single subapical lateral robust seta on either lobe and paired dorsolateral penicillate setules on either lobe at M0.57.

Description of male "b". *Body*: length 5 mm. *First antenna* (Fig. 45): peduncle with sparse setae, relative lengths of articles 10:8:5, 0.5 \times flagellum length; accessory flagellum of two articles, small, reaching to M0.9 of first article of primary flagellum; primary flagellum long, of nineteen articles with

sparse setae, aesthetascs present on articles 2-19. *Second antenna* (Fig. 45): short, 0.5 \times antenna one; peduncle 1.7 \times flagellum, articles 4 and 5 subequal, with sparse setation; flagellum of eight articles, moderately setate, calceoli present on articles 1-5. *Mandibular palp*: left palp article 3 setae 1B3C11D3E; right palp article 3 setae 2B4C12D3E. *First gnathopod* (Fig. 45): coxal plate with few apical setae and several small anterofacial setae; articles 2, 3 and 4 with small rugose posterior keels; carpus short, bearing a strong posterior rugose lobe; propodus with small rugose posterior keel; robust setae of palmar corner two medial, two lateral, palm slightly oblique and convex, palmar robust setae moderately crowded and simple; dactyl bearing three inner margin accessory robust setae, nail reaching to palmar corner robust setae. *Second gnathopod* (Fig. 45): coxa bearing sac like gill, with few apical or facial setae; articles 2-4 with tiny posterodistal rugose keel; carpus with prominent posterior rugose lobe; propodus with moderate to strong rugose posterior lobe, palmar corner with one medial and two lateral robust setae, palm slightly oblique, almost straight, palmar robust setae simple; dactyl with three inner margin accessory robust setae, nail reaching slightly beyond palmar corner robust setae. *Peraeopods* (Fig. 45): similar to female, except propodi of legs 5-7 with long basodactylar setae extending almost to or beyond the dactyl. *Epimera* (Fig. 45): without postventral teeth; with 0-2-3 ventrofacial robust setae; posterior margins convex, sinuous, and straight, all weakly setulate. *Pleon* (Fig. 45): pleonite 5 bearing a single dorsolateral robust seta; pleonite 6 with a dorsal robust seta basal to the telson. *Pleopods* (Fig. 45): peduncles each with two retinacula; third peduncle with a small distolateral slender seta and four setae on the mid posterior margin; rami with 5-9, 7-9, 5-8 medial and lateral articles respectively. *Uropods* (Fig. 45). First uropod: peduncle with four dorsolateral and one apicolateral robust seta, and three dorsomedial and one apicomedia robust seta; medial ramus with two lateral and four apical robust setae; lateral ramus with one lateral and four apical robust setae. Second uropod: peduncle with two laterodorsal and two apicolateral robust setae, and one apicomedia robust seta; medial ramus with one lateral, two medial and four apical robust setae; lateral ramus with one lateral and four apical robust setae. Third uropod: peduncle longer than urosomite three, bearing no marginal robust setae, and two apicolateral robust setae; inner ramus length 0.5 \times peduncle, 0.15 \times outer ramus, bearing one apical robust seta; outer ramus of two articles; proximal article length 5 \times distal, with transverse lateral robust seta rows of 2-2-2 and four distal robust setae, and transverse medial robust seta rows of 1-3-2-2 and one distal robust seta; distal article with one small apical setule. *Telson* (Fig. 45): longer than urosomite three; one apical robust seta on either lobe; lateral penicillate setules at M0.6 on either side.

Description of female "c" (6.5 mm), juveniles (2.5 mm.): essentially as for female "a".

Relationship. This species differs from others of the genus in the following ways: eyes absent; outer plate of first maxillae with five denticulate robust setae, rugosities absent from the posterior angle of article 4 of the second gnathopod of the male; palmar corner of first gnathopod with two or three robust setae rather than six or more; palmar robust setae not dense, or with triggers; the second article of peraeopods 5-7 least expanded on leg six rather than five; accessory seta

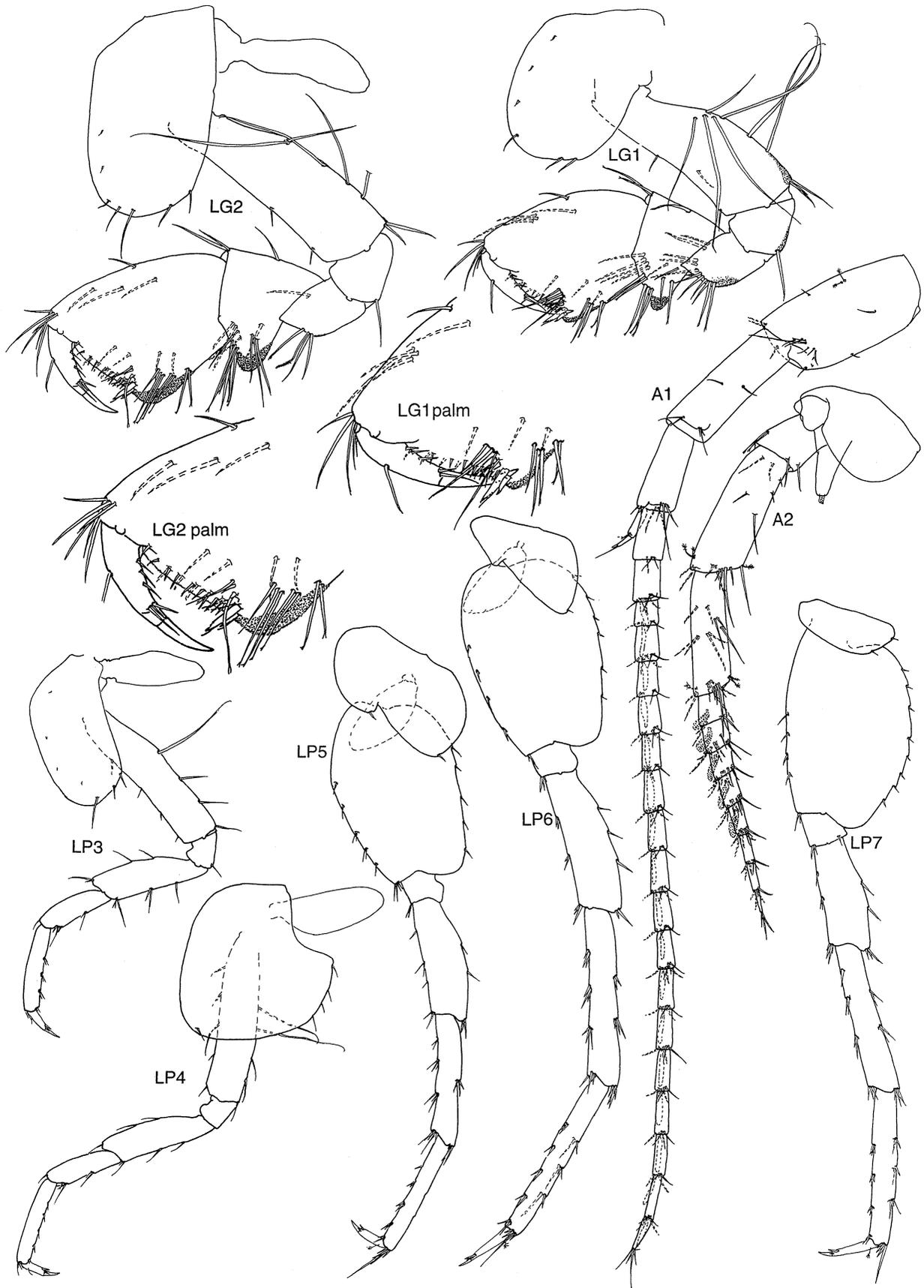


Fig. 45. *Neoniphargus richardi* n.sp. allotype male "b" 5.0 mm; antennae, legs.

present adjacent retinaculum of the first pleopod; one robust seta row on the inner ramus of uropod 2; setae absent from the inner margin of the ramus of uropod 3; telson cleft 50% rather than 60%.

Differences between *N. richardi*, and *N. coolemanensis* and *N. secus* are set out within discussion of those species.

Distribution. River Cave Spring, cave W47, Wombeyan cave system, New South Wales, 34°19'S 149°59'E.

Wesniphargus Williams & Barnard

Wesniphargus Williams & Barnard, 1988: 160–161

Type species. *Neoniphargus nichollsi* Straškraba, 1964.

Composition. This genus was monotypic, but we now add a further species, *W. yanhepensis*, from a cave in Western Australia.

Diagnosis. Williams & Barnard (1988) re-examined the incomplete holotype of *W. nichollsi* and provided both a generic diagnosis of *Wesniphargus* and a partial redescription of the type species, *W. nichollsi*, based on this examination and the original description and drawings of Straškraba (1964). Even so, the generic diagnosis was incomplete. The discovery of a further species that can be assigned unequivocally to the genus, and an examination of fresh material that can be assigned to *W. nichollsi*, permits completion of the generic diagnosis with some minor changes.

Pleonites with weak dorsal arms, rostrum small or obsolescent, lateral cephalic lobes weakly to moderately projecting, antennal sinus weak to moderate. Eyes present or absent. First antenna elongate, longer than second, ratio of peduncular articles 10:7:5 to 10:9:5, accessory flagellum 2-articulate. Second antenna flagellum length equal to or less than length of peduncle, with very large calceoli in male. Ratio of articles of mandibular palp 8:22:22 to 8:28:26, second article moderately setose, article 3 moderately to barely falcate, setae BCDE. Labium without inner lobes. Maxillae not medially setose on inner plates except in some one or two marginal plumose setae on the second; maxilla one inner plate sub rectangular with two apical plumose setae, the outer plate with seven robust setae, palps weakly asymmetric. Second maxilla inner plate lacking oblique row of facial setae, the apicomedial edge with one plumose medial seta. Maxillipedal palp article 3 with or without rugose apical lobe, marginally pubescent or bearing fine setae. Coxae 1–4 elongate, sparsely setose ventrally, coxae 1–3 lacking a row of posterior robust setae, coxa 1 subquadrate or tapering below, coxa 4 emarginate, coxa 5 much shorter than four. Gnathopods small; carpi shorter in male, lobate; articles 4 and 5 with or without rugosities; propodi not expanded apically, palms weakly oblique, lacking rugosities in some, robust setae symmetrically bifid or not, bearing short terminal triggers; robust setae at corner of palm four, with small sub apical triggers; robust setae along palm moderately dense, with or without triggers. Peraeopods 3 and 4, article 6, posterior robust seta sets evenly spaced, legs 5–7 moderately elongate, articles 2 of legs 5–7 broadly expanded, ovate, postventrally lobate. Dactyls of legs three to seven with one facial and one marginal setule. Gills borne on coxae 2–6, simple sac like, those of 5 and 6 slightly reduced in some.

Thoracic segments 2–6 with lateral sternal gills of incipient dendritic form but fingers only small lumps. Pleopods; basomedial setae of inner rami bifid, branches dissimilar, of different length and shape, occasionally one branch of diamond head shape or both simple; two to four retinaculæ each peduncle, with or without accessory retinaculæ or robust setae. Epimera with small, blunt postventral extensions, but not forming teeth, some with facial robust setae, with or without setae near the ventral margin, posterior margins weakly setulate. Uropods: apicolateral corner of the peduncle of uropods 1 and 2 with one robust seta; outer rami of both uropods 1 and 2 shorter than the inner, the margins spinous; uropod 1 lacking basofacial arms. Uropod 3 extended, parviramous or magniramous and dispariramous, the peduncle short; outer ramus 2-articulate, medial setae moderately dense and plumose, article 2 short to very short; inner ramus short to aequiramous, sparsely setulate or with moderately dense plumose setae. Telson length moderate to elongate, cleft 75–85%, the lobes laterally tumid in some, with apical spination or both apical and dorsal robust setae, no major setation, no basolateral arms except for a pair of lateral penicillate setules at M0.6 to M0.7 on either side.

Additional Description. Upper lip uniform, rounded below. Accessory blades of mandibles with few interraker plumose setae, several to many additional setae beyond rakers onto the base of the molar, pappose posterior seta on either or both molars. Inner plates of maxillae weakly to moderately pubescent on inner margins. Maxilliped inner plate with distolateral row of one to three plumose setae, with additional robust setae and plumose setae; outer plate with a distal row of few plumose setae, with a medial submarginal row of blunt naked tooth like robust setae and facial robust setae; palp articles 2 and 3 poorly setose laterally, article 2 moderately to strongly setose medially, article 3 of some with a row of non comb robust setae near the base of the dactyl, the apex slightly produced, rugose in some, marginally pubescent or with fine setae. Gnathopod 1 without one seta of article 4 enlarged and robust seta like; dactyls without recumbent inner tooth like robust seta, with stiff spinules at the inner nail articulation, without additional spinules along the inner dactylar margin. Pleopods similar, peduncles naked, rami extending equally or subequally. Urosomite one with or without a robust seta of moderate length at the base of uropod 1.

Wesniphargus yanhepensis n.sp.

Figs 46–48

Etymology. Named for the type locality.

Type locality. Yanhep Cave, Western Australia, 31°33'S 115°41'E.

Material examined. HOLOTYPE (WAM 520-97) female “a”, 8 mm, ALLOTYPE (WAM 521-97) male “b”, 7 mm. Also in the type series: juvenile “c” 4 mm (WAM 522-97), Western Australian Museum, collected by W.F. Humphreys, M.S. Harvey, C. Rippon, from freshwater pool in limestone cave, with hand net, 19 April, 1991, Yanhep Caves, Western Australia, 31°33'S 115°41'E.

Diagnosis. Pleonites with weak dorsal arms. Head; rostrum obsolescent, lateral cephalic lobes moderately projecting, moderate antennal sinus. Antenna one elongate longer than second antenna, ratio of peduncular articles 4:3:2; accessory flagellum 2-articulate; second antenna flagellum length less

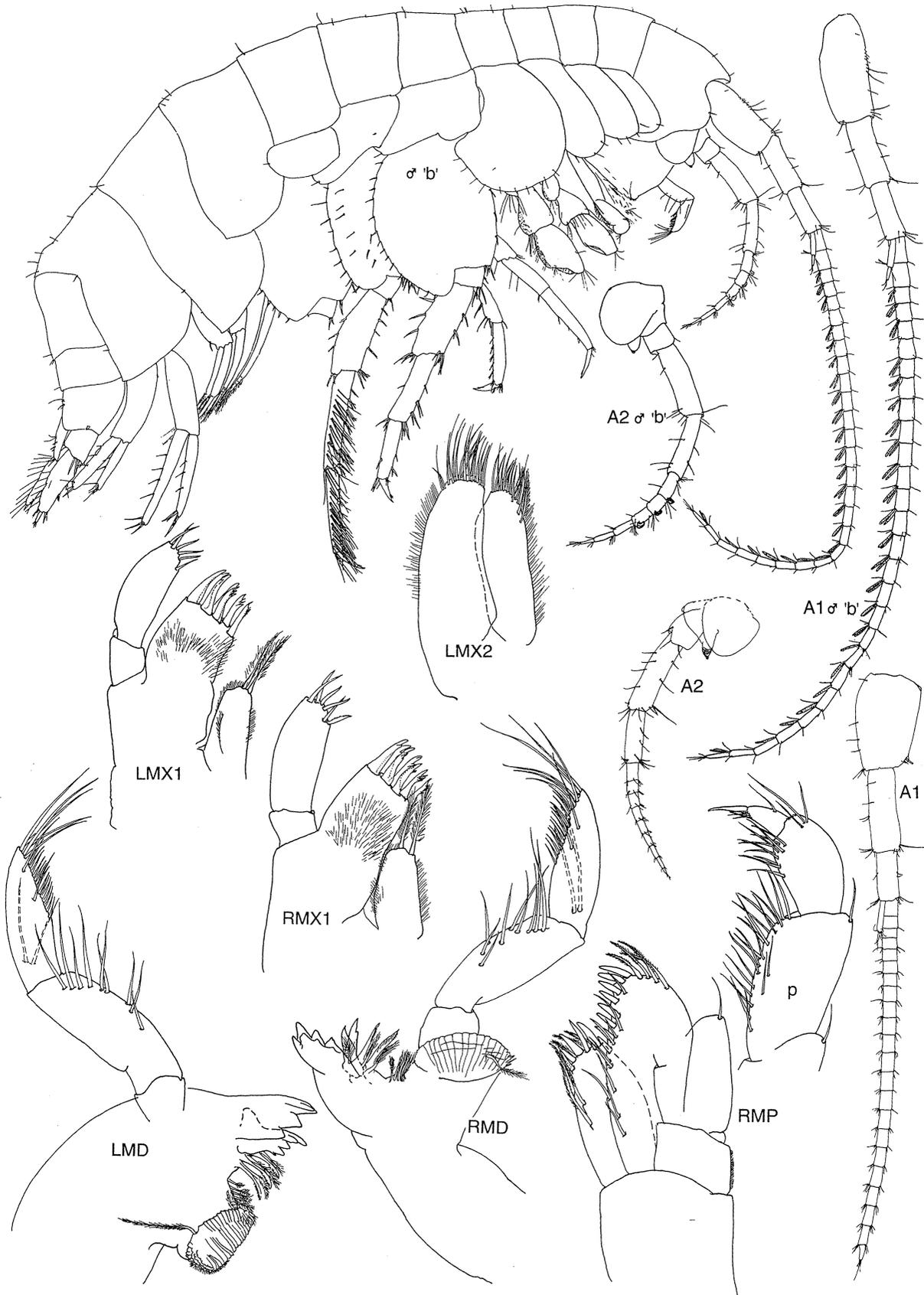


Fig. 46. *Wesniphargus yanchepensis* n.sp. holotype female "a" 8 mm; whole, antennae, mouthparts (all drawings except those indicated). Allotype male "b" 7 mm whole specimen, antennae.

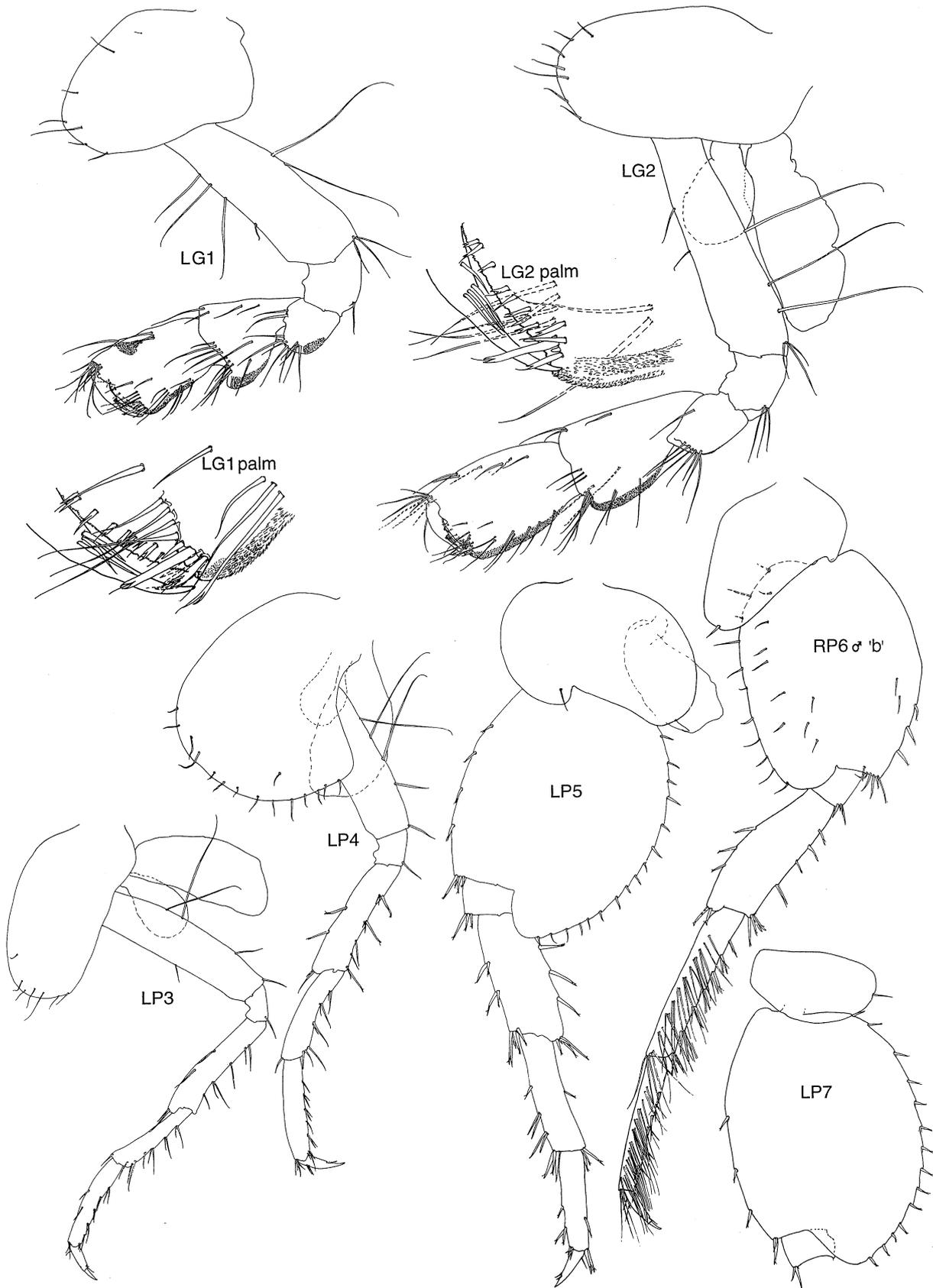


Fig. 47. *Wesniphargus yanchepensis* n.sp. holotype female "a" 8 mm; legs (all drawings except those indicated). Allotype male "b" 7 mm R peraeopod 6.

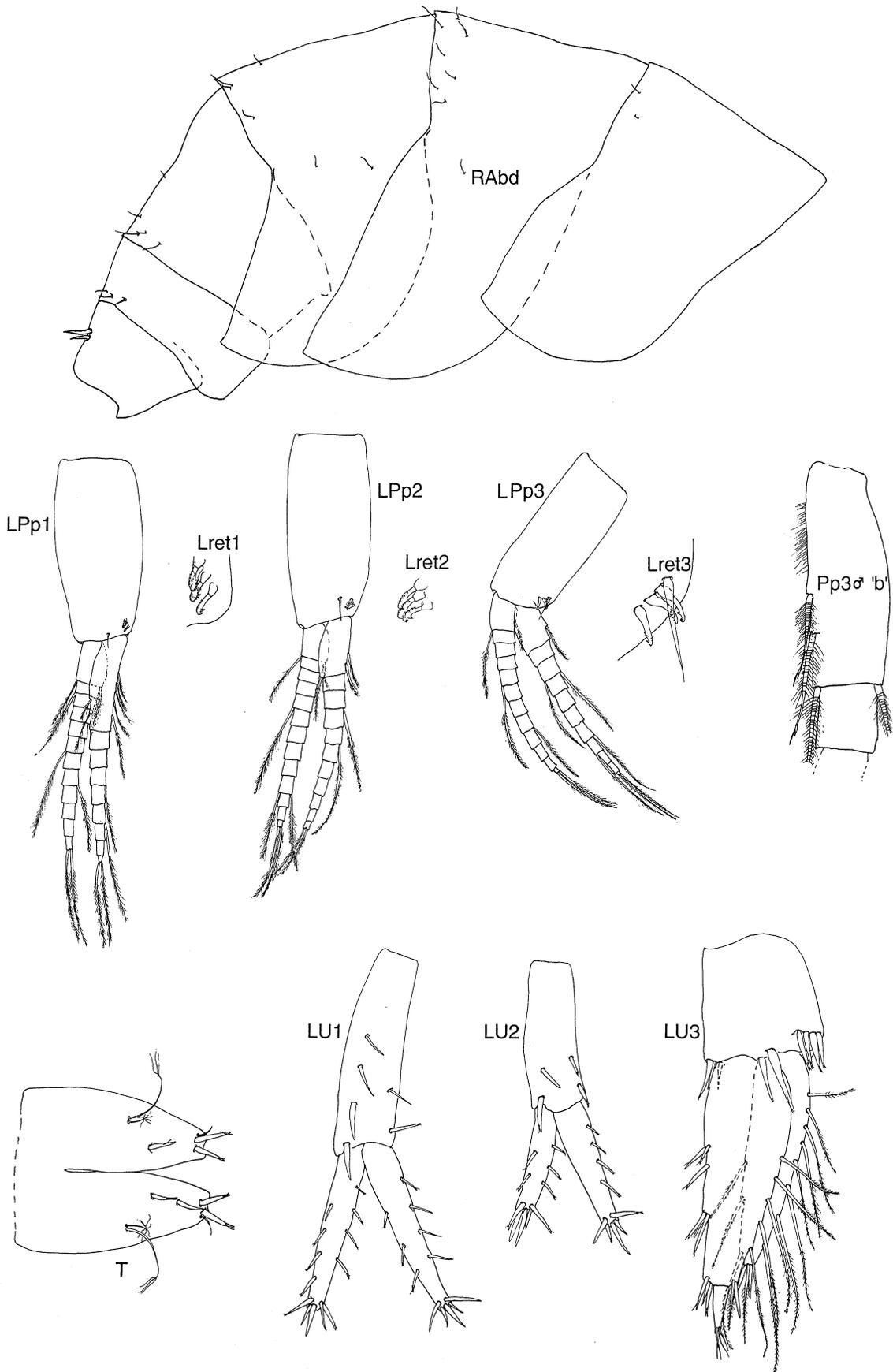


Fig. 48. *Wesniphargus yanchepensis* n.sp. holotype female "a" 8 mm; abdomen, gills, pleopods, uropods, telson (all drawings except those indicated). Allotype male "b" 7 mm articles 1 and 2 inner ramus, pleopod 3.

than peduncle. Mandibular palp ratio of articles 7:25:23; article 2 moderately setose, article 3 barely falcate, setae BCDE. Labium with no inner lobes. Maxillae not medially setose on inner plates except for two marginal plumose setae on second maxilla at M0.8; first maxilla inner plate sub rectangular, with two apical plumose setae; outer plate with seven denticulate robust setae, palps almost symmetric—left side with thin apical robust setae, right palp with mix of stout and slender robust setae. Second maxilla: inner plate lacking an oblique row of setae on the face, apicomedial margin with two plumose medial setae. Maxilliped: palp article 3 with a slight apical lobe bearing fine marginal setules. Coxae 1–4 elongate, sparsely setose ventrally; coxae 1–3 lacking a row of posterior robust setae; coxa 1 tapering below; coxa 4 emarginate; coxa 5 shorter than coxa 4. Gnathopods small, not sexually dimorphic in the palmar spination, carpi longer in female (0.7–0.8× propodi), lobate; articles 4–6 of gnathopods bearing post-marginal rugosities; article 4 of gnathopod 1 bearing a rugose margin; propodi not expanded apically; palms weakly oblique and convex; robust setae symmetrically bifid, also bearing short terminal triggers; robust setae at corner of palm two long and two short, bifid and with small triggers; robust setae along palm moderately dense with triggers on most. Gnathopod 1: propodus posterior margin arms of a single robust seta in tandem, with an additional submarginal transverse row of three robust setae at M0.5. Peraeopods 3 and 4 article 6 with posterior robust seta sets evenly spaced; peraeopods 5–7 moderately elongate; article 2 broadly expanded, ovate, postventrally lobate; peraeopods 3–7 dactyls with one marginal and one facial setule. Oostegites present on female coxae 2–4. Coxae 2–6 with sac like gills; gills 5 and 6 not reduced. Thoracic segments 2–6 with lateral sternal gills; small, lumpy, but not dendritic. Pleopods 1–3 with basomedial setae, bifid, branches dissimilar, of differing length and shape, some with one branch of diamond head, this organ borne at about M0.5 of the branch; retinaculae 4-3-3 respectively, accessory retinaculae 0-1-1. Epimera: post-ventrally bearing very small rounded extensions: blunt, without a tooth; none with facial robust setae, without setae near the ventral margin; posterior margins weakly setulate. Uropods; apicolateral corner of peduncle of uropods 1 and 2 with one robust seta, with a pair of mediomarginal robust setae at M0.7, and at M0.9; outer rami shorter than inner, margins spinose; uropod 1 lacking basofacial arms; all rami with two robust seta rows; uropod 3 extended, magniramous, dispariramous, peduncle short, outer ramus lanceolate, 2-articulate, medial setae moderately dense and plumose; article 2 very short, inner ramus dispariramous, lanceolate, with moderately dense plumose medial setae. Telson of moderate length; cleft 75%; lobes moderately tumid laterally, with apical and dorsal spination; no major setation; no basolateral arms, except for a pair of lateral penicillate setules at M0.6 on the dorsolateral face.

Additional characters. Upper lip uniformly rounded below; accessory blades (rakers) usually with few interraker plumose setae; many additional (penicillate) setae beyond rakers onto base of molar; large basal ragged molarial seta on R mandible; no other apical molarial seta. Lower lip uniform, inner lobes absent; medial margins of inner plates of maxillae moderately pubescent, both plates with long apical setae; inner plate with three distal plumose setae, apical robust setae and mid-facial plumose setae; outer plate with a distal row of plumose setae, medial submarginal teeth and facial robust setae; palp articles 2 and 3 poorly setose laterally, basally naked; article 2 strongly setose medially, article 3 without a row of non comb robust setae near the dactylar base, apex only slightly produced, not rugose, marginally pubescent or with fine setae. Dactyls

without small recumbent inner tooth like robust seta on either gnathopod, with stiff spinules or setules at inner nail articulation line, without additional spinules along inner dactylar margin. First gnathopod without seta of the fourth article enlarged and scythe like. Pleopods similar, peduncles naked, rami extending equally. Urosomite one, at the base of uropod 1 without a robust seta.

Description of holotype (female “a”). *Body* (Fig. 46): pleon sparsely armed dorsally, few setae on pleonites 1–5; moderately setose distolaterally, pleonite 5 without robust setae on each side, pleon six with a pair of dorsolateral robust setae each side, length 8 mm. *Head*: rostrum absent, eyes absent. *First antenna* (Fig. 46): length 0.46× body, 1.8× second antenna; peduncle much shorter than flagellum, ratio of lengths of articles 21:18:11 (= 3.8:3.2:2), flagellum of 22 articles, without aesthetascs or calceoli; articles not uniform, proximal articles 3–6 shorter than distal articles, article 3 shortest; sparsely setulate; accessory flagellum 2-articulate, extending to M0.6 of article 3 of the primary flagellum. *Second antenna* (Fig. 46): length 0.25× body, flagellum of nine articles, the peduncle longer than the flagellum; article 4 longer than five, articles 3–5 with sparse ventral setation, without calceoli or aesthetascs. *Upper lip*: apical margin evenly rounded. *Left mandible* (Fig. 46): ratio of lengths of palp articles 8:28:26, article 2 with nine long naked medial to distofacial setae, article 3 without pubescence, setae 2B2C14D5E; incisor with four teeth; lacinia four large and one small teeth; three setose accessory blades and three plumose interraker setae, a row of plumose setules leading to base of the molar; molar bearing posterior pappose seta, without other penicillate basal setae. *Right mandible* (Fig. 46): incisor with two rows of cusps of four large and three small teeth; lacinia mobilis bifid, both blades acuminate, the medial blade with a medial marginal pair of small teeth at M0.75, the lateral blade bearing weak facial cusps and a row of setae; accessory blades of two rakers and two plumose robust setae; palp article 2 bearing nine facial setae; setae of palp article 3 2B2C13D6E; molar bearing large posterior pappose seta. *Lower lip*: without inner lobes; bearing slender robust setae apically on outer lobes; facially and marginally pubescent; posterior protuberances also marginally pubescent. *Maxillae* (Fig. 46). Left first maxilla: palp article 2 with five thin apical robust setae and one mediolateral robust seta, without other setae; outer plate with seven robust setae, most denticulate, facially pubescent; inner plate with two apical plumose setae borne on the distomedial margin, outer distal and inner margins pubescent, with a mid-facial row of pubescence. Right first maxilla: palp article 2 bearing four slender terminal robust setae and two mediolateral robust setae, one armed on the medial margin with short setules, the other naked, slender; outer plate bearing seven denticulate terminal robust setae, facially pubescent; inner plate with two apical plumose setae, borne on the medial margin; medial and lateral margins as well as a small laterofacial area pubescent. Second maxillae: similar; most robust setae of both plates long, curved; outer plate apex bearing many long, curved robust setae, lateral margins pubescent; inner plate subapical medial corner bearing a short row of plumose setae, apex bearing many long, curved setae; medial margin pubescent. *Maxilliped* (Fig. 46): palp laterally pubescent basally, articles 2 and 3 poorly setose laterally, article 2 strongly setose medially, article 3 without comb robust setae basal to the dactyl, the apex slightly produced bearing a few short marginal setules, and a transverse subapical facial row of three long setae; inner plate bearing three distal plumose setae, four apical stout naked robust setae, two medial subapical robust setae and two facial

plumose setae at M0.4 and M0.6; outer plate bearing a distolateral row of four plumose setae, a submarginal medial row of eight naked tooth like robust setae extending from M0.6 to the mid apex, the medial margin thus robust setae absent beyond M0.6, a discontinuous mediofacial row of eight slender robust setae extending from M0.2 to M0.9 and two slender medial robust setae at M0.4 and M0.55. *First gnathopod* (Fig. 47): coxal plate with four slender apical and three facial anterior setae; articles 2 and 3 without rugosities; article 4 with small posterior rugose hump; carpus short, lobate—lobe tilted apically—and rugose; propodus sub rectangular, slightly expanded apically, longer than wide, length to width ratio; 48:33, bearing an anterior facial area of rugosities, palmar corner rounded, with a narrow rugose posterior keel, the corner marked by two medial and two lateral bifid robust setae which also bear short triggers; one lateral robust seta slightly elongate; palm weakly oblique, slightly convex, dactylus without recumbent inner tooth like robust seta, reaching end of palm. *Second gnathopod* (Fig. 47): coxa moderately setose apically, bearing sac like gill and long naked oostegite; articles 2 and 3 without posterior rugosities, article 4 with a small rugose keel; carpus longer than gnathopod 1, with a long rugose posterior lobe; propodus longer and narrower than gnathopod 1, length to width ratio; 80:130; posterior margin a long rugose keel; palmar corner rounded, marked by four lateral robust setae; dactyl bearing three stiff setules at inner nail articulation line and a single, more proximal robust seta, reaching slightly beyond the robust setae of the palmar corner. *Peraeopods* (Fig. 47): coxa 3 with six apical setae as well as a single anterior seta; coxa 4 emarginate, ventrally and post-ventrally bearing fourteen setae and one ventrofacial seta; peraeopods 3 and 4 weakly setose posteriorly, three less setate than four; articles 6 and 7 post-marginal robust seta formulae 3-2-2-2-1 plus two locking robust setae and 1-2-2-1-2 plus three locking robust setae, respectively; peraeopod 5 article 6 with few posterior robust setae; peraeopod 6 articles 5 and 6 with many robust setae and setae; peraeopods 3-7 dactyls with one medial and one facial setules; coxa 5 only with a single ventromarginal robust seta; coxae 6 and 7 naked ventrally with a single post-ventral robust seta at the posterior corner, coxa 7 also with a single posterior robust seta; article 2 broadly expanded, ovate, lobate postventrally, with short to moderate posterior setules. *Gills* (Fig. 48): coxae 2-6 with sac like gills, 5 and 6 not reduced; sternites 2-6 with pairs of fleshy sternal gills bearing small lumps, of incipient dendritic form, attached between centre and lateral edge of each segment. *Oostegites* (Fig. 47): present on female coxae 2-5, broadly ovate on coxae 2-4, more slender on coxa 5; margins without elongate setae. *Epimera* (Fig. 48): 1-3 without postventral teeth; each with a small blunt protrusion, not acuminate, smallest on epimera three; posterior margins almost straight, without ventral robust setae, adjacent each post-ventral margin a single seta dorsal to the margin. *Pleon* (Fig. 48): with few dorsal setae or robust setae; dorsolateral posterior margin of pleonites 1-6 with setae: 6-11-9-6-4-0, and robust setae: 0-0-0-0-0-2. *Pleopods* (Fig. 48): similar, without peduncular arms, with 4-3-3 retinacula and an associated or accessory robust seta; basal setae of inner ramus bifid with similar and dissimilar branches, rami of 12-9, 13-11, 12-11 articles respectively. *Uropods* (Fig. 48). Uropod 3 extending beyond uropods 1 and 2 in entire animal. Uropod lengths relative to uropod 1; uropod 2 0.65×, uropod 3 1.1×; most robust setae of uropods bearing short subdistal triggers. First uropod: peduncle length 1.1× inner ramus, 1.1× outer ramus; outer margin without apical robust seta, and with weak row of four dorsolateral robust setae, the most distal being medio-subapical; medially 2 weak

robust setae; the lateral ramus slightly shorter than medial (35:37); both with two rows of marginal robust setae, both apices with five terminal robust setae. Second uropod: peduncle about 1.2× length of inner ramus, with two medial and two lateral dorsal robust setae; outer ramus shorter than inner (22:26), with two rows marginal robust setae; inner ramus without a lateral row of robust setae; apices of both rami with five terminal robust setae. Third uropod: peduncle length 0.5× length of first article of outer ramus, 0.75× urosomite three, with a subdistal medial transverse row of four trigger robust setae, a pair of apicodorsal robust setae, two dorsal and one ventral apicolateral robust setae; outer ramus proximal article with four lateral trigger robust seta clusters: discontinuous; lateral robust setae proximal to distal 0-2-1-0-3-0-3; medial margin with six plumose setae and one distal robust seta; distal article small, much shorter than proximal (28:133); apex with four sub terminal dorsal short stiff setae; inner ramus length approximately 0.7× length of outer ramus, bearing on the inner margin a row of eight plumose setae; outer margin with three plumose setae; apex with one plumose seta and two trigger robust setae. *Telson* (Fig. 48): moderately long, 1.2× length urosomite three; cleft 75% of length; lobes moderately tumid laterally; apex notched, both apices blunt, rounded; dorsal subapices each with two large robust setae and a small lateral penicillate setule; a single dorsal robust seta on the right lobe at M0.7, two dorsal robust setae on the left lobe at M0.7 and M0.8; each lobe with a pair of penicillate setules dorsolaterally at M0.6.

Description of allotype (male "b"). Similar to female except in the following. *Body*: length 7 mm. *First antenna* (Fig. 46): length 0.67× body, 2.5× second antenna; ratio of lengths of peduncular articles 4:2.5:2; flagellum of 27 articles all except basal and ultimate article with aesthetascs; calceoli absent. *Second antenna* (Fig. 46): 0.26× body length, flagellum of six articles, without aesthetascs, articles 1-3 bearing large type nine calceoli. *Mandibles*: left palp article 2 with five moderate mediobasal setae, article 3 with setae 1B2C9D4E; right palp article 2 with five moderate mediobasal setae, article 3 with setae 2B2C10D4E. *Gnathopods*: carpi short, about 0.5× propodi. *Pleon*: pleonites 5 and 6 with two distolateral robust setae. *Pleopods* (Fig. 48): peduncles each with two retinacula, one and three with a single small mediobasal robust seta; rami with 6-9, 8-9, 7-10 medial and lateral articles respectively, inner setae of first article of medial ramus apically bifid. *Uropods*: peduncle of uropod 1 with three dorsolateral and two dorsomedial robust setae, margins each with one apical robust seta, outer ramus with three medial, two lateral and five apical robust setae, inner ramus with two medial one lateral and five apical robust setae; peduncle of second uropod with one dorsomedial and one apical robust seta one each side, outer ramus with one lateral, two medial and five apical robust setae, inner ramus with two lateral, two medial and five apical robust setae. *Telson*: slightly longer than urosomite six; two apical robust setae on either lobe plus a dorsal robust seta on each at M0.75, and a pair of lateral penicillate setules at M0.6.

Description of juvenile "c". *Body*: length 4 mm. Similar to female "a".

Relationship. *Wesniphargus yanchepensis* differs from *Wesniphargus nichollsi* in: eyes absent; flagellum of first and second antennae with more articles; flagellum of first antenna with paired aesthetascs on several articles; second article of mandibular palp relatively shorter; third article of mandibular palp without pubescence, bearing

more E setae; lower lip posteriorly pubescent; palps of first maxilla with fewer setae, and outer plate facially pubescent; third article of maxillipedal palp without rugosities, outer and inner plates bearing more setae; propodi of both gnathopods bearing rugosities; carpus of second gnathopod long; coxae of peraeopods 5–7 each bearing a post-ventral robust seta; peraeopod 6, articles 5 and 6 bearing many setae; coxal gills 5 and 6 not reduced; epimera without post-ventral teeth; pleopods bearing 4-3-3 retinacula (cf. two each); third uropod aequiramous, and bearing medial setae; telson broader and bearing dorsal robust setae additional to paired apical robust setae.

Distribution. Yanchep Cave, Western Australia, 31°33'S 115°41'E.

Wesniphargus nichollsi (Straškraba)

Figs 49–53

Diagnosis. As set out by Williams & Barnard, 1988

Description. As described by Williams & Barnard, 1988.

Material Examined. Western Australian Museum: female “a”, 5 mm (WAM 523-97) and male “b”, 2.8 mm (WAM 524-97), outflow of Mammoth Cave, Western Australia, 34°03'S 115°01'E; male “d”, 2.8 mm (WAM 525-97), from a pool of black water beside the Yellingup to Augusta Road near Margaret River, Western Australia, 33°54'S 115°20'E; all collected by K. Davies, C.M. Austin, B. Knott on 29 August, 1991. This material can be assigned without equivocation to the taxon *W. nichollsi*: it conforms in all essential features to the redescription of this taxon provided by Williams & Barnard (1988). Given the incomplete nature of that redescription (see above), and the provenance of some of the fresh material, the opportunity is taken to fully describe this fresh material.

Description of male “b”. *Body:* pleon sparsely armed dorsally; pleonites 1–4 moderately setose distolaterally; pleonite 5 with four lateral robust setae; pleonite 6 with two lateral robust setae; length 2.8 mm. *Head:* rostrum absent; eyes large, dark, reniform. *First antenna* (Fig. 49): length 0.45× body, 1.8× antenna two, peduncle much shorter than flagellum, ratio of lengths of articles 10:7:5, flagellum of fifteen articles, without calceoli, articles 3–11 and 14–15 each with one aesthetasc, articles not uniform, proximal articles shorter than distal, article 3 shortest; accessory flagellum 2-articulate, extending to M0.5 of the second article of the primary flagellum. *Second antenna* (Fig. 49): length 0.25× body; peduncle longer than flagellum, article 4 longer than five, articles 3–5 with sparse ventral setation; left flagellum 6-articulate, right five, weakly setose ventrally, bearing giant calceoli on articles 1–4 of the left flagellum, articles 1–3 of the right, and distal aesthetascs on antepenultimate and ultimate articles of each. *Upper lip:* apical margin rounded evenly. *Left mandible* (Fig. 49): palp article 3 shorter than 2, ratio of lengths 8:35:20, article 2 with long ventrofacial setae and mid-marginal pubescence; article 3 short, falcate, ventrobasally pubescent, setae 0C6D6E; incisor six toothed; lacinia mobilis with five teeth; three setose accessory blades and two plumose interraker setae, several brushy setae onto the base of the molar. *Right mandible* (Fig. 49): ratio of palp article lengths 8:25:20, article 2 ventromedially and facially

pubescent, bearing two medial marginal and five submarginal to facial long setae; incisor with four teeth, lacinia mobilis bifid, the anterior branch with 11 peg like, terminally rounded denticles and terminating in a tooth, the posterior branch with seven peg like denticles; accessory blades of two rakers and plumose setae; molar strongly triturative with posterior pappose seta. *Lower lip* (Fig. 49): without inner lobes, bearing elongate blunt robust setae apically on the outer lobes, facially and marginally pubescent; posterior protuberances marginally pubescent. *Maxillae* (Fig. 49). Left first maxilla: palp article 2 narrow, with five thin apical robust setae and two sub apical facial setae; outer plate with seven strong denticulate robust setae; inner plate with two plumose apical setae. Right first maxilla: palp article 2 broad with one apicolateral long stout robust seta distomarginally setulose, two subterminal facial setae, one armed, two stout naked distal robust setae and one small distomedial robust seta; outer plate bearing seven denticulate terminal robust setae; inner plate with two apical plumose setae. Second maxilla: with long distally curved, blunt and flattened apical setae; outer plate mediolateral submarginal face with a short row of two or three long robust setae; inner plate distomedial corner with a slightly submarginal thick plumose seta. *Maxilliped* (Fig. 49). Palp: article 3 with several thick setae on the inner edge, two ventral submarginal setae, a row of four robust setae basal to the dactyl and the adjacent margin pubescent, three strong distolateral robust setae, the apex weakly produced and rugose; dactyl unguiform with a nail, and two accessory marginal spinules; article 2 well setose medially. Inner plate: bearing three stout naked apical robust setae, a short discontinuous row of three plumose submarginal facial setae extending apically from M0.6, and facially distolaterally a single plumose seta and a naked robust seta. Outer plate: with three slightly submarginal mediolateral naked tooth like robust setae, one apical naked tooth like robust seta and three distolateral pappose robust setae. *First gnathopod* (Fig. 50): coxal plate with few apical setae; articles 3–5 with posterior rugose lobes, small on article 3, moderate on articles 4 and 5; carpus short; propodus sub rectangular—length to width ratio 92:65—not expanded apically, palmar corner sub rectangular, not rugose, with two medial and two lateral naked blunt robust setae, palm very weakly oblique, slightly convex, dactylus without accessory marginal spinules, nail long, reaching to palmar corner. *Second gnathopod* (Fig. 50): coxal plate poorly setose apically with three long and three short setae, bearing a long simple sac like gill; articles 2–4 with small posterior rugose margins, carpus longer than the first gnathopod, the lobe much reduced; propodus longer and narrower than the first—length to width ratio 92:50—palmar corner three lateral and one medial stout robust setae, palm with moderately dense simple robust setae. *Peraeopods* (Figs 50, 52): coxa 3 with three long and six short apical setae and a facioanterior row of four moderate setae; coxa 4 emarginate, moderately setose apically and facially; peraeopods 3 and 4 weakly spinose posteriorly, articles 6 with posterior robust setae 1-1-1-1 and 1-1-2-2 plus two locking robust setae, respectively; posterior lobes of coxae of peraeopods 5–7 dominant, with few ventromarginal robust setae (1-1-2), articles 2 strongly expanded, very broadly lobate postventrally, with short posterior setules. *Gills:* coxae 2–6 with sac like gills, those of 5 and 6 reduced slightly; sternites 2–6 with pairs of fleshy lumped gills attached to the lateral edge of each segment. *Epimera:* postventral teeth small blunt protrusions, not acuminate, smallest on the third; posterior margins almost straight; second epimeron with three anteroventral submarginal robust setae, the third with two. *Pleon:* with few dorsal setae and robust setae; pleonites 1–6 with setae 9-6-9-4-0-0, pleonites 5 and 6 with 4-2

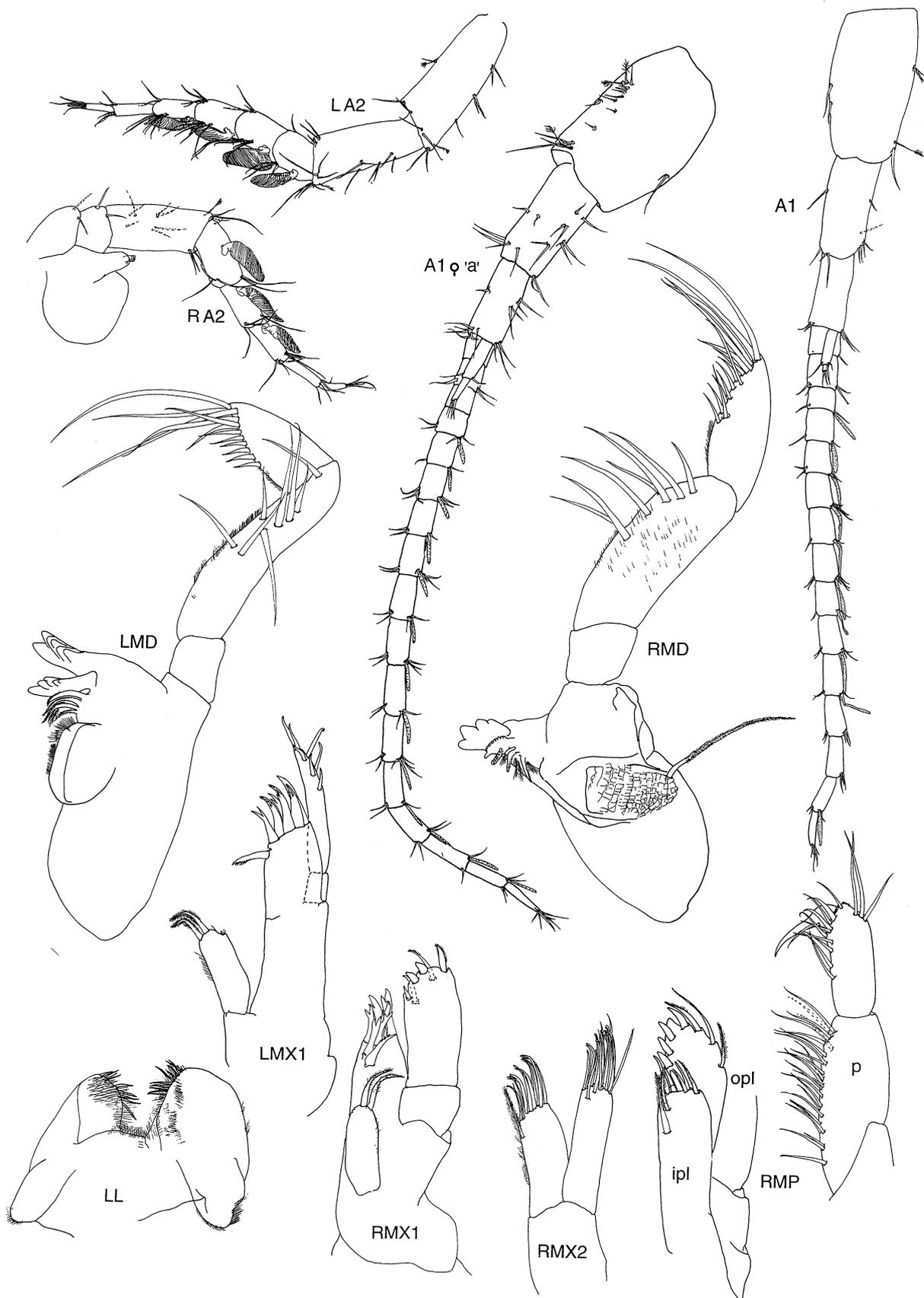


Fig. 49. *Wesniphargus nichollsi* (Straškraba) male "b" 2.8 mm; antennae, mouthparts(all drawings except those indicated). Female "a" 5.0 mm first antenna.

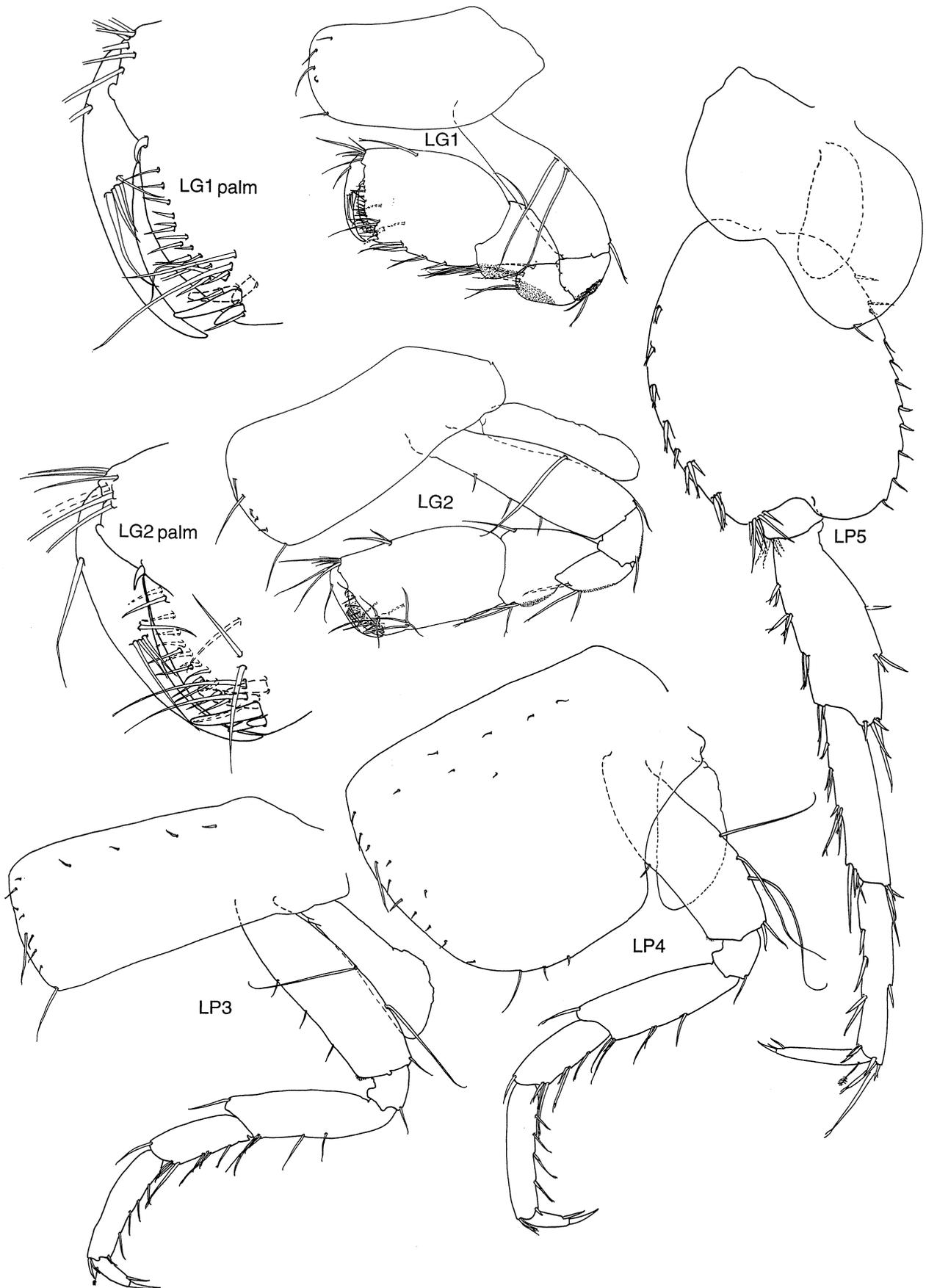


Fig. 50. *Wesniphargus nicholli* (Straškraba) male "b" 2.8 mm; gnathopods.

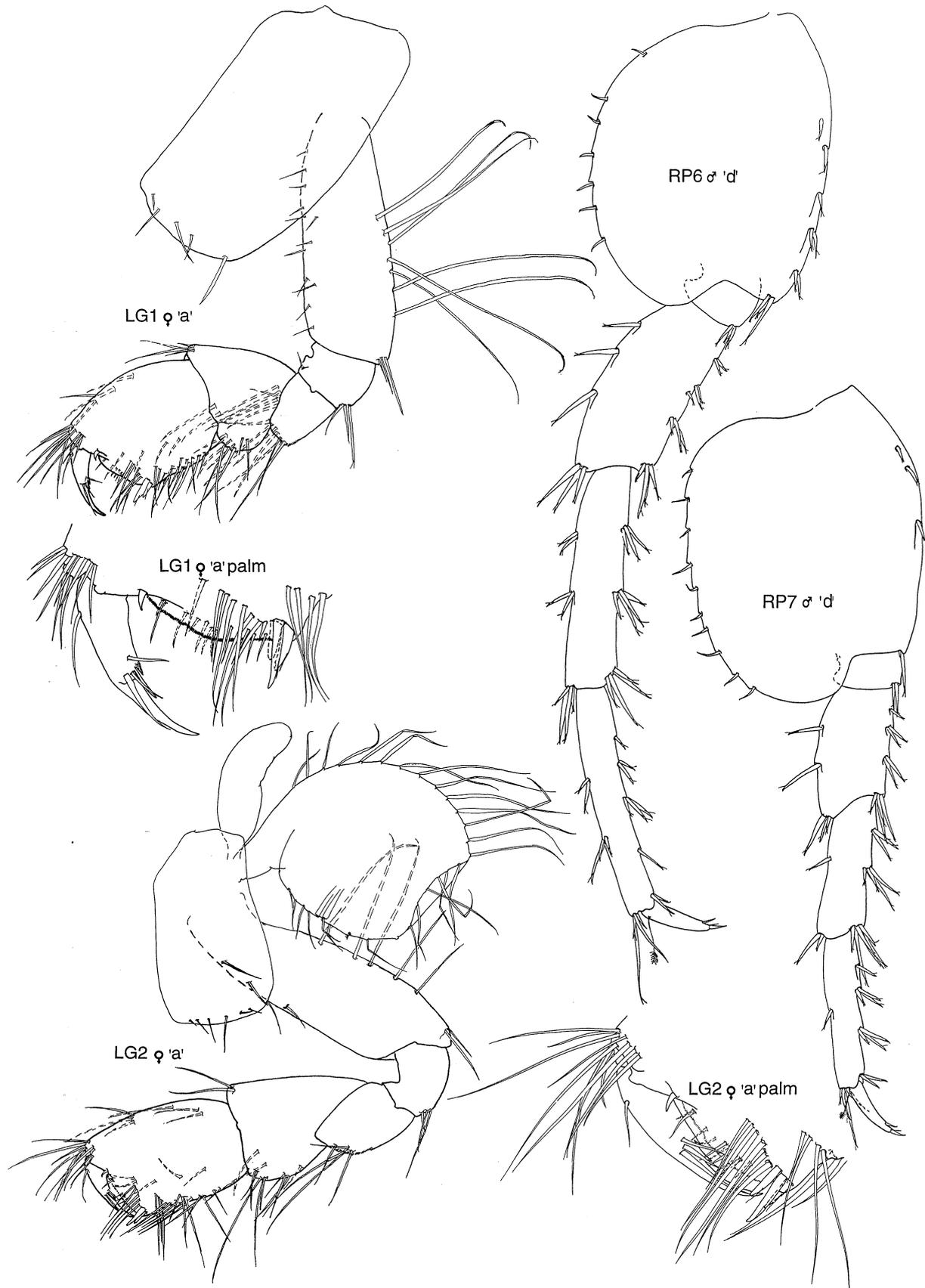


Fig. 51. *Wesniphargus nichollsi* (Straškraba) female "a" 5.0 mm gnathopods 1 and 2, male "d" right pereopods 6 and 7.

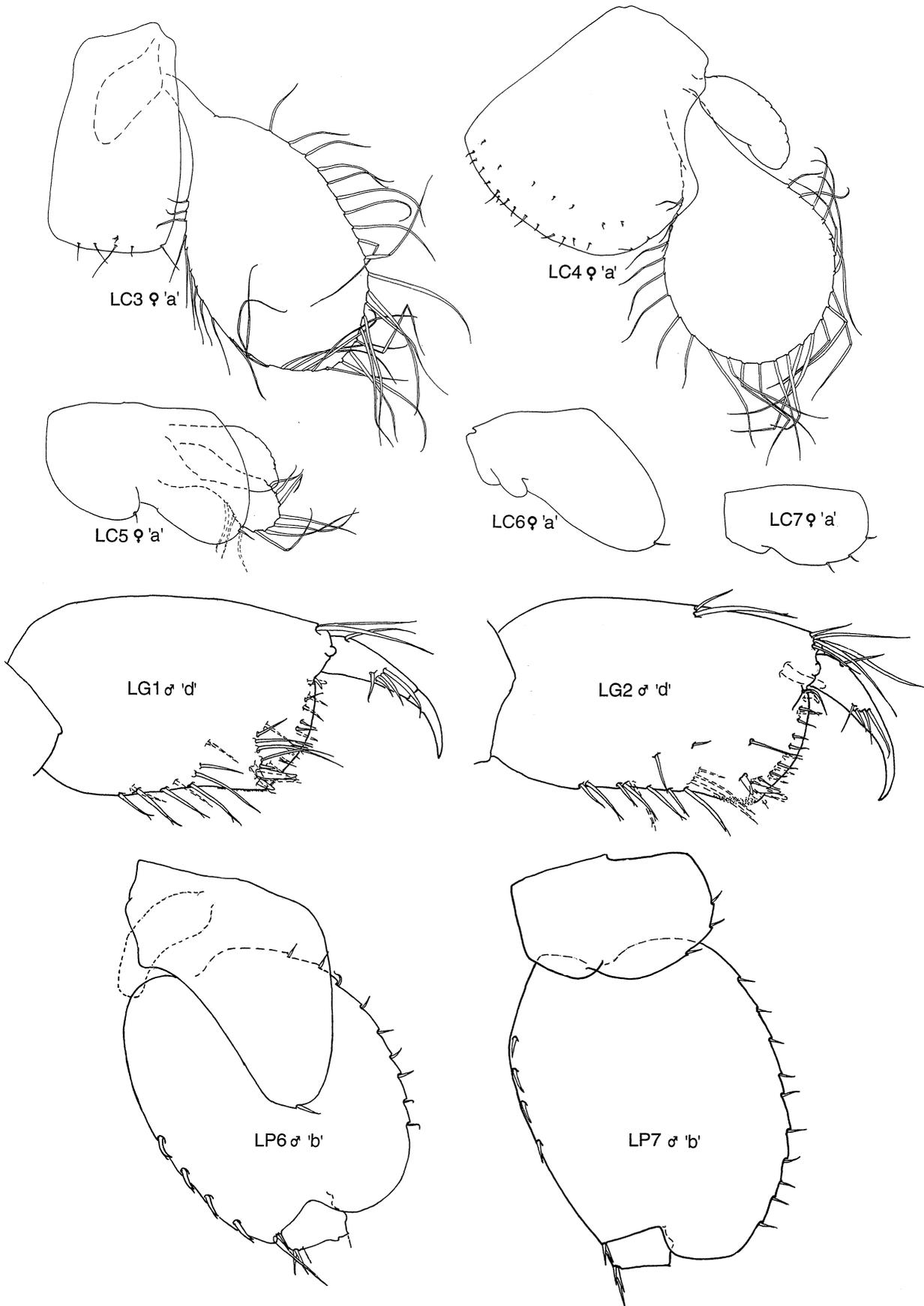


Fig. 52. *Wesniphargus nichollsi* (Straškraba) male "b" 2.8 mm pereopods 6 and 7 (part), male "d" 2.8 mm dactyls of gnathopods 1 and 2, female "a" 5.0 mm coxae 3-7.

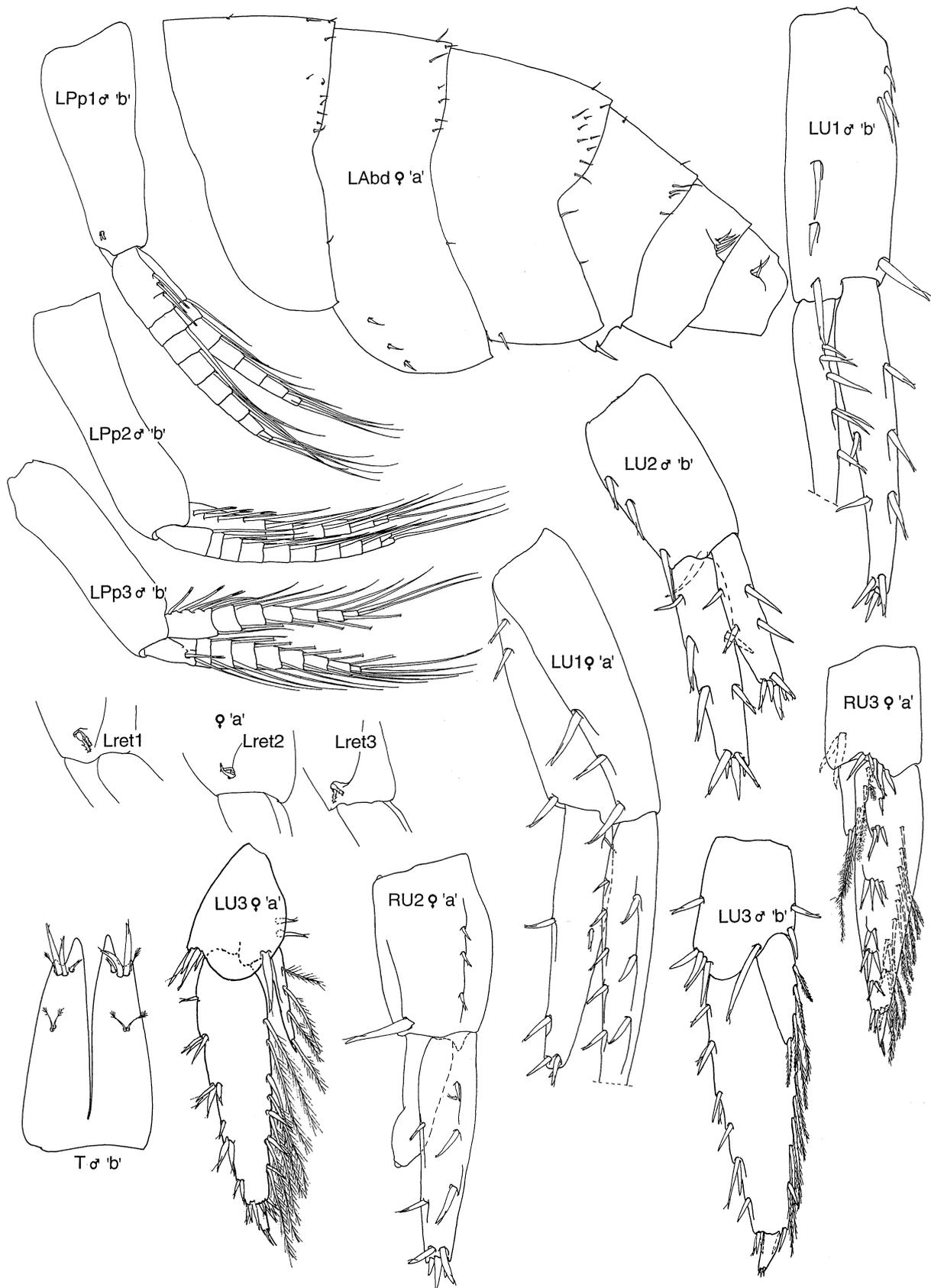


Fig. 53. *Wesniphargus nichollsi* (Straškraba) male "b" 2.8 mm pleopods, left uropods and telson; female "a" 5.0 mm abdomen, retinacula, uropods.

distolateral robust setae. *Pleopods* (Fig. 53): similar; peduncles naked except for a pair of retinaculae; rami moderately long of 8-7, 10-7, 9-7 lateral and medial articles respectively; basal article of the inner rami armed with several terminally bifid setae with asymmetrical apices, some with "diamond" heads, some symmetrical. *Uropods* (Fig. 53). Third uropod: extending beyond first and second in the intact specimen; uropod lengths relative to uropod 1 uropod 2 0.7, uropod 3 0.75. First uropod: peduncle length 1.1× outer ramus, 0.85× inner; outer margin with one apical robust seta and two dorsal robust setae, medial margin with three small basal robust setae and one apical robust seta; lateral ramus shorter than medial, both with two rows of marginal robust setae, the lateral apex with four robust setae, the medial with five. Second uropod: peduncle 0.8× length of the inner ramus with one apicodorsal robust seta and three medial robust setae; outer ramus shorter than the inner—70:100—both rami with two strong rows of marginal robust setae, apices with five robust setae. Third uropod: peduncle length 0.4× outer ramus, much longer than urosomite three—2.9×—with an apicolateral cluster of four faciosubdistal robust setae and a long dorsal robust seta, single mid-medial and mid-lateral robust setae; outer ramus proximal article with six lateral robust seta clusters of 1-2-2-1-2-1 robust setae, the medial margin with a row of seven setae and one distal robust seta; distal article small, 0.14× proximal, with three dorsal sub apical short setae; inner ramus length 0.3× outer, with three medial plumose setae and one apical plumose seta. *Telson* (Fig. 53): elongate, longer than urosomite three; cleft 85%; apices extended mediodistally as short lobes, subapices each with three robust setae in a transverse row, plus a single penicillate setule arising at the base of the largest, most lateral, robust seta; each lobe with a pair of penicillate setules dorsolaterally at M0.6.

Description of female "a". As for male "b" except in the following: *Body*: 5 mm. *First antenna* (Fig. 49): flagellum with seventeen articles, aesthetascs present on articles 4–17; accessory flagellum extending to M0.6 of third article of primary flagellum. *Second antenna*: flagellum without calceoli. *Gnathopods* (Fig. 51): coxal plate of second gnathopod with four long and three short apical setae; carpi longer than male—0.7 to 0.8× propodus; robust setae at corner of palm three (rather than four); posterior margin of propodus with an additional submarginal robust seta; dactyls with two recumbent robust setae on the inner margins. *Peraeopods*: coxa 3 with three long and two short apical setae, no row of facial setae; coxa 4 emarginate with 12 short and two long ventral setae and two posterior setae on the anterior face; coxa 5 anterior lobe strongly reduced with one posterior seta on the anterior lobe and one posterior seta on the posterior lobe; coxa 6 with one posterior seta only, coxa 7 with two postventral setae and one posterior seta. *Oostegites* (Fig. 52): present on coxae 2–5; oostegites two to four broadly ovate with long, strong regularly spaced marginal setae; oostegite five more slender, otherwise similar. *Epimera* (Fig. 53): with sparse posterior setation, ventral face of epimeron two with three robust setae, of epimeron three with one robust seta. *Pleonites* (Fig. 53): 1–4 with small posterior robust setae, 5 and 6 bearing strong lateral spination. *Urosomite one* (Fig. 53): with strong articulate ventrodorsal robust seta at the base of uropod 1. *Pleopods* (Fig. 53): each bearing pair of retinacula, without accessory retinacula or robust setae. *Uropods* (Fig. 53): rami of first uropod both with four apical robust setae; peduncle of third uropod with five (rather than four) apicolateral robust setae; outer ramus proximal article with 1-3-4-2-3-2 lateral robust setae, distal article with two sub terminal setae.

Description of male "d". *Body*: length 2.8 mm. *Gnathopods* (Fig. 52): subrectangular, similar size, less spinous than female "a". *Peraeopods* (Fig. 51): peraeopod 6 much longer than seven—1.3×—both with long basodactylar setae as long or longer than dactyl; peraeopods without other setae; article 2 of peraeopod 6 with moderate single posterior robust setae, anterior robust setae stronger, several paired; article 2 of peraeopod 7 with small to moderate posterior robust setae, few anterior robust setae, none paired; anterior robust setae of both peraeopods 6 and 7 dominant to posterior.

Distribution. Mammoth Cave, and near Margaret River, Western Australia, 34°03'S 115°01'E.

Paramelitidae Bousfield, 1977

Pilbarus n.gen.

Etymology. Named for the type location.

Type species. *Pilbarus millsii* n.sp.

Diagnosis. Pleonites with moderate, mostly posterior transverse dorsal setation, rostrum obsolescent, lateral cephalic lobes moderately projecting, antennal sinus strong. Eyes absent. Antenna one elongate, longer than antenna two, ratio of lengths of peduncular articles about 3:2:1.5, accessory flagellum 4-articulate; second antenna peduncle longer than flagellum—85:74; flagellum of male bearing large calceoli. Mandibular palp of three articles, ratio of lengths about 2:3:2 to 2:4:3, articles 1 and 2 naked laterally, article 2 with distal oblique row of five strong rastellate setae, article 3 falcate, setae CDE. Labium with weak inner lobes. Maxillae without medial setae: first maxilla inner plate linear, apically tapered, with two plumose apical setae; outer plate with nine left, ten right denticulate apical robust setae; palps asymmetric, left palp with slender apical robust setae, right with 2-articulated elements but mostly broad robust setae fused to the article. Second maxilla inner plate without oblique setae, with two plumose mediodistal setae slightly submarginal, both plates with long curved apical setae. Maxillipedal palp with few lateral setae, with dense medial and medioventral setae, article 3 with a row of setae basal to the dactyl, but no comb row. Coxae 1–4 moderately elongate, coxa 3 with a few weak posterior setae, coxa 1 subquadrate, not expanded apically, coxa 4 moderately emarginate, coxae 5–7 posteriorly dominant, shorter than four. Gnathopods small, propodus of first gnathopod of male expanded, wider; carpus of the second relatively long, articles 3 and 4 of the first and four of the second with long posterior scythe robust seta, not lobate; propodus rectangular, palms weakly oblique, robust setae at the corner of the palm two and three, along the palm moderately crowded, without triggers. Posterior robust seta sets on article 6 of peraeopods 3 and 4 evenly spaced, legs 5–7 elongate, second article moderately to broadly expanded posteriorly and lobate, dactyls of peraeopods 3–7 without additional setules. Coxae 2–6 with sac like gills, thoracic segments without sternal gills. Basomedial setae of inner rami of pleopods bifid, branches simple; retinacula two each peduncle with one or two accessory robust setae. Pleonites with dorsal setae or robust setae. Epimera without postventral robust setae, with ventrofacial robust setae and sparse posterior setae. Rami of uropods 1 and 2 extending unequally; each with two rows of robust setae; uropod 1 without basofacial robust setae; uropod 3 extended beyond 1 and 2 in the intact specimen;

peduncle short, variramous; outer ramus 2-articulate, the second article short, the inner ramus reaching to M0.4 or less in the female, to M0.7 of outer ramus of male; poorly armed. Telson moderate length, about the same length as urosomite three, without dorsal setation, tumid, cleft more than 80%, with apical and dorsal spination.

Additional Description. Flagellum of first antenna lacking major arms. Upper lip apical marg evenly rounded. Mandibular accessory blades (rakers) with interraker plumose setae, additional penicillate setae beyond rakers riding onto base of molar; molar with pappose apical seta, palp article 3 shorter than 2, article 2 without sparse basoanterior setae with few facial apicoanterior setae. Maxilla two both plates with rows of long distal setae. Maxillipedal palp article 3 with rows of thin setae on inner edge, and a row of three long setae facial, basal to the dactyl; dactyl with two accessory spinules basal to the nail; the apex weakly produced, pubescent; the outer plate with a row of setose robust setae distally, continuous with a row of teeth medially, the inner plate with three thick robust setae and plumose setae apically and a long medial row of plumose setae. Dactyl of gnathopods reaching ends of palms, some with small recumbent inner tooth like robust seta fused to dactyl, and several setules at inner nail articulation line, leg six longer than seven, legs 5–7 article 2 posterior setae small, regularly spaced. Sternal processes absent, epimera without postventral teeth. Pleopods similar, rami subequal. Apicolateral corner of peduncle of first uropod with one robust seta, rami of uropods 1 and 2 subequal, with four and five apical robust setae. Third uropod with or without facial robust setae, rami without plumose medial setae, ventrodistal robust seta on urosomite one at the base of uropod 1 long and strong, longer than *Austrocrangonyx*.

Relationship. This genus differs from other Paramelitidae, except *Antipodeus*, in the absence of sternal gills. Despite this it is closest to *Austrogammarus* in the form of the antennae, palp of first maxilla, gnathopods, and third uropod. *Pilbarus* differs from *Austrogammarus* in the absence of eyes, longer first article of the mandibular palp which lacks A setae but bears C setae, absence of medial setae on the first maxilla inner plate, absence of long straw like pubescence on the second maxilla, absence of dense lateral setae on the maxillipedal palp, presence of inner lobes on the labium, reduction of the palmar robust setae, more expanded and lobate second articles of peraeopods 5–7, absence of coxal gill 7 and of sternal gills, absence of marginal setation on the third uropod and of dorsal setation on the telson, and the presence of a long and strong robust seta on the first urosomite at the base of the first uropod. *Pilbarus* differs from *Austrocrangonyx* in absence of medial setae on the maxillae, reduced numbers of retinacula and presence of accessory retinacula, greater numbers of ventrofacial robust setae of the epimera, and presence of single rather than paired apicolateral robust setae on the peduncle of the first uropod. *Pilbarus* is similar to *Uroctena* in the absence of eyes, poor setosity of the mandibular palp, asymmetry of the palps of the first maxilla, weakly oblique gnathopodal palms, broad ovate expansion of the second article of peraeopods 5–7, form of the first and second uropods and length of the outer ramus of the third uropod, and absence of posteroventral epimeral teeth, but differs in that lateral cephalic lobes project

moderately, accessory flagellum of the first antenna is no more than 4-articulate, second antenna is not pediform and calceoli are present on the male antenna, first article of mandibular palp relatively long, third article strongly rather than weakly falcate, with CDE setae only, labium bearing inner lobes, inner plate of first maxilla linear rather than ovatotriangular, outer plate with nine or ten (cf. 11) apical robust setae, medial setae of maxillipedal palp dense rather than moderate, apex of the third article pubescent, coxae 1–4 moderately long rather than short, coxa 1 not expanded apically, carpus of second gnathopod long, dactyls of peraeopods without additional spinules, thoracic segments without sternal gills, pleopods bearing spinous accessories to the retinacula, third uropod variramous being parviramous in the female and almost magniramous in the male, telson without dorsal setation but with additional dorsal spination. The genus is similar to *Hurleya* in the presence of only sparse lateral setae on the maxillipedal palp; coxal gill 6 is not reduced; but differs in many ways, including the ratio of lengths of peduncular articles of the first antenna; coxa 1 not short; gnathopods are not large, but are sexually dimorphic and bear scythe robust setae; palmar robust setae are reduced and simple; peraeopod 6 is longer than seven; articles 2 of peraeopods 5–7 are expanded and lobate; dactyls of the legs are not lobate; accessory retinaculae are present on the pleopods; third uropod is extended and variramous; telson is cleft 83% rather than 63% and has both apical and dorsal spination. *Pilbarus* is similar to *Antipodeus* in the fusion of strong palp setae of right the first maxilla; the small size of gnathopods; broad expansion and presence of postventral lobes of article 2 of peraeopods 5 and 7; broad oostegites; and differs in absence of eyes; greater number of accessory flagellum articles; presence of calceoli in the male; longer first article of the mandibular palp and poor setation of the second palp article, and lack of A setae; presence of inner lobes of the labium; absence of trigger robust setae on the gnathopodal palms; absence of coxal gill 7; uropod 3 variramous; telson with basofacial arms; and the ventrodistal robust seta on urosomite one long and strong. The new genus is similar to *Chillagoe* in the asymmetry of the palps of the first maxilla; the absence of a gill on coxa 7 and lack of reduction of gill 6; but differs in that lateral cephalic lobes do not project strongly; flagellum of antenna two is not shorter than peduncle; first article of mandibular palp is relatively short article 2 poorly setose, and C setae present; inner lobes present on labium; coxa 4 moderately emarginate; palms not strongly oblique; palmar robust setae reduced; oostegites are not slender; third uropod has an inner ramus; telson cleft more than 70% and with four rather than one apical robust seta. *Pilbarus* is similar to *Toulrabria* in the terminal setae of the mandibular palp are CDE; palps of first maxilla are similarly asymmetric; palmar robust setae of gnathopods are simple; coxae 2–6 bear gills, the sixth not reduced; peduncles of pleopods bear two retinacula and accessory spinules; but differs in the third peduncular article of antenna one is relatively long; flagellum of the second antenna not

greatly shorter than peduncle; second articles of peraeopods 5–7 ovate rather than pyriform; dactyls of peraeopods not multi-spinose; coxae 2–4, rather than 2–5, bear oostegites; uropod 3 is moderately extended rather than poorly, and the outer ramus has two rather than one article; the telson is longer than broad, cleft 83% rather than 60%, without setae, but with basolateral spination. *Pilbarus* is similar to *Protocrangonyx* in that eyes are absent; the flagellum of antenna two is not much shorter than peduncle; palps of the first maxillae are asymmetric; coxae 2–6 bear gills; and differs in that the body is not sub vermiform; the accessory flagellum of antenna 1 is 4- rather than 2-articulate; calceoli occur on the second antenna; third article of mandibular palp is falcate, and C setae are present; the labium has inner lobes; coxae are moderately long, not short, and coxa 4 emarginate; gnathopodal palms are slightly not strongly oblique; palmar corner robust setae are reduced and palmar robust setae without triggers; leg seven is shorter than six and articles 2 of peraeopods 5–7 ovate and moderately lobate; uropod 3 is strong, not feeble, is extended, variramous, and the outer ramus 2-articulate; telson cleft, moderately long, and with dorsolateral as well as apical spination; peduncles of pleopods weakly to moderately setose, the outer rather than inner rami shortened; ventrodorsal robust seta at the base of uropod 1 present and strong and long.

***Pilbarus millsii* n.sp.**

Figs 54–57

Etymology. Named for the type locality.

Type locality. Deep Reach Pool, Pilbara Springs, Millstream, northern Western Australia, on the Fortescue River, 21°37'S 117°06'E.

Material Examined. HOLOTYPE (Australian Museum P51378) female "a", 9 mm. ALLOTYPE (Australian Museum P51379) male "b", 7 mm. Others in the type series: females "c" 7 mm and "d" 6 mm, several small juveniles 3–5 mm. Collected by W. Ponder and W. Edgecomb, Deep Reach Pool, Pilbara Springs, Millstream, Western Australia, September, 1987. Australian Museum Collection P38475.

Diagnosis. With the characteristics of the genus

Description of holotype (female "a"). *Body* (Fig. 54): pereon with sparse setation; pleon with strong transverse posterodorsal setation and spination, length 9 mm. *Head*: small anterior marginal setae at the base of antenna one; rostrum weak; lateral cephalic lobe moderate; antennal sinus moderate; eyes absent. *First antenna* (Fig. 54): length 0.6× body, 1.9× second antenna; peduncle sparsely setulate, ratio of lengths of articles 10:7:5; flagellum much longer than peduncle, ratio of lengths 200:82, setae sparse, flagellum of 33 articles; accessory-flagellum 4-articulate, reaching to the end of article 4 of the primary flagellum, without aesthetascs or calceoli. *Second antenna* (Fig. 54): length 0.3× body; peduncle longer than flagellum, ratio of lengths 85:74; article 4 longer than five—33:29—articles 3–5 moderately setose; flagellum of fourteen articles, moderately setose, without aesthetascs or calceoli.

Left mandible (Fig. 55): palp of three articles, ratio of lengths 8:16:11, article 1 naked, article 2 naked medially and laterally, mediolateral face bearing an oblique row of six strong rastellate setae the longest reaching beyond M0.5 of the third article; third article broad, falcate, facially pubescent, setae 1C13D4E; incisor six toothed; lacinia mobilis five toothed; accessory blades of three rakers and three plumose setae, with three blunt bent brushy setae and fine setules onto the base of the molar; molar triturative with an anterior plumose seta and short posterior pappose seta. *Right mandible* (Fig. 55): palp articles 1 and 2 naked laterally and medially, second article with an oblique distal row of five strong rastellate setae reaching to beyond M0.5 of the third article, third article with long basofacial setules, facial pubescence, setae 14D4E; incisor with seven teeth; lacinia mobilis bifid, denticulate the posterior lobe bearing anterior and posterior teeth; accessory blades of two rakers and two plumose setae; molar triturative with short anterior plumose seta and long posterior pappose seta. *Left first maxilla* (Fig. 55): palp article 2 with seven simple slender distal robust setae; outer plate with nine apical denticulate robust setae; inner plate with two apical plumose setae, the medial slightly sub apical. *Right first maxilla* (Fig. 55): with five broad mediolateral to apical robust setae fused to the article and a single strong articulated lateral sub apical robust seta and one plumose seta; outer plate with ten apical denticulate robust setae; inner plate with two apical plumose setae, the medial seta slightly sub apical. *Second maxilla* (Fig. 55): lateral margin of outer plate without additional seta, inner margin of inner plate with two plumose setae subdistal sub marginal to the medial edge. *Maxilliped* (Fig. 55): outer plate with long medial robust setae and setae, moderately oblique; from the mid-medial margin ten strong robust setae, which increase in size distally, form a moderately oblique row across the face of the article, the ultimate robust seta mid apical, forming a continuous row with five apicolateral plumose setae; facial to the robust seta row lie four ranks of 1-1-2-2 slender setae; inner plate with five plumose medial setae, transverse row of three stout naked tooth like robust setae, three apicolateral and one ventrofacial plumose seta, and one mid apical fine seta. *First gnathopod* (Fig. 56): coxal plate with moderate apical and apicoanterior marginal setae; articles 3 and 4 bearing strong posterior scythe robust setae, rastellate on article 4; carpus short, about 0.55× propodus, slightly lobate, bearing many strong posterior rastellate robust setae; propodus long, trapezoidal, the posterior margin bearing ranks of moderate rastellate robust setae, corner of palm with one strong and two long slender lateral robust setae and one naked medial robust seta; palm slightly oblique with few short simple robust setae; dactyl with a transverse rank of four accessory setules at M0.4, nail reaching the end of the palm. *Second gnathopod* (Fig. 56): slightly larger than first gnathopod; coxal plate with two posterior setae, bearing sac like gill and broad sparsely setose oostegite; article 4 bearing long posterior robust setae; carpus elongate, as long as the propodus, bearing posterior ranks of many long simple setae; propodus elongate; posterior ranks of many long simple robust setae similar to but slightly shorter than of the carpus; palmar corner with one blunt medial robust seta and two lateral bifid robust setae, palm convex, robust setae simple, moderately long and crowded; dactyl with blunt recumbent inner tooth like robust seta, four facial spinules, nail reaching to the palmar corner. *Peraeopods* (Fig. 56): coxa 3 with few apical setae, posterior corner indistinct, posterior margin with one or two setae; coxa 4 sparsely setose apically with a row of posterior setae, moderately emarginate; both coxae bearing sac like gill and apically setose oostegite; peraeopods 3 and 4 similar, longer

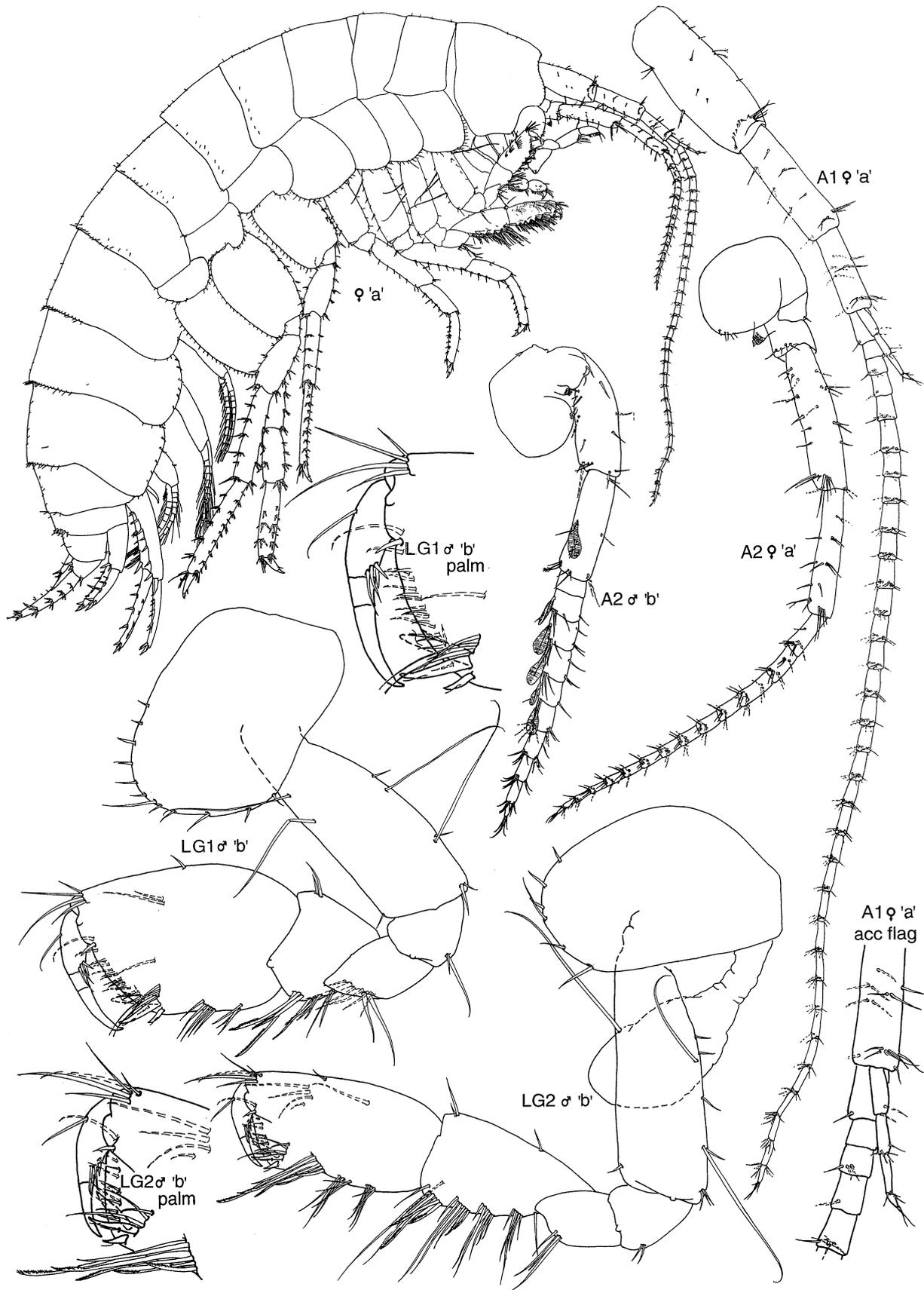


Fig. 54. *Pilbarus millsii* n.sp. holotype female "a" 9 mm whole specimen, antennae, accessory flagellum; allotype male "b" 7 mm antenna two, gnathopods 1 and 2.

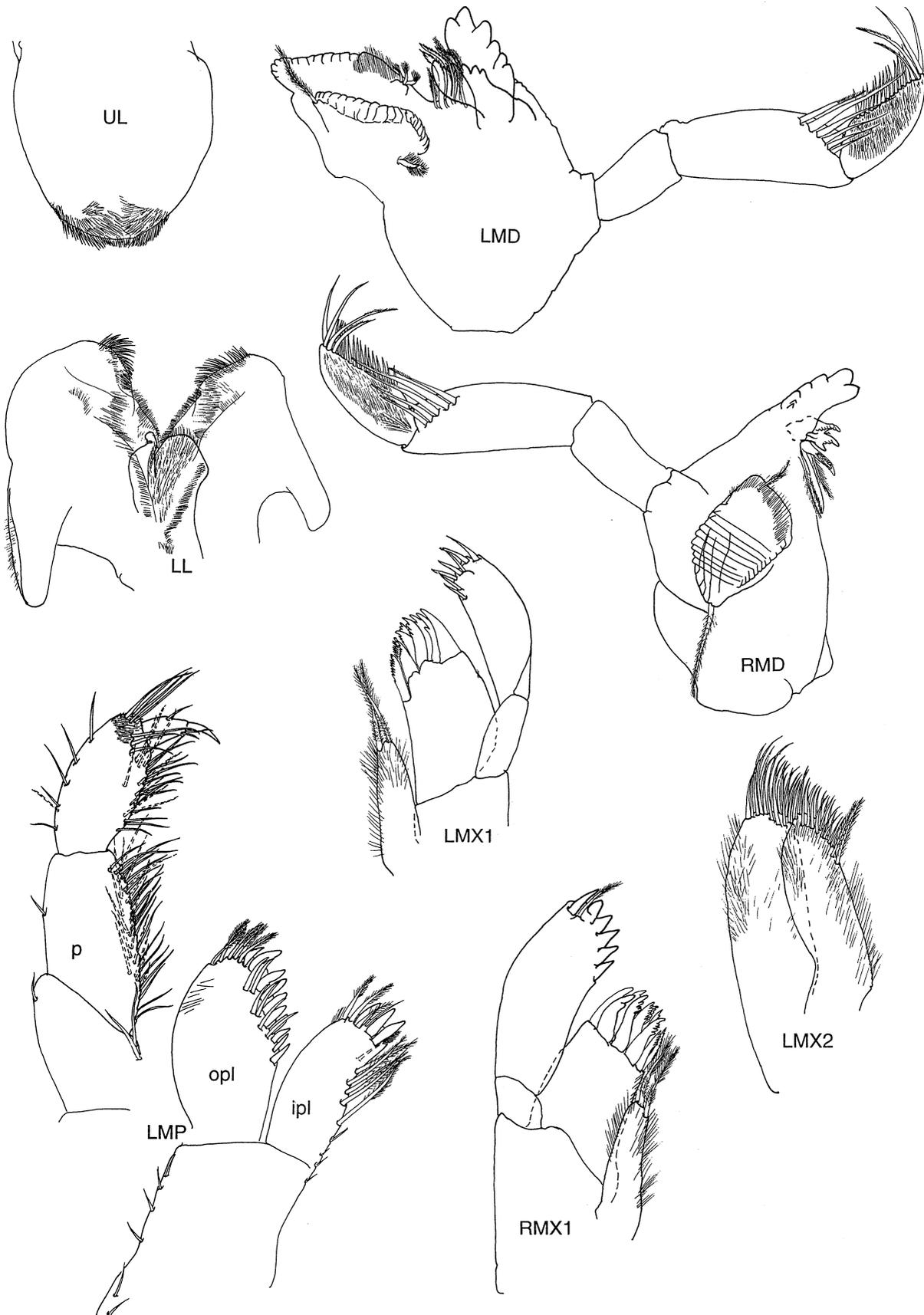


Fig. 55. *Pilbarus millsii* n.sp. holotype female "a" 9 mm; mouthparts.

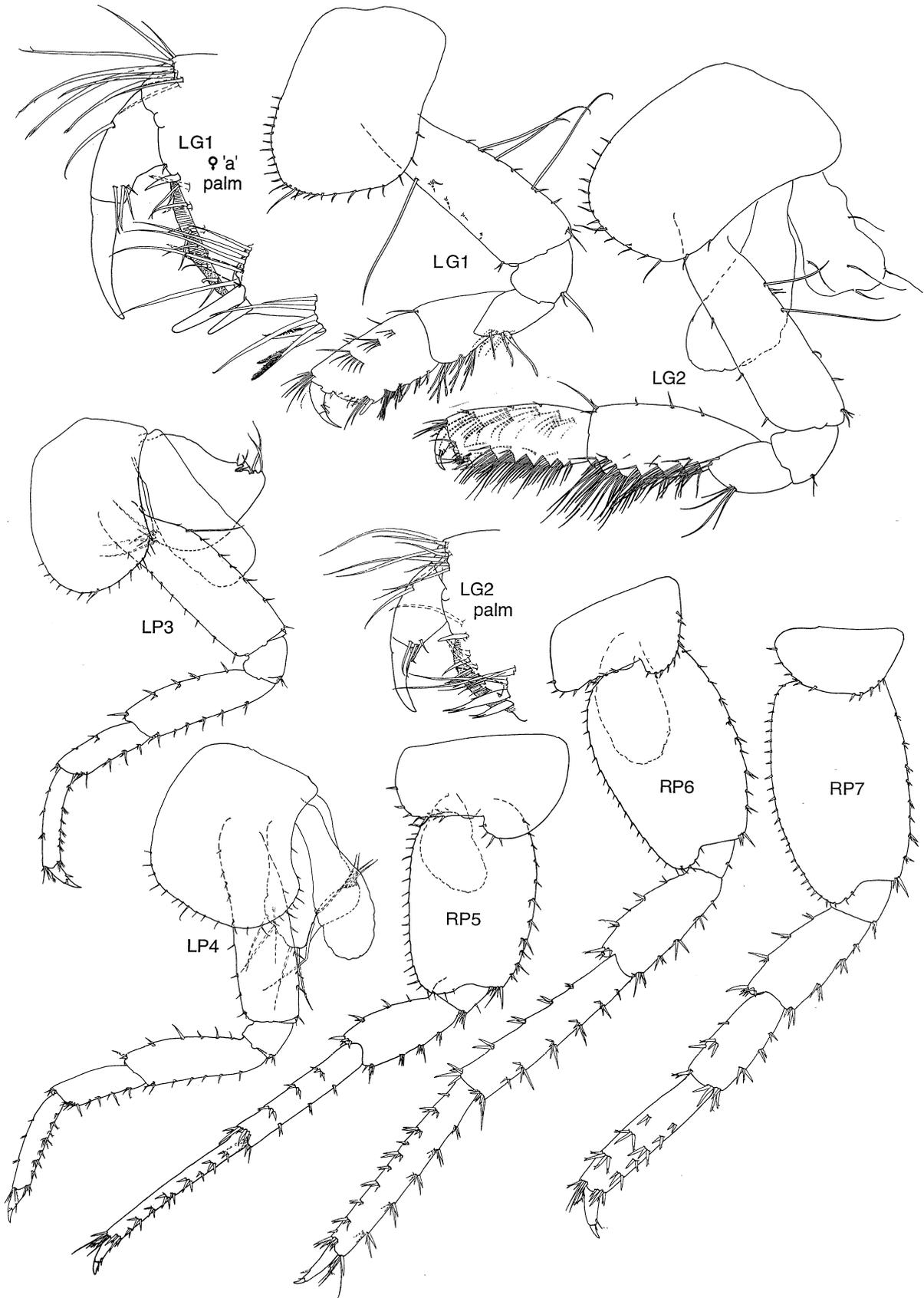


Fig. 56. *Pilbarus millsii* n.sp. holotype female "a" 9 mm; legs (all drawings except those indicated); female "c" palm of first gnathopod.

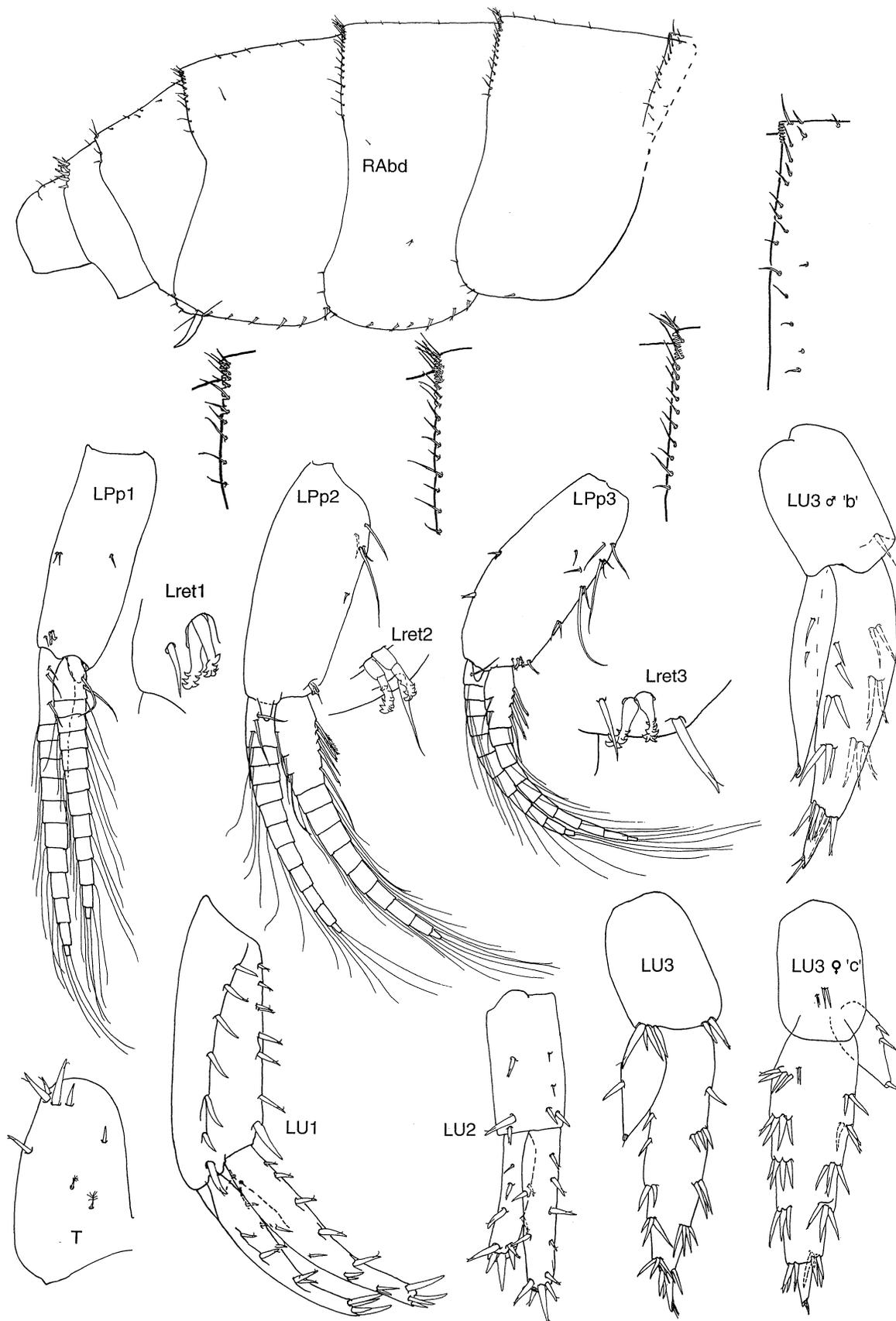


Fig. 57. *Pilbarus millsii* n.sp. holotype female "a" 9 mm; abdomen, gills, pleopods, uropods, telson (all drawings except those indicated); allotype male "b" 7 mm, third uropod; female "c" 7 mm, third uropod.

than gnathopod two, articles 4 and 5 moderately setose posteriorly, article 6 of pereopod 4 with more posterior robust setae than pereopod 3: pereopods 5–7 similar, six longest, seven shortest, coxae shorter than coxa 4, posterior lobe dominant, coxae 5 and 6 bearing sac like gills, articles 2 expanded posteriorly, ovate, moderately lobate postventrally, with many short posteromarginal robust setae, other articles moderately equipped with short stout anterior and posterior robust setae; dactyls of pereopods 3–7 each with one distofacial and one mediomarginal setule. *Epimera* (Fig. 57): without postventral teeth, posterior angles rounded, posterior setae sparse, with 1–6–6 ventrofacial robust setae. *Pleon* (Fig. 57): with sparse dorsal setae; posterior margins of pleonites 1–3 with dense, short transverse setules, and small dorsolateral truncated robust setae; pleonite 4 with sparse, weak posterior spinules; pleonite 5 with a submarginal transverse rank of five moderate and three small robust setae. *Urosomite one* (Fig. 57): with a long strong robust seta at the base of the first uropod. *Pleopods* (Fig. 57): peduncles with scarce armature, peduncle one with two mid facial spinules, two retinacula and one accessory robust seta; peduncle two with four mediobasal and one mid medial robust seta, two retinacula and one accessory robust seta; peduncle three with several strong and weak medial robust setae, two short lateral robust setae, two retinacula and two accessory robust setae; rami similar, basomedial setae of inner rami bifid; rami with 12–12, 11–10, 11–10 articles respectively. *Uropods* (Fig. 57). First uropod: peduncle length 1.2× outer ramus, 1.0× inner ramus; outer margin with dorsal row of six moderate robust setae and one distolateral robust seta; inner margin with seven dorsal and one distomedial robust seta; both rami with two rows of dorsal robust setae and four apical robust setae. Second uropod: peduncle as long as outer ramus, 0.8× inner ramus, weakly spinous on both margins, with paired distolateral and distomedial robust setae; rami with two rows of dorsal robust setae, each with four apical robust setae. Third uropod: variramous; peduncle length 0.5× inner ramus, 1.2× outer ramus; without marginal or facial arms; pair of distolateral robust setae and rank of four distomedial robust setae basal to the inner ramus; proximal article outer ramus with four transverse lateral ranks of 1–3–3–4 and one distal robust seta, and five transverse medial ranks of 1–1–2–3–4 and one distal robust seta; distal article small with three fine apical setules; inner ramus short, with one mid medial robust seta and one apical setule. *Telson* (Fig. 57): slightly shorter than urosomite three; lobes cleft 83%, laterally tumid; lateral sub apical transverse row of two large and two small robust setae, marginal dorsolateral robust seta at M0.6, small submarginal dorsomedial robust seta at M0.67 and mid dorsal penicillate setules at M0.3 and M0.4.

Description of allotype male “b”. As for female “a” except in the following. *Body*: length 7 mm. *Second antenna* (Fig. 54): peduncle articles 4 and 5 with sparse arms, article 5 bearing large calceolis ventrally at M0.0.5; flagellum of ten articles with moderate setation; articles 2–6 bearing large ventral calceoli. *Mandibles*: left palp article 3 with setae 8D4E; right palp with setae 1C8D5E. *First gnathopod* (Fig. 54): articles 3 and 4 with strong simple posterior robust setae; carpus short, with moderate and long rastellate setae; propodus ovate rather than long, length 1.2× width; posterior margin with two transverse ranks of moderate setae, palmar corner rounded, with one large medial tooth like-robust seta, two lateral robust setae; palm slightly convex with moderately crowded simple robust setae; dactylus with a mid rank of four accessory spinules, nail reaching to the palmar corner. *Second gnathopod* (Fig. 54): coxal plate with sparse, moderately long

apical setae, without posterior setae, bearing a large sac like gill; article 4 with several long, simple robust setae; carpus moderately long, 0.7× propodus, with four transverse ranks of mixed simple and rastellate robust setae; propodus trapezoidal, longer than wide length 2× width, posterior margin with two ranks of moderate simple robust setae and one of mixed long simple and rastellate robust setae; palmar corner broadly curved, with one medial and two lateral strong robust setae; palm convex, with moderate numbers of short simple robust setae; dactyl with four accessory setules, nail reaching to palmar corner. *Third uropod* (Fig. 57): variramous, outer ramus 1.45× inner ramus, 0.45× peduncle; peduncle without marginal or facial arms, with a single moderate distolateral robust seta adjacent the base of the outer ramus; outer ramus proximal article with lateral transverse ranks of 2–2–3 marginal robust setae and three distal robust seta, medial transverse ranks of 1–1–2–3 marginal robust seta and four distal robust setae; distal article small, naked except for two small apical setae; inner ramus with two mid facial setae and one small distal seta.

Description of female “c”. As for female “a” except in the following. *Body*: length 7 mm. *Mandibles*: left palp article 3 with setae 1C12D4E; right palp setae 1C11D4E. *First gnathopod* (Fig. 56): palmar corner with one medial strong naked robust seta and five long slender and two strong naked lateral robust setae; palm moderately convex slightly oblique, with moderate numbers of simple robust setae. *Third uropod* (Fig. 57): variramous, peduncle length 0.5× outer ramus, 1.5× inner, with three small facial setae; outer ramus 2-articulate, proximal article with lateral transverse ranks of 4–4–4–3 and three distal robust setae, two small facial setae adjacent the most basal rank of robust setae, and medial transverse ranks of 2–3–3–3 and 4 distal short robust setae; distal article short with two small apical setules; inner ramus with two mediofacial short robust setae and one short distal robust seta.

Description of female “d”. *Body*: length 6 mm. *Right mandible*: right mandibular palp article 3 setae 1C9D5E. Otherwise similar to female “a”.

Distribution. Deep Reach Pool, Pilbara Springs, Millstream, Western Australia, 21°37'S 117°06'E.

Synopsis

Thirty described species of Australian stygobiont amphipods were listed by Bradbury & Williams (1997). The present paper significantly extends this number by adding a further fourteen species and noting another species (*Wesniphargus nichollsi*) previously described, now regarded as a troglophile. Two of the new species fall within the two families which previously contained most of the diversity (Melitidae and Paramelitidae), but most are unequivocally neoniphargids and hence now bring this family into more or less equal position as a contributor to diversity of Australian stygobiont amphipods. Table I provides an updated synopsis of known forms arranged in the same way as did Bradbury & Williams (1997, table I). Figure 58 similarly documents the geographical distribution of all described forms (with some exceptions, as noted).

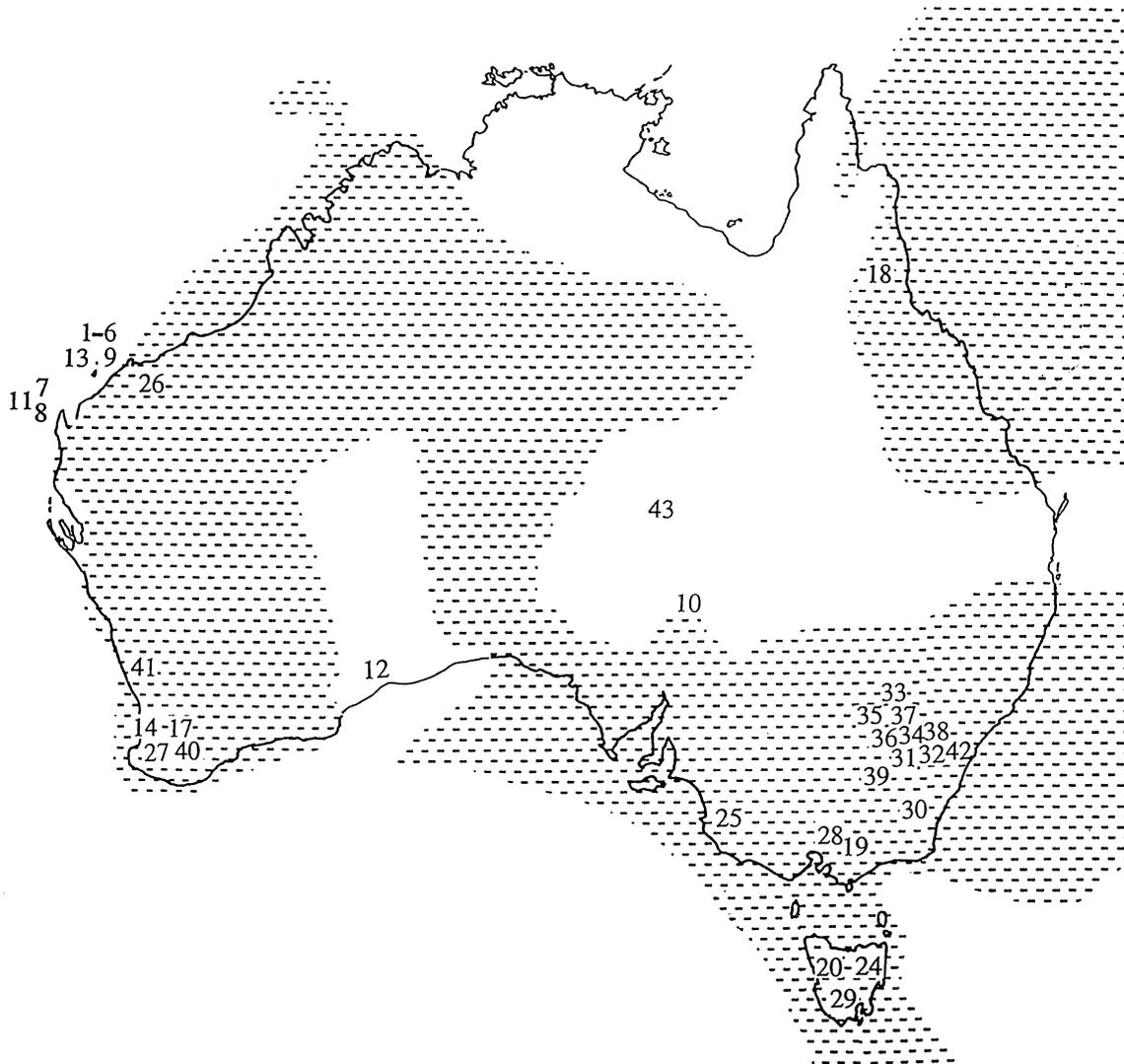


Fig. 58. Distribution of known stygobiont Australian amphipods. Stippled area indicates landmass not inundated during the Cretaceous (119–114 million years ago). Numbers indicate species shown in Table 1—*Austrochiltonia australis* (44) widespread and *Pseudomoera fontana* (45) known from widely separated locations in the southeast, not shown.

Discussion

The taxonomic and distributional information given in this paper support the general conclusions of Bradbury & Williams (1997) on the extent, nature and causes of stygobiont amphipod diversity in Australia. Thus, the description of fourteen new species confirms the significant diversity of this fauna in Australia in both hadzioid and crangonyctoid families, and the geographical distribution of these new species falls clearly within areas of Cretaceous marine transgression (melitoid species) or areas not so inundated during the Cretaceous (Paramelitid and Neoniphargid species). As further confirmation of the importance of karst in promoting stygobiont diversity, note that the new crangonyctoid species (except *Wesniphargus yanchepensis*) were collected from caves in the karst systems of New South Wales.

Much remains for investigation with regard to the stygobiont amphipods of Australia, not least in respect of their evolution and the adaptive and selective processes involved in this. Many areas of karst (for example, eastern Victoria, southeast South Australia, Nullarbor Plain, Camooweal caves in western Queensland, and many caves in Tasmania), as well as other caves (for example, the lava tubes at Undara in Queensland) have yet to be thoroughly examined, or their fauna described. Several of these sites are known to contain populations of stygobiont amphipods (Eberhard *et al.*, 1991; Eberhard & Spate, 1995), and will be the subject of future reports. Australia must now be recognised as a major centre of stygobiont amphipod diversity and we hope the present paper will both promote and support further investigations which build on this recognition.

ACKNOWLEDGMENTS. We thank the Australian Museum and Western Australian Museum for allowing examination of their specimens. Stefan Eberhard and Andy Spate kindly allowed access to collections made in their rigorous survey of the cavernicolous fauna of New South Wales. This work has been supported by funding from the Australian Biological Resources Study.

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Table 1. Systematic position and geographic distribution of Australian subterranean amphipods. Modified after Bradbury & Williams (1997). NP: National Park; NSW: New South Wales; SA: South Australia; WA: Western Australia.

| TAXON | DISTRIBUTION | HABIT | No. |
|--|-------------------------|------------------------|-----|
| Melitidae | | | |
| <i>Nedsia straskraba</i> Bradbury & Williams, 1996a | Barrow Island, WA | troglobite | 01 |
| <i>N. fragilis</i> Bradbury & Williams, 1996a | Barrow Island, WA | troglobite | 02 |
| <i>N. humphreysi</i> Bradbury & Williams, 1996a | Barrow Island, WA | troglobite | 03 |
| <i>N. hurlberti</i> Bradbury & Williams, 1996a | Barrow Island, WA | troglobite | 04 |
| <i>N. macrosculptilis</i> Bradbury & Williams, 1996a | Barrow Island, WA | troglobite | 05 |
| <i>N. sculptilis</i> Bradbury & Williams, 1996a | Barrow Island, WA | troglobite | 06 |
| <i>N. douglasi</i> Barnard & Williams, 1995 | North West Cape, WA | troglobite | 07 |
| <i>Liagoceradocus branchialis</i> Bradbury & Williams, 1996b | | North West Cape, WA | |
| anchialine troglobite | 08 | | |
| <i>L. subthalassicus</i> Bradbury & Williams, 1996b | Barrow Island, WA | anchialine troglobite | 09 |
| <i>Brachina invasa</i> Barnard & Williams, 1995 | Flinders Ranges, SA | hyporheic interstitial | 10 |
| <i>Norcapensis mandibulis</i> n.sp. | North West Cape, WA | troglobite | 11 |
| <i>Melita</i> like. | Nullarbor Plain, WA | troglobite | 12 |
| Bogidiellidae | | | |
| <i>Bogidomma australis</i> Bradbury & Williams, 1996a | Barrow Island, WA | troglobite | 13 |
| Paramelitidae | | | |
| <i>Hurleya kalamundae</i> Straškraba, 1966 | southwestern WA | troglobite | 14 |
| <i>Protocrangonyx fontinalis</i> Nicholls, 1926a | Darling Range, WA | troglophile | 15 |
| <i>Uroctena westralis</i> (Chilton, 1925) | near Perth, WA | troglophile | 16 |
| <i>Totgammarus eximius</i> Bradbury & Williams, 1995 | southwestern WA | troglophile | 17 |
| <i>Chillagoe thea</i> Barnard & Williams, 1995 | northern Queensland | troglobite | 18 |
| <i>Giniphargus pulchellus</i> (Sayce, 1899) | Gippsland, Victoria | troglobite | 19 |
| <i>Austrogammarus</i> sp. | Tasmania | troglophile | 20 |
| <i>Austrogammarus smithi</i> Williams & Barnard, 1988 | Tasmania | troglophile | 21 |
| <i>Antipodeus antipodeus</i> (Smith, 1909) | Tasmania | troglophile | 22 |
| <i>Antipodeus wellingtoni</i> (Smith, 1909) | Tasmania | troglophile | 23 |
| <i>Antipodeus franklini</i> Williams & Barnard, 1988 | Tasmania | troglophile | 24 |
| <i>Uronyctus longicaudus</i> Stock & Iliffe, 1990 | southeastern SA | troglobite | 25 |
| <i>Pilbarus millsii</i> n.sp. | Pilbara Springs, WA | troglophile | 26 |
| Perthiidae | | | |
| <i>Perthia acutitelson</i> Straškraba, 1964 | southwestern WA | troglophile | 27 |
| Neoniphargidae | | | |
| <i>Neoniphargus obrieni</i> Nicholls, 1926b | Mount Buffalo, Victoria | possible troglophile | 28 |
| <i>Neoniphargus</i> spp. | Tasmania | troglophile | 29 |
| <i>N. coolemanensis</i> n.sp. | Kosciusko NP, NSW | troglophile | 30 |
| <i>N. secus</i> n.sp. | Wombeyan, NSW | troglobite | 31 |
| <i>N. richardi</i> n.sp. | Wombeyan, NSW | troglobite | 32 |
| <i>Neocrypta primaria</i> n.sp. | Wellington, NSW | troglobite | 33 |
| <i>N. robiniae</i> n.sp. | Canomodine, NSW | troglobite | 34 |
| <i>N. moniae</i> n.sp. | Bowan Park, NSW | troglobite | 35 |
| <i>N. georginae</i> n.sp. | Abercrombie, NSW | troglobite | 36 |
| <i>N. annae</i> n.sp. | Bowan Park, NSW | troglobite | 37 |
| <i>N. simoni</i> n.sp. | Jenolan NSW | troglobite | 38 |
| <i>Jasptorus solepti</i> n.sp. | Wee Jasper, NSW | troglobite | 39 |
| <i>Wesniphargus nichollsi</i> (Straškraba, 1964) | southwestern WA | troglophile | 40 |
| <i>W. yancheapensis</i> n.sp. | Yancheap, WA | troglobite | 41 |
| <i>Wombeyanus botulosus</i> n.sp. | Wombeyan, NSW | troglobite | 42 |
| Ceinidae | | | |
| <i>Phreatochiltonia anophthalma</i> Zeidler, 1991 | Mound Spring, SA | possible troglobite | 43 |
| <i>Austrochiltonia australis</i> (Sayce, 1901) | southern Australia | troglophile | 44 |
| Eusiridae | | | |
| <i>Pseudomoera fontana</i> (Sayce, 1902) | southeastern Australia | troglophile | 45 |