

A Revision of the Australian Cladocera (Crustacea)

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ABSTRACT. The Australian Cladocera are revised on the basis of numerous samples, collections in the Australian Museum and a critical consideration of the literature.

Six families are represented in inland waters of Australia: Sididae, Chydoridae, Macrothricidae, Moinidae, Bosminidae, and Daphniidae. Altogether 125 species in 40 genera were found, 15 species being new: *Pseudosida australiensis* n.sp., *Archepleuroxus baylyi* n. gen., n.sp., *Rak obtusus* n. gen., n.sp., *Rak labrosus* n. gen., n.sp., *Australochydorus aporus* n. gen., n.sp., *Rhynchochydorus australiensis* n. gen., n.sp., *Alona macracantha* n.sp., *Alona investis* n.sp., *Alona setuloides* n.sp., *Biapertura rusticoides* n.sp., *Monospilus diporus* n.sp., *Monospilus elongatus* n.sp., *Echinisca williamsi* n.sp., *Echinisca flagellata* n.sp., and *Simocephalus victoriensis* n.sp. One new subspecies is recognized: *Alona davidi vermiculata* n.subsp. Some 49 species (including the new species) are recorded in Australia for the first time. In addition, the presence of a further 6 species of marine Cladocera in the families Podonidae and Sididae is noted.

The cladoceran fauna of Australia, besides including many cosmopolitan and pantropical forms, also has some species widely distributed in the Holarctic, some Gondwanaland species, and a large number (46) of endemics. Keys to all families and genera of Cladocera are given as well as keys for Australian species. Ecology, community structure, faunal composition and zoogeography are considered. The revision provides a basis for the identification of Australian Cladocera and for further taxonomic studies.

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There is a renewed interest in the study of Cladocera, stimulated mainly by their importance in biological processes of inland waters and by their significance as biological indicators, particularly in palaeolimnological studies. Since 1959 there have been significant advances in detailed descriptive morphology, in functional morphology and in palaeolimnology based on the remains of Cladocera in lake deposits (see Smirnov, 1975). Several world revisions and regional faunas have been published. This work has been based mainly on the Holarctic fauna, which is comparatively well known.

By contrast the Australian fauna is inadequately studied, yet it is of zoogeographical interest and contains forms of considerable phylogenetic and ecological interest. Only a few zoologists have contributed knowledge on Australian species. The first was the Rev. King, who in the 1850's noted 17 species. G.O. Sars, working mainly on specimens raised from dried mud, added 16 species to make the total 33. Miss Marguerite Henry in two papers (1919, 1922) increased this number to 52. Gurney (1927) comments on 17 species, 4 being new. Various authors subsequently described a few additional species or discussed those previously described. As a result, by 1954 a total of 63 valid species were known from Australian inland waters. New South Wales is the most intensively studied area (due to King, Sars, Henry) followed by Queensland (due to Sars, Gurney) and Tasmania (due to Smith, Brehm). A few records are available for Western Australia (Sars, Serventy, Petkovski), Victoria (Searle, Searle *et al.*) and South Australia (Henry), and apparently none at all for the Northern Territory. Unfortunately for comparative purposes, only a few taxonomic papers (by Sars, Brehm) have been published on New Zealand Cladocera although a book has recently become available on N.Z. freshwater crustaceans (Chapman and Lewis, 1976), and little information is available for New Guinea (Brehm, 1959).

Despite the above, the Australian Cladocera cannot be considered to have been studied in any detail since (a) a figure of 63 species for Australia is very low by comparison with faunas of other continents and suggests that the fauna is either depauperate (hardly likely for

a largely cosmopolitan group) or incompletely known, (b) most distribution records are from only a few areas indicating inadequate collecting, and (c) a study of the 70 published papers on Australian Cladocera reveals little pertinent information. Although there has been a recent partial review of Australian Cladocera (Petkovski, 1973a, 1973b—in German and a journal unobtainable in Australia and based on few new collections) and reference to Australian specimens and species in world reviews (of Moinidae, Goulden, 1968; of Chydoridae, Smirnov, 1971b; of Macrothricidae and Moinidae, Smirnov, 1976), the present work is by far the most comprehensive to date. It considers all families known for Australia (including marine species) and is based on a large number (330) of new collections, a study of museum material and a critical evaluation of all literature on Australian Cladocera. The collections are from most areas of Australia, but unfortunately there are very few from north-west Western Australia, from the Northern Territory and from far inland areas of other mainland states.

Several authors (H. Dumont, P. Hebert, V. Kořínek, N. Korovchinsky and P. Mordukhai-Boltovskoi) have contributed on particular genera. N.N. Smirnov performed mainly the taxonomical part of the study. B.V. Timms made collections, contributed notes on the ecology and distribution of each species, and analysed faunal composition, communities and zoogeographical relationships. The text is composed by both authors, each with equal responsibility.

Materials and Methods

A large variety of inland waters were sampled over a period from 1964 to 1978 by one of us (B.V.T.); some collections were also made available by other workers, particularly Dr I.A.E. Bayly, Mr D. Morton and Dr R. Shiel. Data on the collection sites are listed in Table 1; they are numbered for conciseness in later listing of materials for each species. Most littoral collections were made with a Birge cone net (diameter 17 cm) and limnetic collections with a plankton net (33 cm in diameter); mesh size in both nets was 159 μ m. Samples

were preserved in 5% formalin. More than 330 collections were obtained and in addition collections in the Australian Museum, including Henry's types, were examined. The section on *Daphnia* by P.D.N. Hebert is based on his own materials and methods (Hebert, 1977).

For the Chydoridae and some other species having resistant exoskeletons slides were made using Canada balsam. Whole specimens of soft-shelled cladocerans, and where necessary dissected specimens of others, were mounted in polyvinyl alcohol (as described in Smirnov, 1975). Slides of representatives of most species, including holotypes of most new species, have been deposited in the Australian Museum. Many paratypes have been lodged in the Zoological Museum of Moscow University, as well as some other slides. Paratypes and slides of many species have been placed in the Zoological Institute of the U.S.S.R. Academy of Sciences, Leningrad. A few paratypes have been given to the British Museum, London.

For each new species and also for those recently described by Dr N.N. Smirnov or Dr T. Petkovski full descriptions of available material are given. This approach is adopted for the latter group because most of the original descriptions are in Russian or German and in publications not readily available in Australia. For the remainder only differential diagnoses are given, though in some difficult cases or in synonymies some discussion of taxonomic features is provided. In the family and generic keys all known extant taxa are included, even though we have not found some of them in Australia. Since at least some of them could occur (e.g. we have only recently found *Kurzia* and *Euryalona* despite 15 years study) this will facilitate their recognition. In the species keys we generally preferred to include only species known to occur in Australia; in cases where specimens do not conform with the characteristics given in the couplets it will be necessary to consult specialized monographs (see References).

A number of abbreviations are used in the text. They are explained below:

AM	Australian Museum (Sydney)
Bb.	billabong (oxbow lake)
BM	British Museum (London)
Ck	creek
D.	dam
DF	D.G. Frey's collection
F.D.	farm dam
I.D.	irrigation dam
I.	island
L.	lake
Lag.	lagoon (commonly a shallow lake)
MGU	Zoological Museum of Moscow University
MNHB	Museum of Natural History, Budapest, Hungary
N.S.W.	New South Wales
N.T.	Northern Territory
P.	pond
Qld	Queensland

R.	river
Res.	reservoir
S.A.	South Australia
Sw.	swamp
Tas.	Tasmania
Vic.	Victoria
W.A.	Western Australia
ZIN	Zoological Institute of the U.S.S.R. Academy of Sciences, Leningrad
ZMO	Zoological Museum, Oslo.

Morphology

In all Australian species of Cladocera the body is contained within a two-valved shell, fused anteriorly to the head shield. The body consists of the head, thorax, abdomen (that part of the trunk posterior to the thoracic limbs), and postabdomen. The latter is peculiar to the Cladocera; it is chitinized and bent forwards and commonly ends in two claws. The appendages of the head are: antennule (first antenna), antenna (second antenna), maxillule, mandibule. The thorax bears I-VI thoracic limbs. All appendages are paired.

Of the internal organs the shape of the intestine is useful taxonomically; there may be convolutions, and in addition, caeca either anteriorly or posteriorly. In species diagnosis, size and situation of the eye is important, as well as presence or absence of an ocellus (eye-spot).

At the generic and subfamily level of identification the structure and setation of thoracic limbs I, II, IV, the head pores and also body proportions are important. For identification of species it is necessary to consider the general form, shape and setation of the postabdomen and valve borders, characters of the claws, sculpture of the valves, and relative sizes of the head

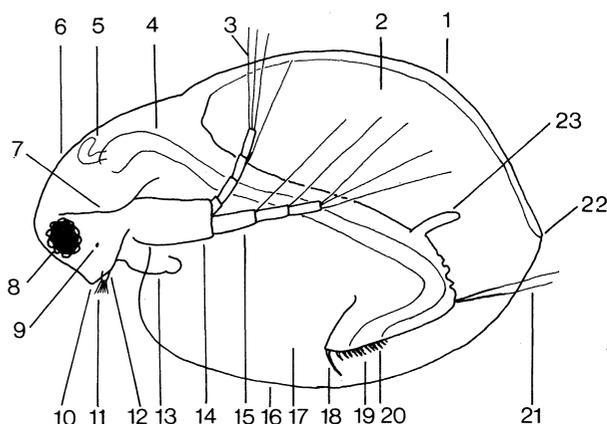


Fig. 1. Schematic representation of a cladoceran with planktonic adaptations (*Daphniopsis*) (thoracic limbs omitted). 1 = dorsal side, 2 = brood chamber, 3 = antennal setae, 4 = gut, 5 = hepatic caecum, 6 = head, 7 = fornix, 8 = eye, 9 = ocellus, 10 = rostrum, 11 = sensory papillae, 12 = antennule (1st antenna), 13 = labrum, 14 = antenna (2nd antenna), 15 = antenna branch, 16 = ventral side, 17 = valve, 18 = claw, 19 = postabdomen, 20 = anal teeth, 21 = setae natatoriae, 22 = dorso-posterior corner of the shell, 23 = abdominal outgrowth.

appendages. Sometimes (as in species of *Moina*) it is necessary to have parthenogenetic females, gamogenetic females, and males. Features of taxonomic importance are illustrated in Figs 1-3.

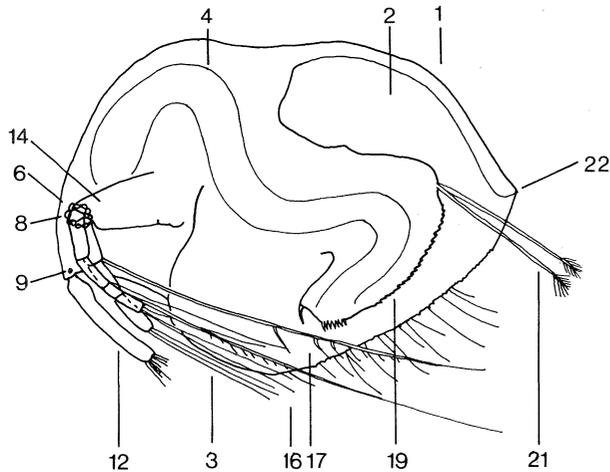


Fig. 2. Schematic representation of a cladoceran with bottom-living adaptations (*Echinisca*) (thoracic limbs omitted). Code as in Fig. 1.

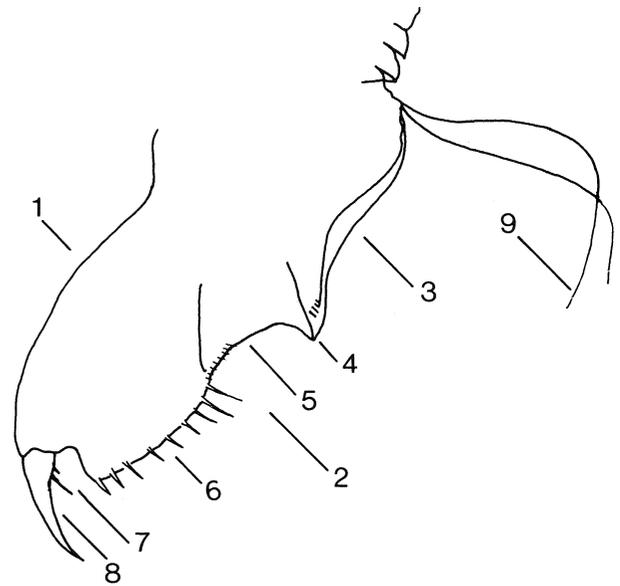


Fig. 3. Postabdomen of a chydorid (*Rak*). Code: 1 = ventral side, 2 = dorsal side, 3 = pre-anal margin, 4 = pre-anal angle, 5 = anal margin, 6 = post-anal margin with anal teeth, 7 = basal spines, 8 = claw, 9 = setae natatoriae.

Key to All Families of Cladocera

- 1. Trunk and thoracic limbs covered by valves 2
 - Trunk and thoracic limbs not covered by valves 8
- 2(1). Six pairs of thoracic limbs, all similar 3
 - Five or six pairs of thoracic limbs, dissimilar 4
- 3(2). Body length much greater than height; head usually clearly delimited; antenna branched SIDIDAE Baird, 1850
 - Body length no greater than height; head not clearly delimited; antenna not branched in female (Holarctic and North Neotropical) HOLOPEDIDAE Sars, 1865
- 4(2). Antennule fused with rostrum BOSMINIDAE Sars, 1865
 - Antennule not fused with rostrum 5
- 5(4). Both branches of antenna 3-segmented CHYDORIDAE Stebbing, 1902
 - One branch of antenna 3-segmented, the other 4-segmented 6
- 6(5). Antennule immovable and short (in females) DAPHNIIDAE Straus, 1820
 - Antennule movable, mostly long 7
- 7(6). Antennule situated on anterior side of head ... MACROTHRICIDAE Baird, 1843
 - Antennule situated on posterior side of head MOINIDAE Goulden, 1968
- 8(1). Head elongated (Holarctic) LEPTODORIDAE Lilljeborg, 1861
 - Head short 9
- 9(8). Caudal appendix very short PODONIDAE Mordukhai-Boltovskoi, 1968
 - Caudal appendix well developed 10

- 10(9). Caudal appendix somewhat shorter than body
(Holarctic) POLYPHEMIDAE Baird, 1845
 — Caudal appendix much longer than body
(Palearctic) CERCOPAGIDAE Mordukhai-Boltovskoi, 1968

Family SIDIDAE Baird, 1860

Sididae Baird, 1850: 89.

Key to All Known Genera of the Sididae

1. One or two of antennal rami 3-segmented 2
 — Both rami of antenna 2-segmented (marine) *Penilia* Dana, 1849
 2(1). Both antennal rami 3-segmented (in *Sida* the proximal segment of
 lower ramus very small) 3
 — One ramus of antenna 3-segmented, the other 2-segmented 4
 3(2). Head round-rectangular, with a small distinct rostrum
 (Holarctic and north Neotropical) *Sida* Straus, 1820
 — Head triangular, no rostrum (Palearctic) *Limnosida* Sars, 1862
 4(2). Ventral side of head with a foliar outgrowth
 (Holarctic, India) *Lathona* Straus, 1820
 — No outgrowth on ventral side of head 5
 5(4). Body and head elongated, narrow; long setulated setae present only
 along ventral edge of valves *Diaphanosoma* Fischer, 1850
 — Body and head massive; long setulated setae along whole edge of valve 6
 6(5). Anal teeth of postabdomen conical and arranged singly *Latonopsis* Sars, 1888
 — Anal teeth of postabdomen lanceolate and arranged
 in groups *Pseudosida* Herrick, 1884

Genus *Latonopsis* Sars, 1888

(section written by N.M. Korovchinsky)

Latonopsis Sars, 1888: 6.—Richard, 1895: 376-378.

Massive head and body connected without noticeable folds (but folds sometimes formed after preservation as an artefact). Rostrum very small (if any), as a short outgrowth between bases of antennules. Antennule short, cylindrical, bearing on its distal end sensory papillae and a sensory seta possessing setules. Ocellus small and situated near bases of antennules. Eye situated closer to dorsal side of head. Antenna with a two-segmented and a three-segmented branch. Two ventral-most setae of three-segmented ramus noticeably larger than the others, their ends hooked. Whole free posterior margin of valve with long setulated setae. Three especially long naked setae on ventro-posterior corner of valve.

Postabdomen with conical and single anal teeth (sometimes grouped into 2's or 3's). Setae natatoriae situated on separate processes. Intestine lacks convolutions and caeca. In both known Australian

species shell-gland tripartite, with long posterior loop. The type species is *Latonopsis australis* Sars, 1888.

Key to Australian species of *Latonopsis*

1. Biarticulate branch of antenna with
 <12 setae; claw with two basal
 spines; female length to
 1.6 mm *L. australis* Sars, 1888
 — Biarticulate branch of antenna with
 >20 setae; claw with three basal
 spines; female length to
 3.5 mm *L. brehmi* Petkovski, 1973

Latonopsis australis Sars, 1888

Fig. 4

Latonopsis australis Sars, 1888: 6-15, pl. I.—Richard, 1895: 378-80, pl. XVI, figs 11, 13, 20; Petkovski, 1973b, 162.

Material. *Qld.*: 12, 15, 17, 22, 24, 25, 40, 48. *N.S.W.*: 80, 85, 98, 100, 133, 134. *W.A.*: 411.

Slides. AM ♀ P27759, MGU ♀ 106, ZIN ♀ 286.

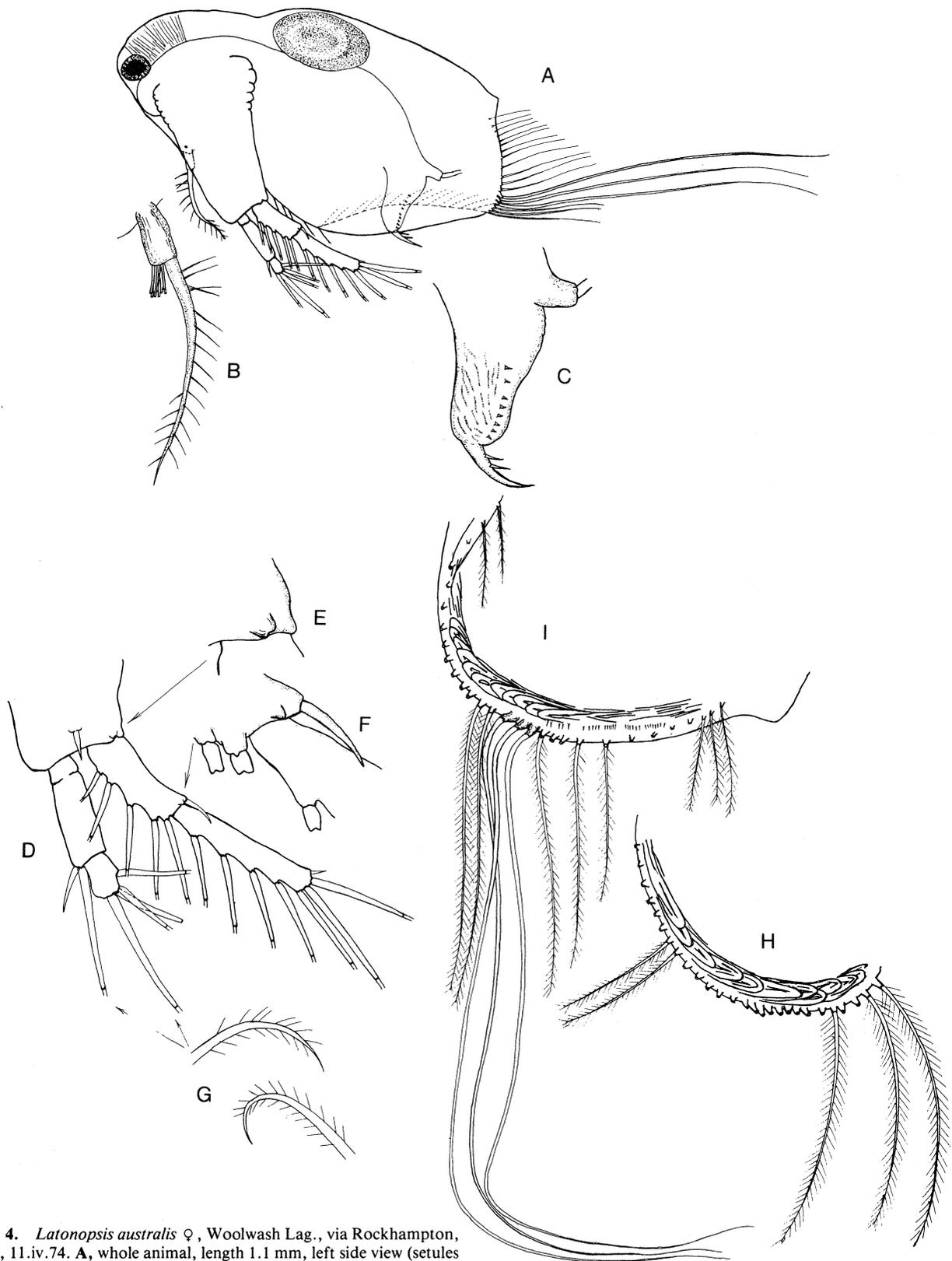


Fig. 4. *Latonopsis australis* ♀, Woolwash Lag., via Rockhampton, Qld, 11.iv.74. **A**, whole animal, length 1.1 mm, left side view (setules on marginal setae of valve not figured); **B**, antennule; **C**, postabdomen; **D**, antenna; **E**, distal end of antennal base; **F**, distal end of proximal branch of antenna; **G**, hooked ends of larger ventral setae of tripartite branch of antenna; **H**, anterior margin of valve from outside; **I**, posterior margin of valve from inside (not all setae figured).

Comments. From a comparison of specimens of *Latonopsis australis* from Australia (including some from near the type locality) with those of related species, it is clear that Sars' description is too general. The following characteristics now seem to be taxonomically important: density of setulation of the sensory setae of the antennule, the form of the postabdomen, the ratio of the width of the proximal part of the postabdomen to its length, body size, and probably egg number.

Female. Antennule with sparsely-spaced setae three to four times longer than it. Antenna on a thick base; its length about 60% of body length. Distal end of antennal basipodite with a spine on outer side from bases of rami; two rounded outgrowths on its dorsal corner. Proximal segment of biarticulated branch noticeably shorter and wider than distal one. Distally, the proximal segment bears a large, slightly incurved spine and a small rounded outgrowth. Antennal setae 5(4)-7/0-1-4. (Proximal segment with 4 setae in about 40% of individuals studied.) Two ventral-most setae of triarticulate branch especially large and with their ends hooked (cf. similar structure in *Pseudosida* [Rühe, 1921]).

Setulated setae of valve edges mounted on conical bases. These setae longer on anterior and posterior edges of valves. Ventral margin of valve incurved, so its setae directed inwards and somewhat posteriorly. The ventro-posterior corner of valve has 3 especially long, naked, diverging setae, mounted on larger and deflexed bases. Length of these setae 70–80% of body length. Coiled, newly-forming, pre-moulting marginal setae discernible inside valve margin. A few groups of spinules on inside surface of posterior margin of valve.

Postabdomen relatively small, averaging 33% of body length, slightly dilated in proximal part. Its maximum width 54–67%, averaging 60.7% of length. Anal teeth small, 7–9 in number, more often 8–9, and situated closer to distal end of postabdomen. Some anal teeth doubled. Numerous small setules on lateral surface of postabdomen, arranged in oblique rows on its distal part. Claw much incurved. Two basal spines.

Length. Up to 1.6 mm (according to Sars, 1888, but no specimens in our material >1.1 mm). The length of a female with embryos 0.83 mm (slide 106).

Male. Unknown.

Ecology. Benthic, occasionally planktonic; hides itself in loose bottom deposits. In both the University Pond, Brisbane (Timms, 1967) and Borumba Res. (Timms and Midgley, 1969) it was present only during warmer months.

Type locality. A water-body 32 km from Rockhampton, Qld.

Distribution. Qld, N.S.W., W.A., i.e. probably Australia-wide except the colder southern parts. Present literature indications are that it occurs mainly in tropical regions of the world, but this needs revision.

Differential diagnosis. *Latonopsis australis* is separable from other Australian species by its

comparatively small size, by having fewer setae on the antennae, and by the claw having two basal spines.

Latonopsis brehmi Petkovski, 1973

Fig. 5

Latonopsis (Birgella) brehmi Petkovski, 1973b: 163-170, figs 1-16.

Material. Literature (Petkovski, 1973b).

Female. Ventral margin of valve incurved, bearing ciliated setae along its entire length. Posterior margin of the valve with spinules grouped in 3–5's. Antennule twice as long as wide; its flagellum about three times longer than the antennule itself, and densely covered with setules along its whole length. Antenna does not reach posterior third of body. The proximal segment of its biarticulate branch about 1.5 times longer than its width. Antennal setae 8(10)-12(13)/0-1-4, spines 1-1/0-1-0. Postabdomen wide, noticeably narrower distally. Its lateral sides with 13–16 anal teeth. Some of these double or triple. Claw slightly bent distally and with 3 basal spines, thick and straight, the distal one being twice as large as the rest. Short spinules located distally from basal teeth and thin setules on inner side of claw. Thoracic limbs I–V with an epipodite but VI with none. Limbs I–IV with a narrow exopodite, V and

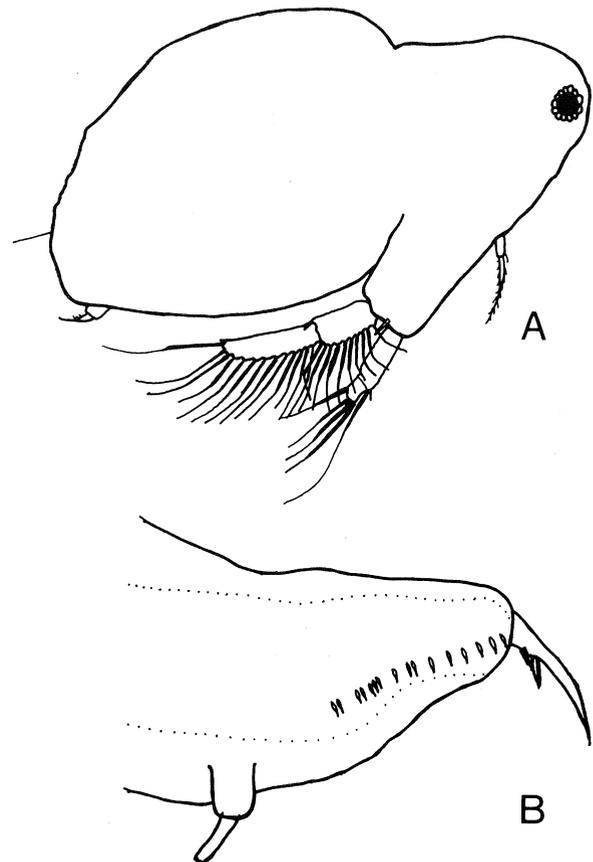


Fig. 5. *Latonopsis brehmi* ♀ after Petkovski, 1973b. A, whole animal, B, postabdomen.

VI with a short wide exopodite. Ten exopodite setae on limb I; filter plate of its endite large (with about 86 setae) and gnathobase small (13 setae). Eleven exopodite setae on limbs II-IV. Limb V with 9 exopodite setae and a large filter plate on its endite of similar size to the gnathobase; the two together compose one filter plate. Limb VI with 6 exopodite setae; its endite with setae similar to that of its exopodite, but with one much smaller; its gnathobase with two long and two short setae.

Length. Up to 3.5 mm.

Male. Unknown.

Type locality. L. Cronin (East of Hyden, W.A.) and Clybucca Swamps (via Kempsey, N.S.W.) (two places are listed by Petkovski).

Distribution. N.S.W., W.A.

Differential diagnosis. *Latonopsis brehmi* differs by its larger body size, by more numerous setae on the antennae, and by three basal spines on the claw.

Genus *Pseudosida* Herrick, 1884
(section written by N.M. Korovchinsky)
Figs 6, 7

Pseudosida Herrick, 1884: 20.—Birge, 1910: 1027-1029.
Parasida Daday, 1904: 111-112; 1905: 218.

Head of moderate size, rounded, with eye situated frontally, an ocellus and a small rostrum. Females of most species with long antennules with sensory papillae situated laterally and a sensory seta on the apex. Antenna with a thick big basipodite, a three-segmented branch and a two-segmented branch. Segments of branches with various numbers of setae in different species, generally (5-8)-(8-12)/0-1-4, the number of setae increasing with size. Two ventralmost setae of three-segmented branch may have hooked ends.

Ventral margin of valve infolded and bearing long setulated setae; similar or longer setae situated on anterior margin of valve. In some species the ventro-posterior margin bears several long naked setae. Anal teeth of postabdomen grouped in 2-5's. Setae natatoriae situated on separate bases.

Male with long antennule; thoracic limb I with complex grasping structures, and copulating organs.

The type species is *Pseudosida bidentata* Herrick, 1884.

Until this review *Pseudosida* was unknown in Australia, though various species are sometimes found

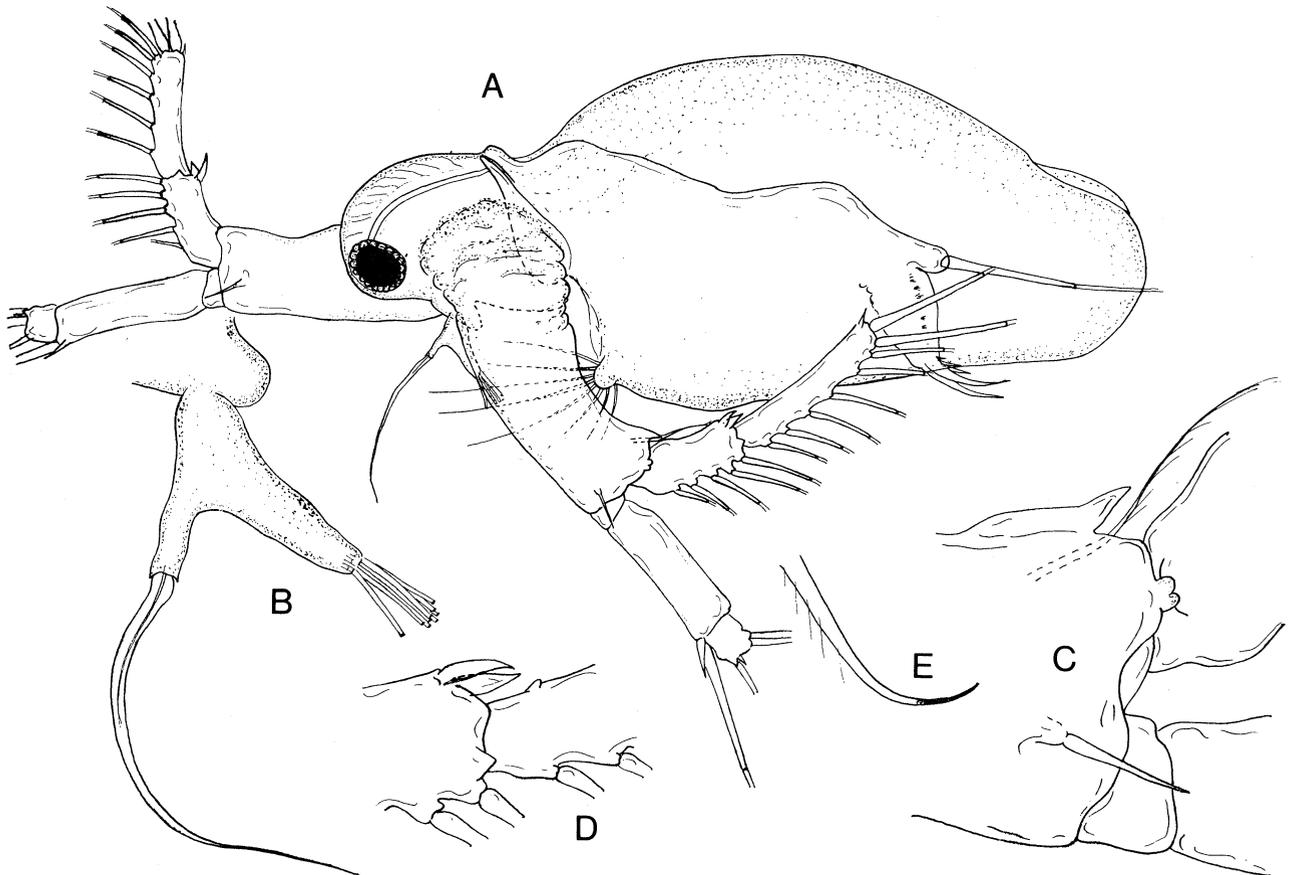


Fig. 6. *Pseudosida australiensis* ♀, a dune swamp near Red Rock National Park, via Woolgoolga, N.S.W. 16.iii.77. **A**, left side view (antennal setae not shown in full length), length 1 mm; **B**, antennule; **C**, distal end of basipodite of antenna, from outside; **D**, distal end of first segment of two-segmented ramus of the antenna; **E**, hooked end of the large seta of the second segment of the three-segmented ramus of the antenna.

in New Guinea, Indonesia and continental South-East Asia. In this respect Brehm's (1953) indication of *P. bidentata* in Borneo and the Philippines needs confirmation. In samples from eastern New South Wales a few individuals were found of a new species. Due to the possibility of two species from nearby lands occurring in Australia, a key is given for all three.

Key to Species of *Pseudosida* Occurring in Australia and Nearby Lands

1. Antennule long, with papillae laterally; postabdomen with a lateral outgrowth at its distal end near base of post-abdominal claws (India, Sri Lanka, Thailand, Sumatra, Africa and possibly elsewhere—data in need of revision) *P. szalayi* Daday, 1898
 - Antennule short; postabdomen with no outgrowths 2
- 2(1). Antennule rod-like with sensory papillae and a sensory seta distally; basal spines of postabdominal claw long, of similar size *P. papuana* Daday, 1901
 - Antennule bifurcated, with sensory papillae in an apical position and a sensory seta on apex of its other branch; proximal spine of postabdominal claw much smaller than other two spines *P. australiensis* n.sp.

***Pseudosida australiensis* n.sp.**

Figs 6, 7

Material. N.S.W.: 83, 91, 97

Holotype. AM ♀ P31301

Female. Head moderately sized, roundish. Eye large, situated closer to anterior-lower side of head. Antennule short and bifurcated; sensory papillae on apex of its larger branch and a sensory seta on apex of its smaller branch. Antenna with a long and thick basipodite. Distal end of basipodite with a thick spine on dorsal side, a small double tubercle at base of two-segmented branch and a long acute spine opposite the three-segmented branch. Inner distal end of basipodite with a long seta. Antennal seta 5-8/0-1-4. Large seta at end of middle segment slightly longer than body; its end hooked and chitinized as described (Rühe, 1927) for *Pseudosida bidentata*. Two large spines and a cone on distal end of first segment of two-segmented branch.

Shell oblong-oval with ventral edge infolded. Ventral and antero-ventral edges with long setulated setae; these especially long anteriorly. Only small spinules on inner side of postero-ventral edge.

Postabdomen thick and with 10 groups of anal teeth laterally. Each group with 2-4 teeth, commonly 3. Claw with 3 basal spines, the proximal one much smaller than other two. Five bent spinules on middle convex side of claw. Terminal end of postabdomen with a few thin spines situated between claw bases.

Length. Up to 1 mm.

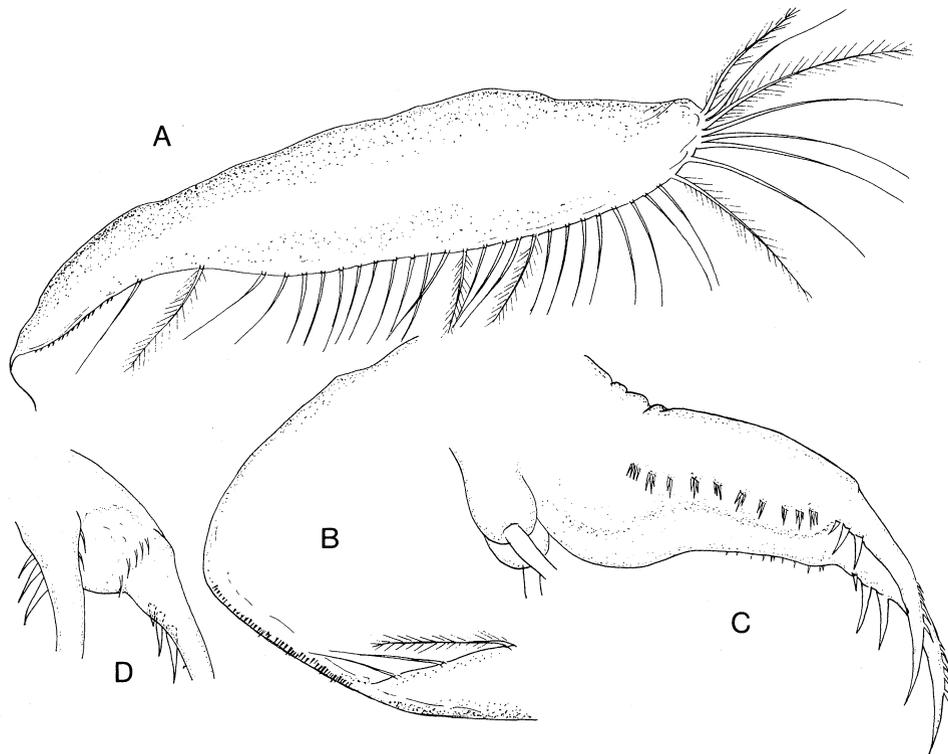


Fig.7. *Pseudosida australiensis* ♀, a dune swamp near Red Rock National Park via Woolgoolga, N.S.W. 16.iii.77. **A**, valve, from below (setules not shown on all setae); **B**, posterior part of valve, from inner side (setules are not shown on all setae); **C**, postabdomen; **D**, distal end of postabdomen.

Male. Unknown.

Age variability. In larger individuals the relative size of the head decreases, the antennular outgrowth bearing sensory papillae increases, the number of antennal setae increases, and the number of anal teeth groups increases, as well as the number of teeth in each group. However, species identity can be confirmed even in the smallest individuals by the structure of the antennule.

Type locality. A dune swamp just north of the Red Rock National Park, via Woolgoolga, N.S.W.

Distribution. Acid coastal dune lakes in N.S.W.

Differential diagnosis. *Pseudosida australiensis* is readily distinguishable from other species by its short bifurcated antennule.

Genus *Diaphanosoma* Fischer, 1850

(section written by V. Kořínek)

Diaphanosoma Fisher, 1850: 3-11.

Daphnella Baird, 1850: 109.

Antenna with upper branch biarticulate and lower branch triarticulate. Number of setae natatoriae 4 - 7 to 8/0-1-4. Head narrow and separated by a distinct dorsal impression from trunk. Postabdomen narrow, tapering posteriorly, and bearing long sickle-shaped terminal claws with three long spines near their bases. Intestine lacks convolutions. Males with long whip-like antennules and a pair of copulatory appendages over postabdomen.

The type species is *Diaphanosoma brachyurum* (Liévin, 1848).

When this was written in 1978 only two species, *Diaphanosoma excisum* and *D. unguiculatum*, were known for Australia, but a recent revision of Australian species by Korovchinsky (1981) listed 5 species. Two of his species, *D. volzi* and *D. australiensis*, are apparently uncommon and a third, *D. sarsi*, occurs mainly in northern Australia (BVT, unpublished data), while *D. excisum* and *D. unguiculatum* are widely distributed. Only the latter two species are considered here, but a key is given for all of Korovchinsky's species plus two others which occur in nearby areas and could conceivably be found in Australia.

Key to Australasian Species of *Diaphanosoma*

1. Valve inflexed ventrally, forming a free flap 2
 - Ventral margin of valve gradually inflexed without a broad free flap 6
- 2(1). Denticles or spines along lower part of posterior margin of valve 3
 - No denticles or spines along lower part of posterior margin of valve; margin finely ciliated *D. volzi* Stingelin, 1905 (Thailand, China, north coast of N.S.W.)
- 3(2). Lateral rows of stout denticles on postabdomen *D. senegal* Gauthier, 1951 (India, Africa)
 - No lateral denticles on postabdomen 4
- 4(3). Free flap of valve tapering somewhat and joining its ventral margin almost at right angles; < 17 (usually 12) denticles on lower part of posterior margin of valve *D. excisum* Sars, 1885 (Asia, Africa, Australia)
 - Free flap of valve extending beyond its junction with the ventral margin; > 18 denticles on lower part of posterior margin of valve 5
- 5(4). 18-22 denticles on lower part of posterior margin of valve; distal part of flap on valve quite prominent *D. sarsi* Richard, 1894 (Borneo, India, Taiwan, Nepal, Sumatra, Philippines, Aru Is, New Hebrides, northern Australia)
 - 26-38 denticles on lower part of posterior margin of valve; distal part of free flap on valve not quite prominent *D. australiensis* Korovchinsky 1981 (Cape York, Qld)
- 6(1). Postabdomen with lateral row of stout denticles *D. unguiculatum* Gurney, 1927 (Australia)
 - No denticles on postabdomen *D. modigliani* Richard, 1894 (Sumatra, Philippines, SE Asia, Japan)

Diaphanosoma excisum Sars, 1885

Figs 8, 9

Diaphanosoma excisum Sars, 1885: 13-18, pl. 2.*Diaphanosoma paucispinosum* Brehm, 1933: 656-657, pl. 80, figs 17-19.**Material.** Qld: 15, 28. N.S.W.: 186.**Slides.** AM ♀ P27757, MGU ♀ 2881, ZIN ♀ 2885, ZMO ♀ 168/9724.

Female. Head short with eye situated frontally near its top. Dorsal part of head vaulted serving as a support for antennal muscles. First segment of biarticulate branch of antenna with a well-developed spine on top. Ventral part of valve inflexed, forming a free flap gradually tapering distally and bordered with long feathered setae. Lower part of posterior margin of valve with a variable number (3-16) of thorn-like denticles (forms with only a few denticles were described by Brehm as *D. paucispinosum*). Denticles followed by a row of setules of diminishing size. Postabdomen with groups of setules on both sides, three basal spines and finely ciliated terminal claws.

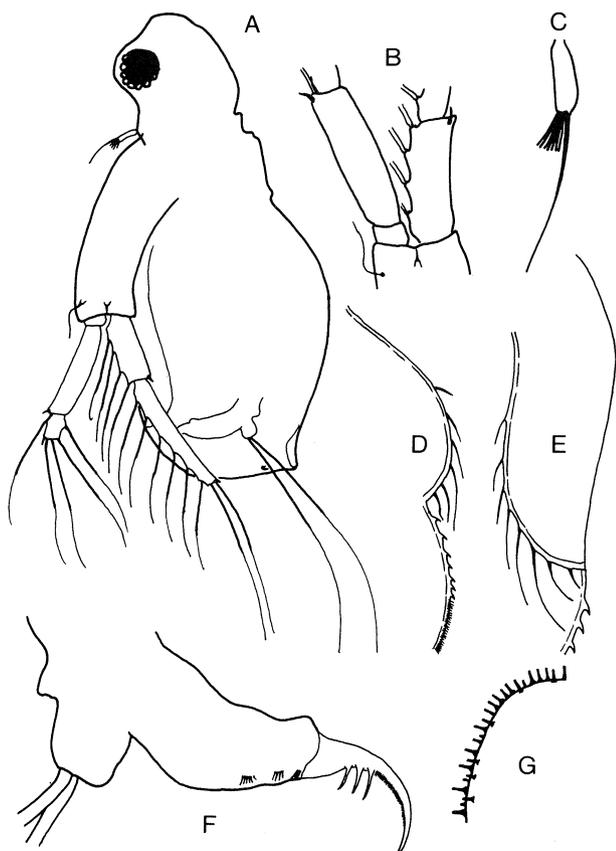
Length. Up to 1.3 mm.

Fig. 8. *Diaphanosoma excisum* ♀. **A**, whole animal, Handapangala Tank, Ceylon, 10.vii.69; **B**, antenna, idem, 28.xii.70, **C**, antennule, idem, 28.xii.70, **D**, free flap on the ventral margin of the valve, Bun Boraped Reservoir, Thailand, 12.i.72, **E**, same folded, Handapangala Tank, Ceylon, 10.vii.79, **F**, postabdomen, Gracemere Lagoon, Australia 7.i.60, **G**, sexual egg, 80x, New Pottery Pond, Malaysia, 3.xii.73.

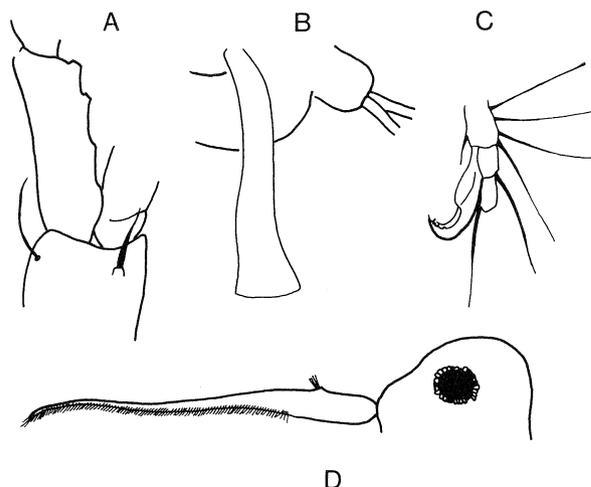


Fig. 9. *Diaphanosoma excisum* ♂. **A**, antenna, Volta Lake, Ghana, 27.xi.64; **B**, copulatory appendage, idem, **C**, first thoracic limb, idem, **D**, antennule, idem.

Male. Resembles female, but with long, whip-like antennules. A strong spine situated near end of basal segment of antenna. First leg with a slender hook on its distal end. Copulatory appendages resemble long, funnel-shaped tubes.

Length. Up to 1.1 mm.

Ecology. Mostly limnetic; usually present only during summer and early autumn (Timms, 1967, 1970a, 1970b).

Type locality. Gracemere Lagoon (11 km W of Rockhampton, Qld).

Distribution. Qld, N.S.W., (also Africa, S. Asia).

Differential diagnosis. Valve ventrally inflexed, its free flap tapering distally. There is a row of thorn-like denticles along the lower part of the posterior margin of the valve. The male has funnel-shaped copulatory appendages.

Diaphanosoma unguiculatum Gurney, 1927

Figs 10, 11

Diaphanosoma unguiculatum Gurney, 1927: 64-65, figs A-D.*Diaphanosoma senegal.*—Brehm, 1959: 2-3 (misidentification)

Material. Qld: 2, 12, Longreach (SYNTYPES): pool in dried river bed near Quilpie. N.S.W.: 83, 91, 96, 97, 184. Vic.: 228, Bostock Res., Prospector's diggings in Reith Reserve, Beralla. Tas.: Brady's L. S.A.: 351, 358.

Slides. AM ♀ P27758, MGU ♀ 709, ZIN ♀ 838, BM 14-3-1929 (SYNTYPES), ♀ ♂ 9-11-1967.

Female. Head broad and not too distinctly marked off from shell. Antennules stout and with a long flagellum. All spines on antenna elongated and sometimes setae-like. Ventral margin of valve not inflexed; long hairs along its proximal part, followed distally by fine ciliation. More than two setae in the group near junction of both valves of shell. Postabdomen with stout lateral denticles (up to 10) on

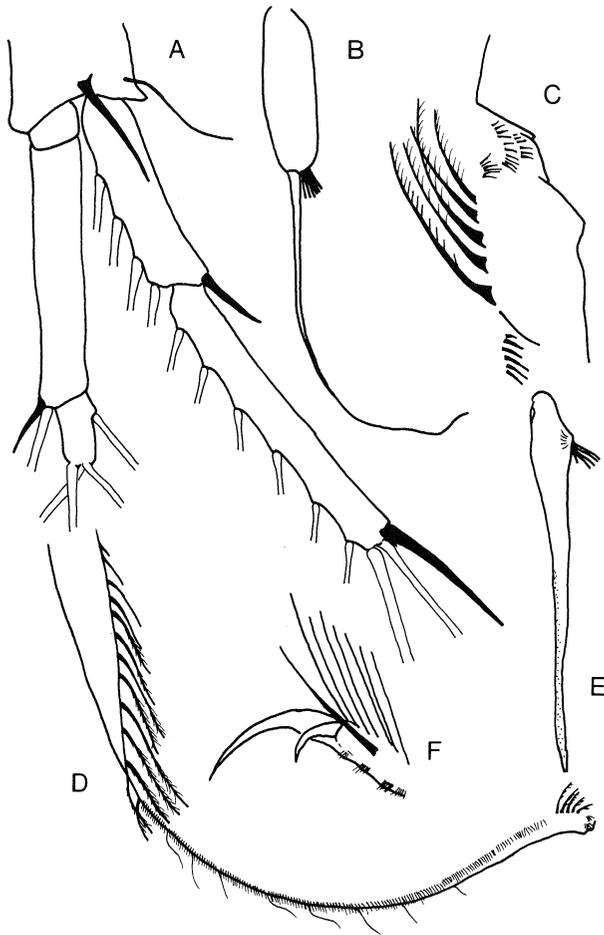


Fig. 10. *Diaphanosoma unguiculatum*. A, ♀ antenna, Reith Reserve, Vic., 23.xi.64; B, ♀ antennule, idem; C, ♀ posterior setae on the valve, idem; D, ♀ ventral margin of the valve, idem; E, ♂ antennule, idem; F, ♂ first thoracic limb and terminal hooks, idem.

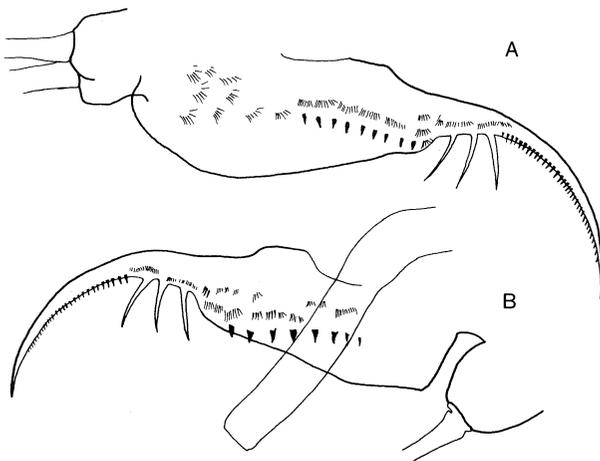


Fig. 11. *Diaphanosoma unguiculatum*. A, ♀ postabdomen, Reith Reserve, Vic., 23.xi.64; B, ♂ postabdomen with copulatory appendage, idem.

both sides. Terminal claws with three basal spines and a row of needle-like denticles along their dorsal margin.

Length. Up to 1.5 mm.

Male. Head narrower than in female. Setae and spines on antenna same as those of female. One stout and one small hook on end of first thoracic leg. Tube-like copulatory appendages present.

Length. Up to 1.2 mm.

Ecology. Mostly littoral; a number of records are from markedly acid waters, indicating a tolerance of a wide pH range.

Type locality. Reared from mud taken near Longreach, Qld.

Distribution. Qld, N.S.W., Vic., Tas., S.A., so probably Australia-wide. Endemic.

Differential diagnosis. The ventral margin of the valve is not inflexed. All spines on the antenna are elongated. There are stout lateral denticles on the postabdomen and the terminal claws have needle-like denticles along their dorsal margin.

Genus *Penilia* Dana, 1852

(Section written by N.M. Korovchinsky)

Penilia Dana, 1852a: 47; 1852b: 1268-1269.—Richard, 1895: 343-344.

Antennule small and stick-shaped with 6 olfactory setae. Two biarticulated branches on swimming antenna. Brood pouch closed.

This genus was considered to consist of several species (Richard, 1895; Kramer, 1895), but Calman (1917) and Steuer (1933) concluded that there is only one widely distributed species *P. avirostris* Dana. This position is adopted here, but further study is needed.

Type species is *Penilia avirostris* Dana, 1852.

Penilia avirostris Dana, 1852

Fig. 12

Penilia avirostris Dana, 1852a: 47; 1852b: 1269-1270, pl. 89, figs 2a, 2b—Richard, 1895: 351-352, pl. 15, fig. 9; Calman, 1917: 157-158; Steuer, 1933: 80-83; Dakin & Colefax, 1940: 73, fig. 93.; Dolgopolskaya, 1958: 38-46, figs 6-12.

Penilia orientalis Dana, 1852a: 47; 1852b: 1270-1271, pl. 89, figs 3a-e.—Richard, 1895: 350, pl. 15, fig. 12.

Penilia schmackeri Richard, 1895: 344-350, pl. 15, figs 5, 7, 11, 15, pl. 16, fig. 8.; Zernov, 1908: 232.; Behning, 1927: 345-348, Abb. 1-12.

Penilia pacifica Kramer, 1895: 222-223, pl. 23, figs 1-5.

Female. Head relatively small and broad, with two ventral rostral projections. Antennal setae 2-6/1-4. Posterior dorsal part of the shell with a deep depression. Edges of the valve carry a number of larger denticles with some smaller ones between them. Postabdomen with anal denticles wanting and with numerous groups of the minute setae present on both its lateral sides. Terminal claw of the postabdomen very long with two small basal spines. The claw also possesses rows of the minute denticles along its dorsal and ventral margins.

Length. 0.6-1.2 mm.

Male. Head relatively small and without two ventral

rostral projections. Antennule very long, about 80 per cent of the body length with very long setules on the distal end. Copulatory appendages resemble long tubes.

Length of male. c. 0.8 mm.

Ecology. Euryhaline marine, restricted to surface coastal waters (see Lochhead, 1954).

Type locality. Rio de Janeiro Harbour.

Distribution. Coastal waters off N.S.W. (Dakin and Colefax, 1940); off Port Hacking estuary, N.S.W. (Sheard, 1949); Lake Macquarie, estuaries, and coastal waters from Evans Head to Eden, N.S.W. (Kott, 1955, 1957); Port Phillip Bay, Vic. (Arnott, 1974); and the Great Australian Bight (Markina, 1975).

Differential diagnosis. *Penilia avirostris* is the only marine ctenopod and as such is easily recognized by its

six similar pairs of filter feeding trunk appendages enclosed by a bivalve carapace. Among the Ctenopoda it is the only form with both branches of the second antenna two-segmented.

Family PODONIDAE

(Section written by the late P.D. Mordukhai-Boltovskoi)

Podonidae Mordukhai-Boltovskoi, 1968: 200.

Antennules immovable and fixed to lower part of head. Antennae short with 6 or 7 setae on four-segmented branch. Mandibles terminate in an acute cutting denticle and in a peculiarly branched 'masticatory' process. Exopodites of legs poorly armed with only one to four almost unfeathered setae. Abdomen very short but with caudal claws variously strongly developed or in the form of triangular projections. Body covered dorsally with a well-developed, hard shell, surrounding the brood pouch and often larger than body. 'Cervical organ' small and situated above bases of antennae.

Males differ from females by presence of hooks on distal end of first leg, two penes, and the larger eye.

All species of Podonidae live in the upper layers of the oceans, preferably in the neritic zone but partly in brackish waters and estuaries. Usually they produce resting eggs in autumn and disappear till spring.

Key to Australian Genera of Podonidae

1. Exopodites of legs II and III bear three or four setae. Shell rounded on top .. 2
 - Exopodites of legs II and III bear one or two setae. Shell rounded or pointed on top 3
- 2(1). Exopodites of leg I bear three or four setae. Shell hemispherical, delimited from head *Pleopis* Dana, 1852
 - Exopodites of leg I bear two setae. Shell elongated, elliptical or tapering to top (but still rounded at top) *Pseudevadne* Claus, 1877
- 3(1). Exopodites of legs I and III bear only one strong seta. Head delimited by a depression from hemispherical shell *Podon* Lilljeborg, 1853
 - Exopodite of leg II bears two setae, of leg III one or two setae. Head not delimited from elongated shell *Evadne* Loven, 1836

Genus *Pleopis* Dana, 1852

Pleopis Dana, 1852b: 1275; Sars, 1861: 292-293; P.E. Müller, 1867: 214-215 (*Podon*, partim); Lilljeborg, 1900: 625-627 (*Podon*, partim); Dolgopolskaya, 1958: 60-71

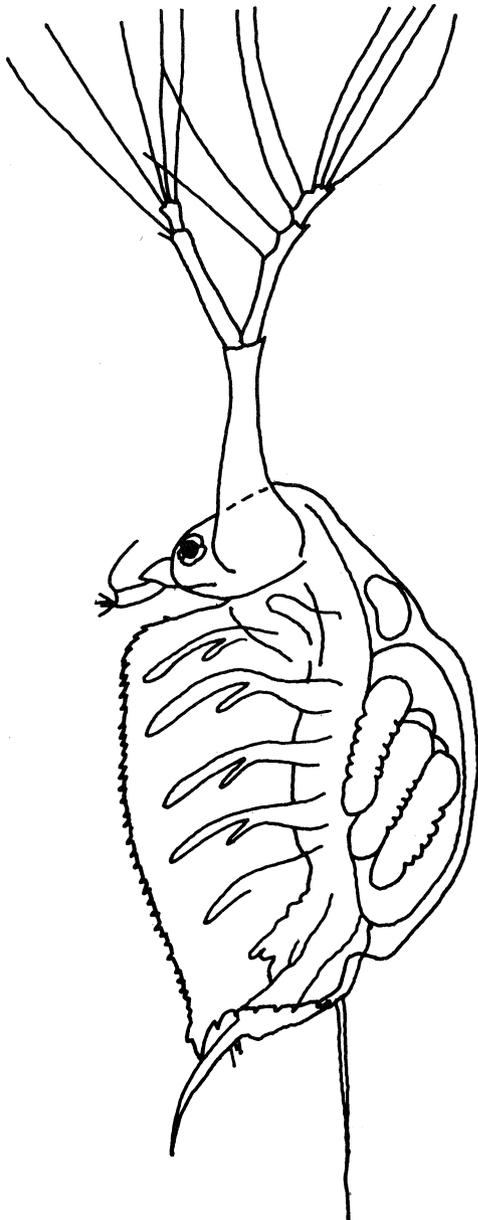


Fig. 12. *Penilia avirostris* ♀ after Zernov, 1908.

(*Podon, partim*); Mordukhai-Boltovskoi, 1968: 197-209; 1969: 20-21.

Exopodites of legs I, II, and III with three or four setae, those of leg IV with two. Shell hemispherical, rounded and delimited from head. Caudal claws short.

There are two species, *P. schmackeri*, Poppe and *P. polyphemoides* (Leuckart), but only the latter occurs in Australian waters.

Pleopis polyphemoides (Leuckart, 1859)

Fig. 13

Pleopis brevicauda? Dana, 1852b: 1276.

Evadne polyphemoides Leuckart, 1859: 261.

Pleopis minutus Sars, 1862: 294.

Podon polyphemoides.—Poppe, 1889: 289; Lilljeborg, 1900: 627-636; Dolgopolskaya, 1958: 67-71; Manuilova, 1964: 303-304.

Pleopis polyphemoides Mordukhai-Boltovskoi, 1968, 1969: 21.

Female. Head comparatively large. Exopodites of legs I to III with three setae and those of leg IV two setae, so setal formula of 3.3.3.2. First segment of endopodite of leg I with six setae. Caudal claws short, in shape of triangular processes. Female length 0.35–0.45 mm. Height approximately the same. (It

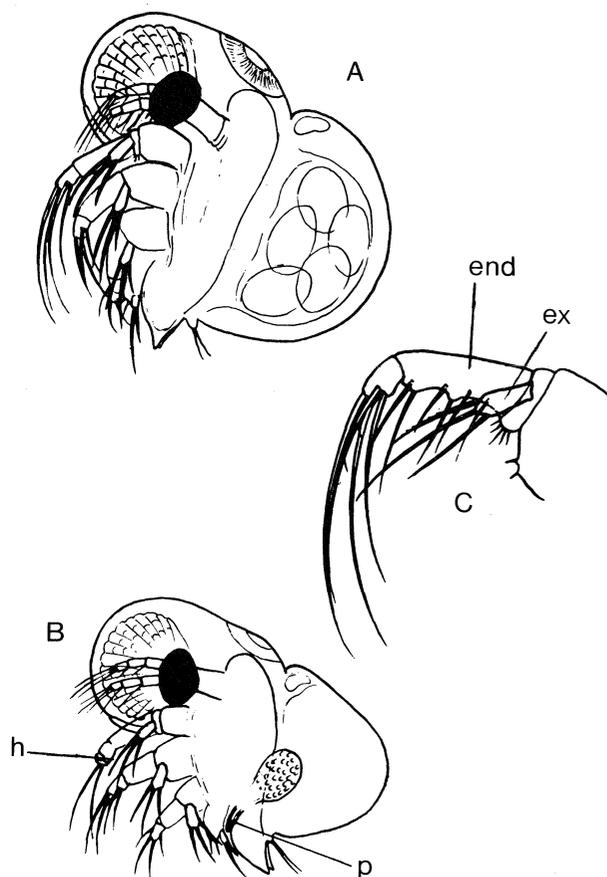


Fig. 13. *Pleopis polyphemoides*. A, ♀; B, ♂; C, thoracic limb I of ♀ (ex = exopodite, end = endopodite, p = penes, h = hook of leg I).

should be kept in mind that all podonids are drawn in their natural positions, i.e. with the head upwards, so that the longitudinal body axis is vertical.)

Male. Shorter (length not greater than 0.4 mm), with a larger eye and a smaller shell than female. Shell tapers upwards.

Ecology. *Pleopis polyphemoides* is eurythermic and euryhaline. It is especially common in shallow and brackish waters (to 5 ‰).

Distribution. All oceans between 70°N and 40°S; not so common in the equatorial zone. For Australia there are records in and off Sydney Harbour (Dakin and Colefax, 1940); Jibbon (Sheard, 1949); Port Stephens, off Jibbon (Port Hacking Point), L. Macquarie (Kott, 1955); N.S.W. coastal waters from Eden to Port Stephens (Kott, 1957); and Gippsland Lakes, Vic. (specimens ex G. Arnott).

Genus *Pseudevadne* (Claus, 1877)

Evadne Claus, 1877: 140.

Pseudevadne Mordukhai-Boltovskoi, 1969: 24.

Exopodites of leg I with two setae, of legs II and III three and of leg IV one seta, so setal formula of 2.3.3.1. Shell elongated, elliptical or tapering but rounded at the top, and often, but not always, delimited from body by a depression. Lateral sides of shell (crista of fornix) partly overhang, covering basipodites of legs. Caudal claws in form of triangular processes.

This genus, established by Claus and later united with *Evadne* and later still with *Pleopis*, must be reinstated.

Pseudevadne tergestina (Claus, 1877)

Figs 14, 15

Evadne tergestina Claus, 1877: 140.

Podon schoedleri Caporiaccio, 1938: 6-9.

Evadne tergestina.—Dolgopolskaya, 1958: 56-60.

Pleopis tergestina.—Mordukhai-Boltovskoi, 1969: 21-22.

Comments. The shape of the shell is variable; sometimes its upper part is considerably narrower, but it is always rounded on top. A distinguishing feature is the presence of some (5-8) rows of coloured hypodermal cells on the shell (sometimes decoloured if preserved in formalin). The female reaches 0.9 mm in length and 1.2 mm in height.

The male is smaller: length 0.6 mm, height 0.8 mm.

Distribution. All oceans, mainly between 40–45°N and 40°S. Common in Australian waters—found off Sydney Harbour (Dakin and Colefax, 1940); Jibbon (Sheard, 1949); Jibbon, L. Macquarie and Port Stephens (Kott, 1955); N.S.W. coastal waters from Eden to Coff's Harbour (Kott, 1957); Gippsland Lakes and Port Phillip (specimens ex G. Arnott).

Genus *Podon* Lilljeborg, 1853

Podon Lilljeborg, 1853: 161.—Poppe, 1889: 295; Lilljeborg, 1900: 46-60 (partim); Mordukhai-Boltovskoi 1968: 197-208; 1969: 22.

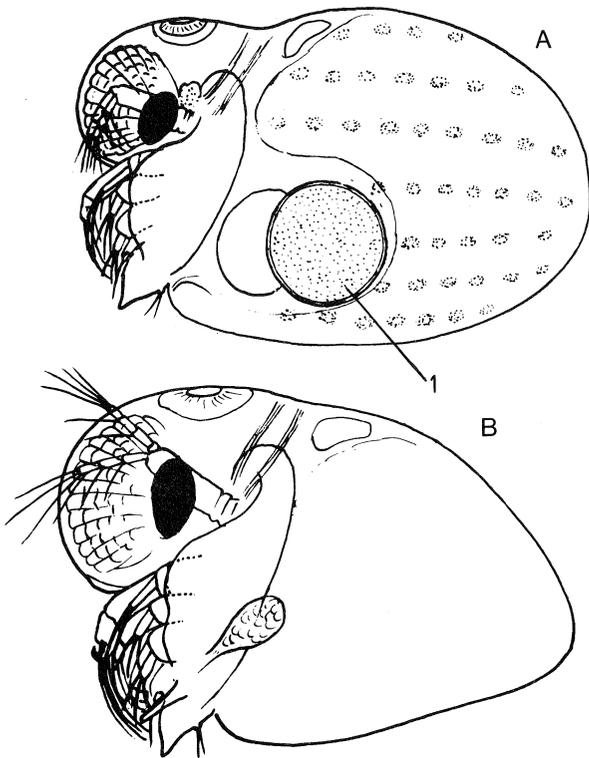


Fig. 14. *Pseudevadne tergestina*. A, ♀; B, ♂ (1 = latent egg).

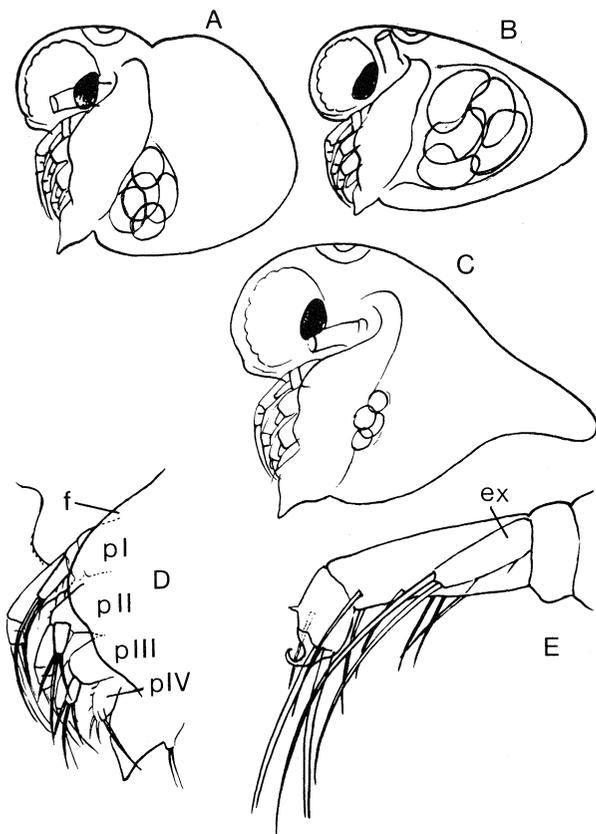


Fig. 15. *Pseudevadne tergestina*. A, B, C: various forms of the shell in the ♀; D, thoracic limbs I-IV of the ♀; E, thoracic limb of the ♂ (ex = exopodite, f = fornix, pl-IV = thoracic limbs I-IV).

Exopodites of leg I with one or two setae, of legs II and III with one short but strong seta, and of leg IV with two setae. Head always clearly delimited by a depression from the hemispherical shell.

There are two species, *P. leuckarti* Sars and *P. intermedius* Lill., but only the latter occurs in Australian waters.

Podon intermedius Lilljeborg, 1853

Fig. 16

Podon intermedius Lilljeborg, 1853: 161.—P.E. Müller, 1867: 215-220; Lilljeborg, 1900: 627-633; Mordukhai-Boltovskoi, 1969: 22.

Female. Exopodites of leg I with two setae, legs II and III with one seta, and leg IV with two setae, so setal formula 2.1.1.2. Setae on exopodites of leg II and III short, strong and covered with spines. Postanal knobs with comparatively long setae. Shell spherical or somewhat elliptical. Female length up to 1.0 mm and height to 1.2 mm.

Male. Larger head and a very small shell, triangular but rounded at top. Length up to 0.9 mm and height to 1.0 mm.

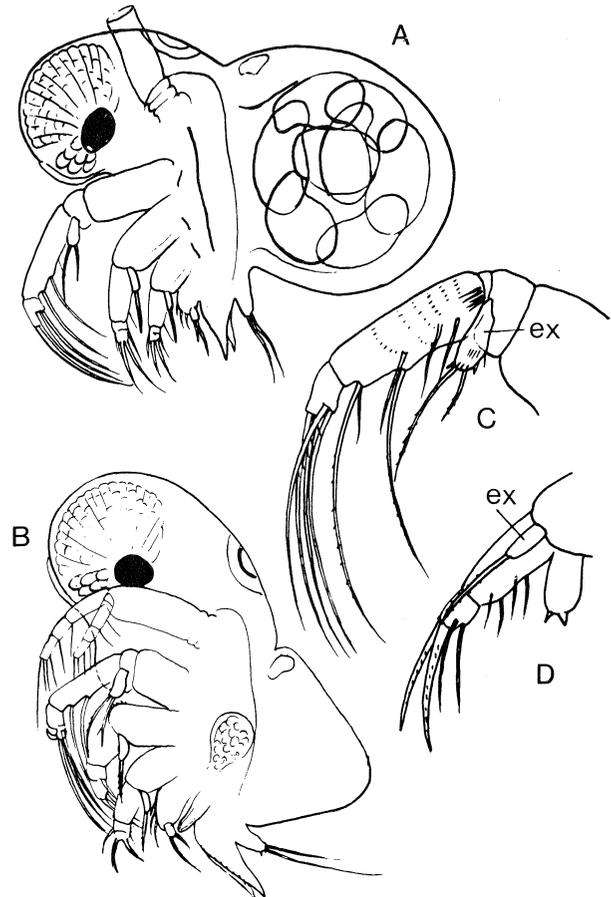


Fig. 16. *Podon intermedius*. A, ♀; B, ♂; C, thoracic limb I of the ♀; D, thoracic limb III of the ♀ (ex = exopodite).

Distribution. In all oceans, mainly in temperate and northern zones, and preferably in neritic waters. In Australia it has been recorded from the Gippsland Lakes, Port Phillip Bay, Vic. (Arnott, 1974) and in the estuaries of the Paterson and Yarra Rivers, Vic. (Neale and Bayly, 1974).

Genus *Evadne* Loven, 1836

Evadne Loven, 1836: 3.—P.E. Müller, 1867: 222; Dolgopolskaya, 1958: 46-60 (partim); M.-Boltovskoi, 1969: 23.

Exopodites of legs I and II with setae, of leg III one or two setae, and of leg IV one seta. Head never delimited from shell. Latter elongated with an acute or pointed tip. Caudal claws clearly delimited, but with shape of triangular processes.

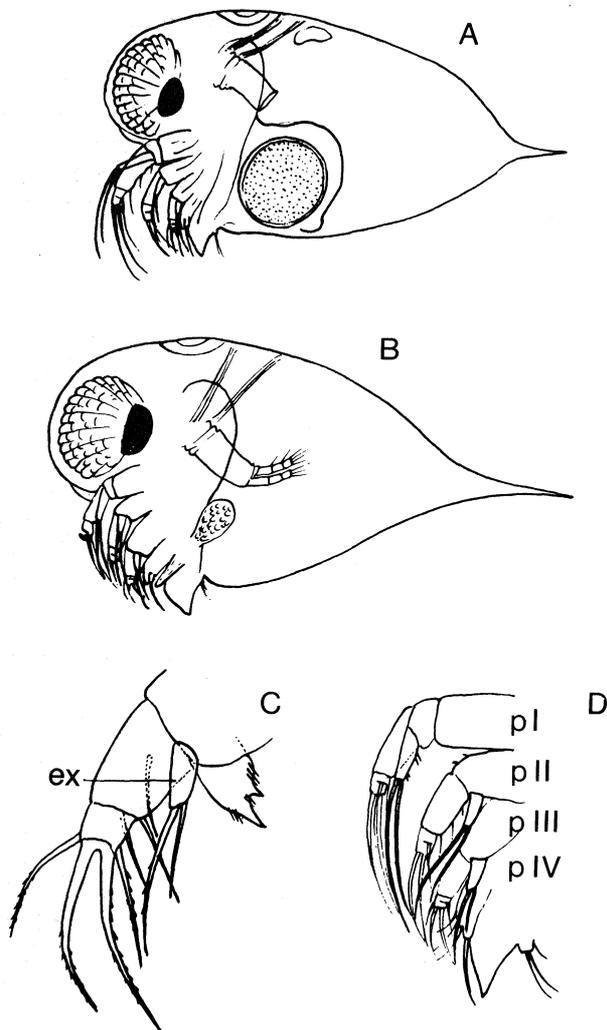


Fig. 17. *Evadne spinifera*. A, ♀; B, ♂; C, thoracic limb III; D, thoracic limbs I-IV of the ♀ (ex = exopodite, pI-IV = thoracic limbs I-IV).

Key to Australian Species of *Evadne*

- 1. Exopodites of leg III with two setae; muscles of antennae diverge to dorsal side *E. spinifera* P.E. Müller, 1867
- Exopodites of leg III with one seta; muscles of antennae parallel or approach one another to dorsal side
..... *E. nordmanni* Loven, 1836

***Evadne spinifera* P.E. Müller, 1867**

Fig. 17

Evadne spinifera P.E. Müller, 1867: 225-226.—Lilljeborg, 1900: 647-649, tab. LXXXVI, fig. 18, tab. LXXXVII, figs 1-3; Dolgopolskaya, 1958: 51-55, figs 17-22.

Female. Setal formula for exopodites of legs 2.2.2.1. Muscles of antennae diverge to anteriodorsal side of shell. Tip of shell always with an obvious, though sometimes short, point. Female length 0.5-0.8 mm and height 1.3-1.4 mm (including the point).

Male. Larger head and a narrower shell with a longer point than female.

Distribution. All oceans, mainly between 60-65°N and 40°S, preferably in neritic waters but also in the pelagic zone. In Australian waters it has been found off Sydney Harbour (Dakin and Colefax, 1940); Gibbon (Sheard, 1949); Gibbon, L. Macquarie, Port Stephens (Kott, 1955); and N.S.W. coastal waters from Coff's Harbour to Eden (Kott, 1957).

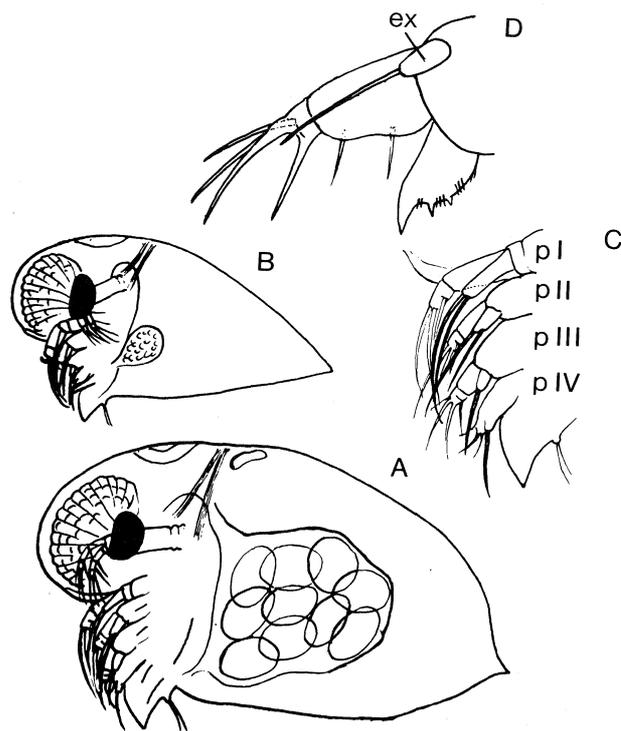


Fig. 18. *Evadne nordmanni*. A, ♀; B, ♂; C, thoracic limbs I-IV of the ♀; D, thoracic limb III (ex = exopodite pI-IV = thoracic limbs I-IV).

Evadne nordmanni Loven, 1836

Fig. 18

Evadne nordmanni Loven, 1836: 3.—P.E. Müller, 1867: 222-225; Dolgopolskaya, 1958: 46-50, figs 14, 15.

Female. Setal formula for exopodites of legs 2.2.1.1. Muscles of antennae parallel or converge to dorsal side of shell. Shell tapers to top, acute or angulate, sometimes with a small point. Shell triangular in juveniles. Female length 0.4–0.7 mm and height 1.2–1.4 mm.

Male. Larger head than female and with a triangular shell.

Distribution. All oceans, preferably in the neritic zone and mainly between 40°N and 40°S. In Australian waters it has been found off Sydney Harbour (Dakin and Colefax, 1940); Jibbon (Sheard, 1949); Jibbon, L. Macquarie and Port Stephens (Kott, 1955); N.S.W. coastal waters from Port Macquarie to Eden and the east coast of Tasmania (Kott, 1957) and in Port Phillip Bay, Vic. (Arnott, 1974).

Family CHYDORIDAE Stebbing, 1902

Chydoridae Stebbing, 1902: 101-106.—Smirnov, 1971b:1-531.

Lynceidae Baird, 1850: 115.

Euryercidae + Lynceidae.—Dybowski & Grochowski, 1895: 149-154.

Key to Subfamilies of Chydoridae

1. Exopodites of thoracic limbs III and IV with 8–10 setae 2
 - Exopodites of thoracic limbs III and IV with 7 or fewer setae 3
- 2(1). Six pairs of thoracic limbs; limb IV with an exopodite. Exopodite of limb V with 7 or 8 setae. Postabdomen long and wide, with many (>80) denticles. Head pores present. Animal oval in lateral view. (Holarctic with records from South Africa and South America) **Euryercinae** Kurz, 1875
 - Five pairs of thoracic limbs. Postabdomen short. Major head pores absent. Animal circular in lateral view **Sayciinae** Frey, 1967
- 3(2). Exopodites of limbs III and IV with 7 setae. Major and minor head pores on longitudinal axis of head shield; major pores are separate, or only a single major head pore. Two or more parthenogenetic eggs **Chydorinae** Stebbing, 1902
 - Exopodites of limb IV with 6 setae. Major head pores on longitudinal axis of head and connected, separate, or single; minor head pores laterally positioned. Two parthenogenetic eggs **Aloninae** Frey, 1967

A Shortened Key to the Genera of Chydoridae Known for Australia

1. Parthenogenetic eggs numerous. No major head pores. Animal circular in lateral view 2
 - Parthenogenetic eggs two. Major head pores typically present (when absent, body oblong). Animal usually not circular in outline 3
- 2(1). Exopodites of thoracic limbs III and IV with 8 setae. Postabdomen short, wide, its dorsal side angular *Saycia* Sars, 1904
 - Exopodites of limbs III and IV with 7 setae. Postabdomen comparatively narrower, its dorsal side rounded *Archepleuroxus* n.gen.
- 3(1). Ocellus only, no eye *Monospilus* Sars, 1862
 - Both ocellus and compound eye 4
- 4(3). Exopodites of limbs III and IV with 7 setae. Major and minor head pores on longitudinal axis of head shield; major head pores separate, or only single major head pore, or rarely none 5

- Exopodite of limb IV with 6 setae. Major head pores on longitudinal axis of head shield and connected, separate, or single; minor head pores laterally positioned 14
- 5(4). Labrum with a lamellar outgrowth 6
- No lamellar outgrowth on labrum *Pseudochydorus* Fryer, 1968
- 6(5). Rostrum extremely long, reflexed posteriorly *Rhynchochydorus* n.gen.
- Rostrum relatively short 7
- 7(6). Setae on posterior half of ventral margin of valve inserted on its edge 8
- Setae on posterior half of ventral margin of valve inserted on its inner surface 10
- 8(7). Labrum protrudes well beyond tip of the blunt rostrum *Rak* n.gen.
- Labrum comparatively short and rostrum acute 9
- 9(8). Height of posterior margin of valve about a third of body height (if more, postabdomen comparatively long and bent) *Pleuroxus* Baird, 1843
- Height of posterior margin of valve about half body height. Antennule almost reaches tip of rostrum, or slightly protrudes beyond its tip. *Alonella* Sars, 1862
- 10(7). Head shield with two major head pores 11
- Head shield with one major head pore or none 12
- 11(10). Spherical in outline. Postabdomen not oval; anal opening on its functionally ventral side *Chydorus* Leach, 1816
- Oval in outline. Postabdomen oval; anal opening on its functionally posterior side *Dunhevedia* King, 1853
- 12(10). Head shield without head pores. Ventral margin of valve with a serrated infolded lobe anteriorly. Claw with two basal spines *Australochydorus* n.gen.
- Head shield with one major head pore 13
- 13(12). Eye and ocellus extremely large. Postabdomen not elongated. Labral lamella with an elongated pointed apex *Dadaya* Sars, 1901
- Eye and ocellus moderately sized. Postabdomen elongated. Labral lamella with a blunt apex, its tip with an impression *Monope* (Smirnov, 1977)
- 14(4). Head shield with three major head pores 15
- Head shield with one or two major head pores 20
- 15(14). Lateral setae of postabdomen extremely large. Anal teeth of postabdomen very small *Leydigia* Kurz, 1875
- Lateral setae of postabdomen not very large 16
- 16(15). Anterior margin of head shield broadly rounded, protruding (if viewed laterally). Ventral margin of valve straight. Postabdomen short *Graptoleberis* Sars, 1862
- Anterior margin of head shield not broadly rounded and protruding (in lateral view) 17
- 17(16). Postabdomen of various forms, but not narrow or very long *Alona* Baird, 1843
- Postabdomen long and narrow 18
- 18(17). Postabdomen straight with parallel dorsal and ventral margins . *Acroperus* Baird, 1843
- Postabdomen narrows distally 19

- 19(18).Rostrum elongated. Legs III and IV noticeably different *Kurzia* Dybowski & Grochowski, 1894
- Rostrum not elongated. Legs III and IV superficially similar. Most species with a keel on carapace *Camptocerus* Baird, 1843
- 20(14).Head shield with two major head pores 21
- Head shield with one major head pore. Body length considerably exceeds its height *Euryalona* Sars, 1901
- 21(20).Major head pores connected by a narrow connection *Biapertura* Smirnov, 1971
- Major head pores separate *Oxyurella* Dybowski & Grochowski, 1894

Subfamily SAYCIINAE Frey, 1967

Sayciinae Frey, 1967: 35.—Smirnov, 1971b: 212-215.

The type genus is *Saycia* Sars, 1904.

Genus *Saycia* Sars, 1904

Saycia Sars, 1904a: 4-5.

Body circular in lateral view; no impression between head and rest of body. Antennule conical, not reaching the end of the acute rostrum. Antenna setae 0-0-3/1-1-3. Postabdomen short, with irregular groups of denticles. Polyembryonic.

Saycia is a monotypic genus endemic to Australasia. The type species is *Saycia cooki* (King, 1866).

***Saycia cooki* (King, 1866)**

Fig. 19

- Eurycercus cooki* King, 1866: 165-166, pl. XIII.
- Saycia orbicularis* Sars, 1904a: 3-15, figs 1-15.
- Saycia cooki*.—Smirnov, 1966: 399-340; 1971b: 212-215, figs 196-199; Frey, 1971: 254-308.

Key to Subspecies of *Saycia cooki*

- 1. Anal margin comparatively more concave. Preanal denticles comparatively less numerous (4-12) .. *S. cooki cooki* (King, 1866)
- Anal margin comparatively less concave. Preanal denticles comparatively more numerous (7-25) (New Zealand) *S. cooki novaezealandiae* Frey, 1971

***Saycia cooki cooki* (King, 1866)**

Fig. 19

Saycia cooki cooki Frey, 1971: 254-308.

Material. Vic.: 205, 206, 216, 219.

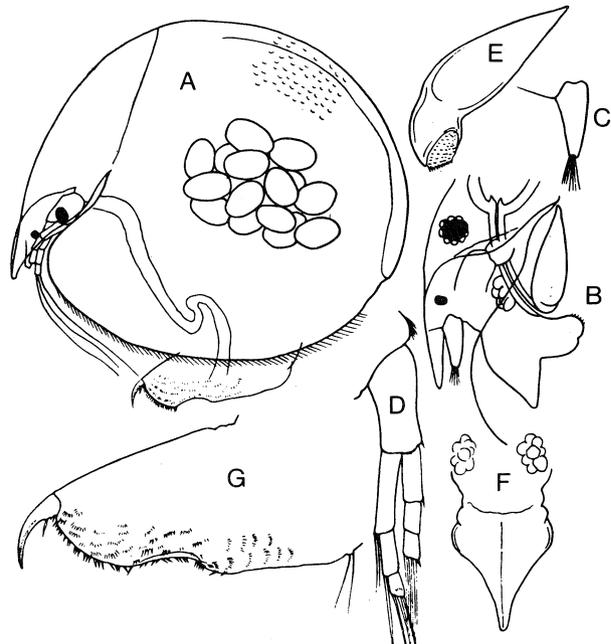


Fig. 19. *Saycia cooki* ♀, after Smirnov, 1971b. A, whole animal, length 1.7 mm; B, head; C, antennule; D, antenna; E, mandible; F, labrum; G, postabdomen.

Slides. AM ♀ P27725, ♀ ♂ head shield P27726, MGU ♀ 665, ♀ ♂ exuvium 2920, ZIN ♀ 680, 1443, ♀ ♂ 2921.

Comments. Our material is definitely *S. cooki cooki*. The New Zealand form differs morphologically and corresponds to the geographical criterion of subspecies.

Ecology. *Saycia cooki cooki* lives in temporary ponds where it is the dominant cladoceran. It is present mainly during the winter months (Morton, 1973).

Type locality. Environs of the cities of Sydney and Melbourne.

Distribution. Eastern Australia.

Subfamily CHYDORINAE Stebbing, 1902

Chydorinae Frey, 1967: 36.—Smirnov, 1971b: 215-216.

The type genus is *Chydorus* Leach, 1816.

Key to the Genera of Chydorinae

1. Parthenogenetic eggs numerous *Archepleuroxus* n.gen.
 — Parthenogenetic eggs two 2
- 2(1). Ventral margin of valve entire (i.e. no tooth or impression) 3
 — Ventral margin of valve with a tooth and an impression behind it
 (Holarctic) *Anchistropus* Sars, 1862
- 3(2). Labrum with a lamellar outgrowth 4
 — Labrum without a lamellar outgrowth *Pseudochydorus* Fryer, 1968
- 4(3). Rostrum extremely long, reflexed posteriorly *Rhynchochydorus* n.gen.
 — Rostrum relatively short 5
- 5(4). Setae on posterior half of ventral margin of valve inserted on its edge 6
 — Setae on posterior half of ventral margin of valve inserted on its inner surface 9
- 6(5). Labrum protrudes well beyond tip of the blunt rostrum *Rak* n.gen.
 — Labrum comparatively short. Rostrum acute 7
- 7(6). Height of posterior margin of valve about one third body height (if more,
 postabdomen comparatively long and slightly bent) *Pleuroxus* Baird, 1843
 — Height of posterior margin of valve about half body height 8
- 8(7). Antennule almost reaches to tip of rostrum, or protudes slightly
 beyond it *Alonella* Sars, 1862
 — Antennule does not reach tip of rostrum by about one antennule length
 (Holarctic, Ethiopian and Neotropical and recently found near Darwin by
 BVT) *Disparalona* Fryer, 1968
- 9(5). Head shield with two major head pores 10
 — Head shield with one major head pore or none 11
- 10(9). Spherical in outline. Postabdomen not oval; anal opening on its functionally
 ventral side *Chydorus* Leach, 1816
 — Oval in outline. Postabdomen oval; anal opening on its functionally
 posterior side *Dunhevedia* King, 1853
- 11(9). Head shield without head pores. Ventral margin of valve with a serrated
 infolded lobe anteriorly. Claw with two basal spines *Australochydorus* n.gen.
 — Head shield with one major head pore 12
- 12(11). Eye and ocellus extremely large. Postabdomen not elongated. Labral lamella
 with an elongated pointed apex *Dadaya* Sars, 1901
 — Eye and ocellus of moderate size. Postabdomen elongated. Labral lamella
 with a blunt apex, the tip having an impression *Monope* (Smirnov, 1977)

Archepleuroxus n.gen.

Body circular in lateral view, but ventral edge less curved. No impression between head and rest of body. Rostrum acute. Head shield rounded posteriorly and

lacking head pores. Ocellus situated closer to eye than to tip of rostrum. Antennule conical and almost reaching tip of rostrum. Antennal setae 0-0-3/1-1-3. Labral lamella with an acute apex. Mandibular articulation of chydorine type.

Thoracic limbs of chydorine type, corresponding in structure to that of the type for this subfamily—*Chydorus*. Limbs different from those of *Saycia* (Sayciinae). Exopodite of limb II with 7 setae. Post-abdomen rounded distally, with anal aperture opening on middle of dorsal side. Polyembryonic.

The name is derived from *Pleuroxus* because of its external similarity, and “Arche” (Greek—origin) implying the presence of some primitive features. The gender is masculine. *Archepleuroxus* is a link in the series *Saycia*–*Archepleuroxus*–*Pleuroxus jugosus*–*Pleuroxus*–*Alonella*–specialized Chydorinae genera.

Archepleuroxus is a monotypic genus endemic to Australia. The type species is *Archepleuroxus baylyi* n.sp.

Archepleuroxus baylyi n.sp.

Fig. 20

Material. Vic.: 210, 213, Tas.: 296, 297, 311, 315, 318, 323, 331, W.A.: 416.

Holotype. AM ♀ P27684.

Paratypes. MGU ♀ 2903, ZIN ♀ 2905, BM ♀ 1980.358, DF ♀ 2906, MNHB ♀ 2910.

Slides. MGU ♀ 2901, 2902, 2903.

Female. Body approximately circular in lateral view. Posterior corners of valves rounded, and in some females denticles present on ventro-posterior corner. Setae of ventral margin of valve situated along its edge. Shell brownish and granulated. Rostrum acute. Head shield rounded posteriorly and lacking head pores. Antennule conical and almost reaching tip of rostrum; its sensory papillae rather long and of uniform length. Antennal setae 0-0-3/1-1-3, and spines 0-0-1/0-0-1; its basal segments with a few transverse rows of denticles. Labrum lamella elongated with an acute apex.

Thoracic limb I with three setae on external branch of its endite. One short; the two long ones unspecialized and similar to the long seta of exopodite. Internal branch of endite with three groups of four setae. Limb II with a big endopodite bearing a row of 8 stiff setae, unspecialized, but of various sizes. Its gnathobase with 7 setae and also short apical ones. Limb III with two rows of setae on its endite, 8 gnathobasic setae, and apical setae on the gnathobase. Its exopodite with 7 setae. Exopodite of limb IV with 7 setae, of limb V, 4 setae.

Postabdomen rounded in its distal part; anal aperture opening in middle of its dorsal side. Its postanal margin with groups of teeth and anal margin with groups of smaller teeth, which pass into groups of setae proximally. Claw with two basal spines.

Intestine convoluted. Ocellus smaller than eye, and situated closer to eye than to tip of rostrum.

Archepleuroxus baylyi is polyembryonic. In the holotypic female there are 22 embryos (and probably more as some may have been lost).

Length. 1.14 mm (holotype P27684). The other size characteristics of the type population (from a pool near

Yunderup, W.A.) are: juvenile females (minimum length) 0.33 mm, minimum length of females with embryos 0.38 mm (such females have only two embryos). Egg diameter is 0.12 mm, which is about 14% of female mean length, and length of developed embryos is about 0.25 mm, which is 1/3 of female mean length.

Male. Unknown.

Ecology. *Archepleuroxus baylyi* typically lives in temporary ponds, but is occasionally found in the littoral of permanent lakes and farm dams. Most records are from winter and spring. In a pool near Oatlands, Tas., it was found under ice.

Type locality. A pool near Yunderup, W.A. (Loc. No.416).

Etymology. The species is named after Dr I.A.E. Bayly, of Monash University.

Distribution. Southern Australia.

Differential diagnosis. *Archepleuroxus baylyi* is a polyembryonic *Pleuroxus*-like chydorid. It differs from *Pleuroxus* (including the very similar *P. jugosus*) by the polyembryonic condition. Externally it is similar to *Saycia*, but its rounded postabdomen, position of the anal aperture and structure of the thoracic limbs distinguishes it.

Genus *Pleuroxus* Baird, 1843

Subgenus *Pleuroxus* Baird, 1843: 93.

Pleuroxus.—Smirnov, 1966b: 161-194; 1971b: 217-258.

The setae of the ventral margin of the valve are situated on its edge along its whole length, this feature being shared also by *Alonella* and *Disparalona*. However, *Pleuroxus* can be distinguished from these genera in that the distance between the posterior major head pore and the hind margin of the head shield is greater than the distance between the two major head pores, whereas in *Alonella* and *Disparalona* it is shorter.

The type species is *Pleuroxus aduncus* (Jurine, 1820).

Key to Australian Species of *Pleuroxus*

1. Ventro-posterior corner of valve angular, with denticles 1
 - Ventro-posterior corner of valve widely rounded, without denticles *P. inermis* Sars, 1896
- 2(1). Large (0.74 mm), high, keeled, and heavily chitinized (brownish) *P. jugosus* (Henry, 1922)
 - Smaller (0.6 mm), not so high and less chitinized 3
- 3(2). Postabdominal anal teeth small and irregular; distal end of postabdomen rounded *P. aduncus* (Jurine, 1820)
 - Postabdominal anal teeth comparatively large and regular 4

- 4(3). 8-12 anal teeth, four distal ones noticeably larger
 *P. denticulatus* Birge, 1879
- 14-16 anal teeth, size gradually increasing distally *P. similis* Vavra, 1900

Pleuroxus jugosus (Henry, 1922) n.comb.
 Figs 21, 22

Chydorus jugosus Henry, 1922: 46, pl. VII, figs 5, 5A.

Material. N.S.W.: 133, 137, 138, 140, 141, 145, 167. Tas.: 334. W.A.: 417, 420, 423.



Fig. 20. *Archepleuroxus baylyi* ♀, temporary pool near Yunderup, W.A., 17.viii.1973. A, whole animal, length 1.14 mm, from holotype AMP 27684, also showing the ventro-posterior corners of the shell of the specimen on slide 2905 (paratype); B, postabdomen, slide 2902; C, labrum and antennule, slide 2902; D, antenna, slide 2901; E, thoracic limb I, slide 2903; F, limb II, slide 2901; G, limb III, slide 2901; H, limb IV, slide 2901; I, limb V, slide 2902.

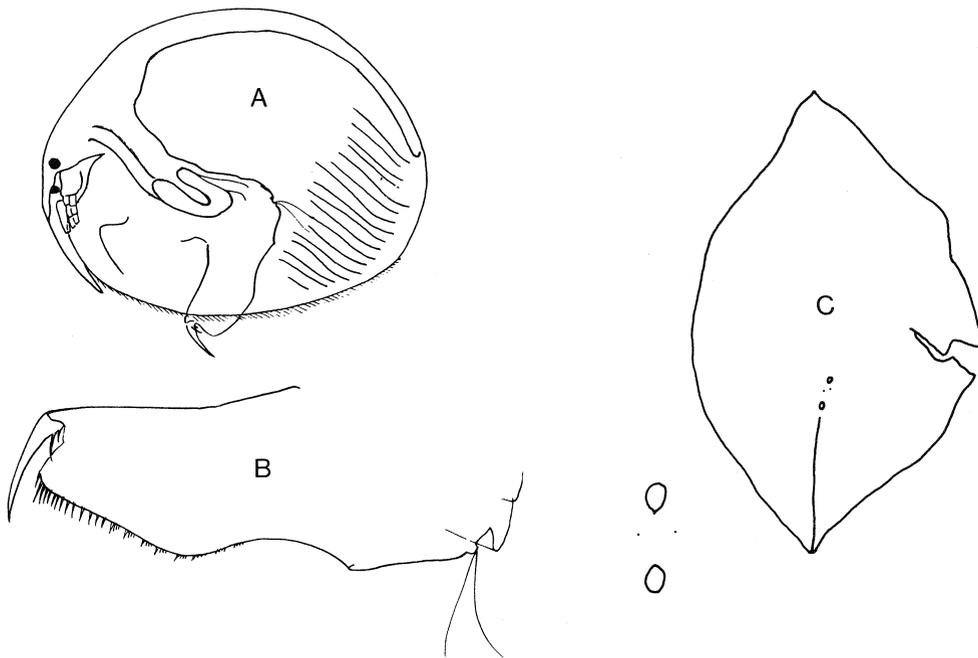


Fig. 21. *Pleuroxus jugosus* ♀, pool on Muirillup Rock, near Northcliffe, W.A., 18.vi.77. A, whole animal, length 0.81 mm, slide 2803; B, postabdomen, slide 2803; C, head shield and head pores, slide 2198.

Holotype. "P:5889 *Chydorus jugosus* Henry (type). Loc.: Holbrook" in the Australian Museum.

Slides. AM ♀ P27723, MGU ♀ 2803, ephippial ♀ 2808 ♂ 2196, ZIN ♀ 2804.

Comment. Since the type specimen has definite *Pleuroxus* characters, (namely the distance between the posterior head pore and the hind margin of the head shield is greater than the distance between the two major head pores and all the ventral setae of the valve are situated on its edge), it is concluded that this taxon belongs to that genus.

Female. Head shield expressly convex with both anterior and posterior ends angular and pointed; keeled behind posterior head pore and finely punctate. Distance behind posterior head pore exceeds interpore distance several times. Minor head pores very small.

Length. 0.81 mm.

Mas novus. Lines on valve more expressed anteriorly; its ventral edge straight in anterior part; small denticles on its ventro-posterior corner. Thoracic limb I with a chitinized hook. Tip of rostrum bears two spines (a structure not described for any other cladoceran). Postabdomen elongated and without pre-anal and post-anal angles. Anal teeth arranged proximally into about 4 groups and distally into about 7 single teeth.

Length. 0.61 mm.

Ecology. Commonly benthic in gritty or silted sand.

Type locality. Holbrook (N.S.W.)

Distribution. Isolated areas of N.S.W. (mainly southern tablelands and slopes), midland Tas. and south-western W.A.

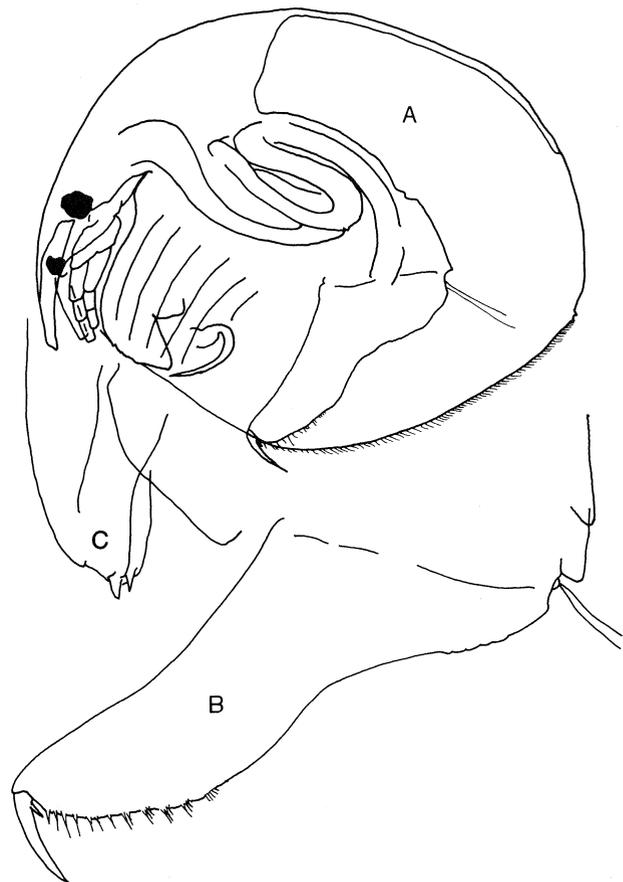


Fig. 22. *Pleuroxus jugosus* ♂, pool on Muirillup Rock, near Northcliffe, W.A., 18.vi.77. A, whole animal, length 0.61 mm; B, postabdomen; C, tip of rostrum. (Both from slide 2196.)

Differential diagnosis. Female has a high body and is large and brown. The valve is roughly lineated (i.e. with widely spaced lines). There is a dorsal keel on the shell, partly advancing onto the posterior part of the head shield. The postabdomen is long, narrowing slightly distally. It is superficially similar to *Archepleuroxus baylyi*, but the latter is polyembryonic whereas two is the maximum number of embryos in *P. jugosus*.

Pleuroxus aduncus (Jurine, 1820)

Fig. 23

Monoculus aduncus Jurine, 1820: 152-153, t.15, figs 7, 8.
Alonella nasuta Smith, 1909: 84, pl. 16, figs 4, 5; n. syn.
Chydorus denticulatus Henry, 1919: 480-481, pl. XLII, fig. 15, 16.

Chydorus unispinus Henry, 1922: 46, pl. VIII, figs 4, 4A; n. syn.

Pleuroxus aduncus.—Harding, 1955: 348-350, figs 83-92; Smirnov, 1971b: 220-225, figs 201-206.

Material. Qld.: 52. N.S.W.: 94, 126, 131, 132, 133, 135, 137, 143, 144, 153, 155, 156, 160, 165, 184, 187. Vic.: 207, 208, 210, 216, 218, 230, 236, 238, 242, 246, 249, 251, 254, 255, 259, 260, 261. Tas.: 320, 321, 322, 326, 327, 329, 330, 332, 333, 336, 337, 339. S.A.: 361, 367, 368, 370, 374, 376, 378, 382, 385, 388, 389, 392. W.A.: 415.

Slides: AM ♀ P27721, MGU ♀ 995, 1225, 1591, (intestine packed with diatoms), ZIN ♀ 1590.

Comment. A study of the type slides in the Australian Museum of *Pleuroxus denticulatus* Henry, 1919 ("P: 4334, University Pond") and *Chydorus unispinus* ("P: 5892 Loc. Botany") showed that these taxa are synonyms of *Pleuroxus aduncus*. In addition *Alonella nasuta*, 1909, most probably belongs to *Pleuroxus aduncus sensu lato* by reason of its long rostrum, general outline, form, and indentation and the postabdomen.

Female. Postabdomen comparatively short; anal teeth small and irregular. Ventro-posterior corner of

valve with denticles of various forms. Surface of valve variously sculptured, but usually faintly. This is a polymorphic species or a complex of related forms requiring further study (see Harding, 1955). A key to subspecies has been suggested by Smirnov (1971b).

A female having an abnormal labrum with an elongated tip was found in a sample from Victoria (Fig. 23b).

Length. Up to 0.66 mm.

Ecology. *P. aduncus* is known from variety of water types, including temporary localities and slightly saline waters (salinity up to 2.9‰). In both Borumba Reservoir and Lake Purrumbete it occurs throughout the year (Timms, 1973; Timms and Midgley, 1969). In the latter site it was most common in *Scirpus* weedbeds.

Distribution. *P. aduncus* is a southern Australian species (southern N.S.W., Vic., Tas., S.A., south-west W.A.) with isolated occurrences in northern N.S.W. and southern Qld.

Differential diagnosis. *P. aduncus* differs from other species of *Pleuroxus* in having a postabdomen which is rounded distally and armed with small irregular anal teeth. The denticles of the ventro-posterior corner of the valve are small, variable, and sometimes absent.

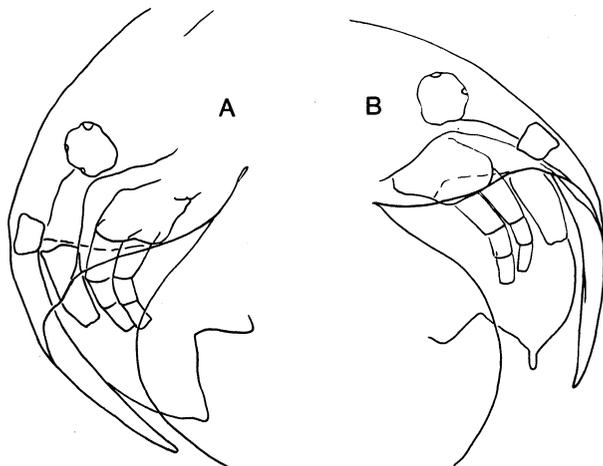


Fig. 23. *Pleuroxus aduncus* ♀, Sheepwash Lag., via Nelson, Vic., 11.viii.72. A, head, slide 1225; B, head of a modified ♀, slide 995.

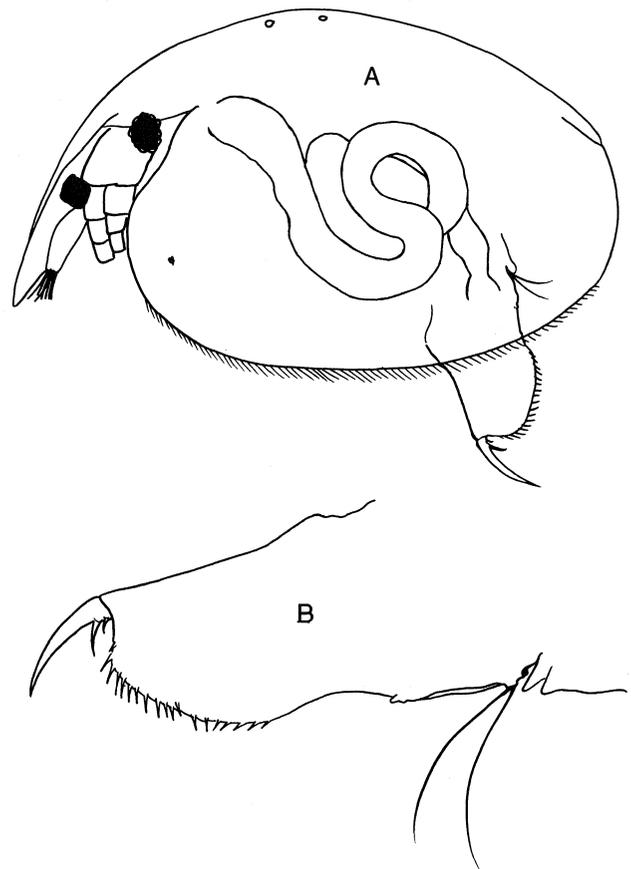


Fig. 24. *Pleuroxus inermis* ♀, Murray River at Mannum, S.A., 24.iii.78. A, whole animal, length 0.43 m; B, postabdomen. (Both from slide 3080.)

Pleuroxus inermis Sars, 1896

Fig. 24

Pleuroxus inermis Sars, 1896: 31-35, pl. 5, figs. 8, 9.—Henry, 1922: 44-45; Smirnov, 1971b: 221 (attributed to *Pleuroxus aduncus sensu lato*).

Material. S.A.: 394.

Slides. MGU ♀ 3078, 3077, ZIN ♀ 3079.

Female. Body oval in lateral view. Posterior corners of valves rounded; ventro-posterior corner without denticles. Rostrum acute. Antennule not reaching tip of rostrum.

Postabdomen narrows distally; its preanal angle not prominent. Anal margin slightly concave; postanal margin with numerous thin anal teeth. Intestine convoluted. Ocellus smaller than eye and sited slightly closer to eye than to tip of rostrum.

Length. 0.43 mm.

Male. Unknown.

Distribution. Lower Murray River.

Differential diagnosis. *Pleuroxus inermis* is characterized by the rounded posterior corners of the valve, lack of denticles on ventro-posterior corner of valve, and the numerous thin anal teeth of the postabdomen. It is similar to the Holarctic *Pleuroxus pigroides* Lilljeborg (Frey, 1976), but differs from the latter by its non-protruding preanal angle.

Pleuroxus denticulatus Birge, 1879

Fig. 25

Pleuroxus denticulatus Birge, 1879: 20-21, pl. I, fig. 21.—Smirnov, 1971b: 231, fig. 220.

Non *Chydorus denticulatus* Henry, 1919.

Material. Qld.: 16, 39, 41. N.S.W.: 77, 81, 85, 86. Vic.: 203.

Slides. AM ♀ P27722, MGU ♀ 1901, ZIN ♀ 2297.

Comments. This species may be polymorphic, as according to Flössner and Kraus (1977: 470-471) "the female from New South Wales illustrated by Smirnov (1971b) cannot be considered as typical, because it differs from our specimens in the polygonal reticulation of the shell, the shape of the distal-dorsal angle of the postabdomen, and the minute proximal basal spine of the postabdominal claw. Most likely this is a separate subspecies."

Length. 0.6 mm.

Distribution. Sparsely distributed in eastern Qld, N.S.W. and Vic.

Differential diagnosis. The postabdomen of the female is truncate; its width is about 4 times the width of the claw. The anal teeth are large, with the distal ones grouped on the dorsal angle of the postabdomen. The postabdomen of *P. laevis* is comparatively longer; its width in the distal part is much less than 4 times the width of the claw. In *P. laevis* there is a denticle on the

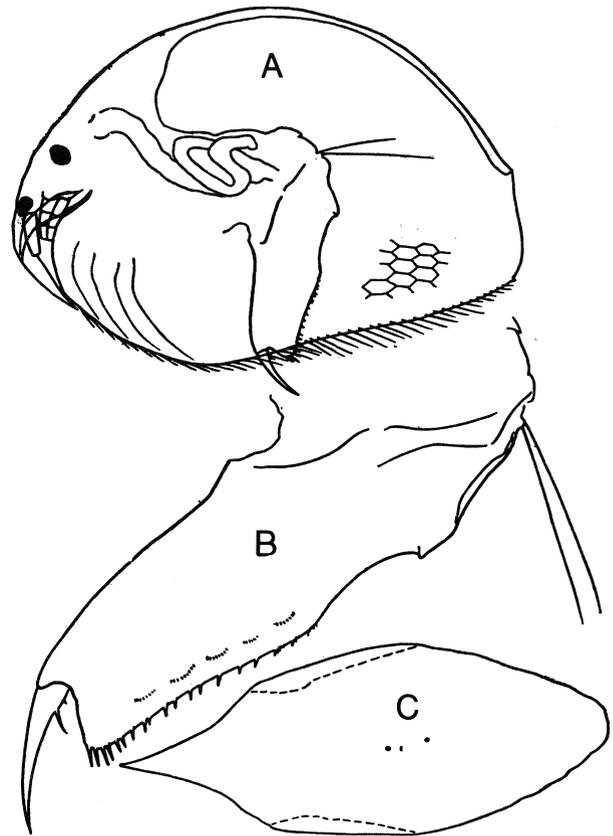


Fig. 25. *Pleuroxus denticulatus* ♀, after Smirnov, 1971b. A, whole animal, length 0.6 mm; B, postabdomen; C, head shield.

ventro-posterior corner of the valve, while in *P. denticulatus* there are commonly several denticles situated on the vertex of this corner.

Pleuroxus similis Vavra, 1900

Pleuroxus similis Vavra, 1900: 23-24, fig. 6.—Smirnov, 1971b: 231, figs. 218, 219.

Pleuroxus australis Henry, 1922: 45, pl. VII, fig. 3.

Material. Type slide of *Pleuroxus australis* in the Australian Museum "P: 5893 *Pleuroxus australis* Henry (Type). Loc. Bangalow."

Length. 0.5 mm.

Distribution. Known only from coastal northern N.S.W. in Australia; elsewhere in the world it is found in southern U.S.S.R. and in Chile.

Differential diagnosis. The postabdomen is truncated, slightly narrowing distally, and the anal teeth are comparatively large, regularly diminishing proximally. Overall it is brownish and rather small.

Incertae sedis

Eurycercus cunninghami King, 1853b: 257, pl. VIIA.—Sars, 1888: 69 (*Kingia*).

Genus *Alonella* Sars, 1862

Alonella Sars, 1862b: 300-301.—Smirnov 1971b: 258-259

Posterior margin of body high in comparison with body height. Head pores located near posterior margin of head shield. All setae of ventral border of valve originate from its edge.

The type species is *Alonella excisa* (Fischer, 1854).

Key to Australian Species of *Alonella*

1. Polygons of valve reticulation with fine longitudinal striations 2
- Polygons without such striations *A. exigua* (Lilljeborg, 1853)
- 2(1). Ventro-posterior corner of valve with few blunt indentations. Postabdomen comparatively short *A. excisa* (Fischer, 1854)
- Ventro-posterior corner of valve without indentations; corner right-angled or rounded. Postabdomen comparatively elongated *A. clathratula* Sars, 1896

***Alonella excisa* (Fischer, 1854)**

Lynceus excisus Fischer, 1854: 428-429, tab. 3, figs 11-14.
Alonella excisa.—Lilljeborg, 1900: 510-513, tab. LXXII, figs 9-19.

Material. Qld.: 37, 41, 43, 48, 49, 51, 55. N.S.W.: 76, 81, 82, 89, 93, 176. Vic.: 222, 225, 232, 259, 260, 261. Tas.: 301, 303, 309, 314. S.A.: 369, 372, 388. W.A.: 421.

Slides. AM ♀ P27694, P27695, MGU ♀ 909, ZIN ♀ 1943.

Length. 0.45 mm.

Ecology. In various waters, but rarely in acid dune lakes.

Distribution. Widespread in Australia.

Differential diagnosis. *A. excisa* is similar to *A. clathratula* in having striated polygons on the valve, but it differs because it has blunt indentations on the ventro-posterior corner of the valve.

***Alonella clathratula* Sars, 1896**

Fig. 26

Alonella clathratula Sars, 1896: 43-45, pl. 6, figs 7-8.—Henry, 1922: 48.

Alonella excisa var. *clathratula*.—Delachaux, 1919: 31, pl. III, fig. 6.

Material. Qld.: 12, 13. N.S.W.: 79, 83, 91, 93, 96, 97, 98, 99, 100, 125. W.A.: 421, 425, 426.

Slides. AM ♀ P27693, MGU ♀ 2702, ZIN ♀ 2703.

Comments. Contrary to Delachaux's (1919) opinion, we now prefer the original status for it, as suggested by Sars (1896).

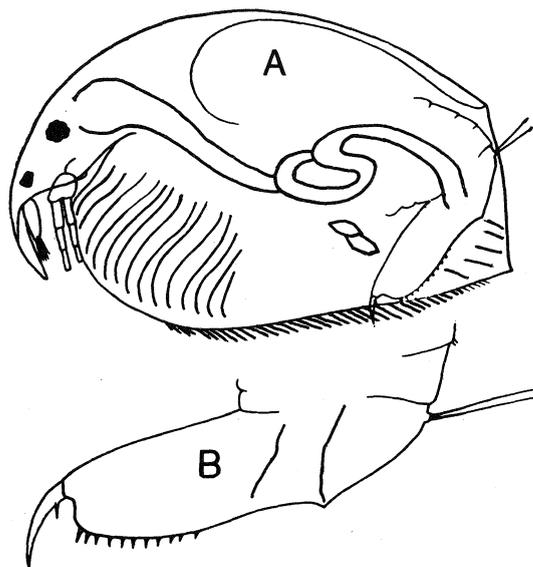


Fig. 26. *Alonella clathratula* ♀, after Smirnov, 1971b. A, whole animal, length 0.36 mm; B, postabdomen.

Length. Sars (1896) indicates a length of up to 0.36 mm, but a population from W.A. (No. 426) consisted of large individuals up to 0.49 mm.

Ecology. *A. clathratula* is most likely to be found in very acid (pH 3.5-5.0) coastal dune lakes, or similar acid waters in adjacent areas.

Type locality. Maroubra Swamp, Sydney (since drained).

Distribution. Eastern areas of Qld, N.S.W., and in south-west W.A.; also in southern Africa and South America.

Differential diagnosis. *A. clathratula* is readily distinguishable from *A. excisa* by comparatively more elongated valve and postabdomen, and by the lack of indentations at the ventro-posterior corner of the valve. The latter is right-angled or rounded.

***Alonella exigua* (Lilljeborg, 1853)**

Lynceus exiguus Lilljeborg, 1853: 79, tab. VII, figs 9, 10.
Alonella exigua.—P.E. Müller, 1867: 187-188, tab. IV, figs 16, 17.

Material. N.S.W.: 88.

Comments. *Pleuroxus reticulatus* Henry, 1919: 478-479, pl. XLII, figs 13, 14, seems similar to *Alonella exigua*. However the holotype mentioned by Henry (Australian Museum N.P. 4333) has the surface of the carapace marked by reticulate sculpturing and minute pitting, so it is actually *Monope reticulata* (see later). In *A. exigua* there are no striations on the polygons of the shell (Fryer, 1968).

Length. 0.42 mm

Distribution. Known only from one swamp (since drained) near Kempsey, N.S.W., but widespread in Holarctic.

Differential diagnosis. There are no striations on the polygons of the valve.

Nomen dubium

Alonella propinqua Smith, 1909: 84, pl. 16, figs 6, 7

Rak n. gen.

Exopodite of thoracic limb IV with 7 setae. Head shield with one major head pore and broadly rounded anteriorly and posteriorly. Setae of ventral margin of valve situated on its edge, typically for its whole length. Antennule does not reach tip of rostrum, but lamellar outgrowth of labrum protrudes well beyond it. Mandibular articulation is of the Chydorinae type.

The name is derived from the Russian word for crustacean. The gender of the name is masculine.

The type species is *Rak obtusus* n. sp.

Key to Species of Rak

1. Blunt indentation on labrum
 *R. obtusus* n. sp.
 — Labrum entire *R. labrosus* n. sp.

***Rak obtusus* n. sp.**

Fig. 27

Material. N.S.W.: 81, 96, 98, 99, 100, W.A.: 426.

Holotype. AM ♀ P27698.

Paratypes. MGU ♀ 2841, ZIN ♀ 2842.

Slides. MGU ♀ 2848, 2849, 2850.

Female. Body in lateral view oval, length not much exceeding height. Dorso-posterior corner of shell just apparent. Ventro-posterior corner of valve rounded and usually with a denticle (absent on right valve of the paratype 2841). Setae of ventral border of valve situated

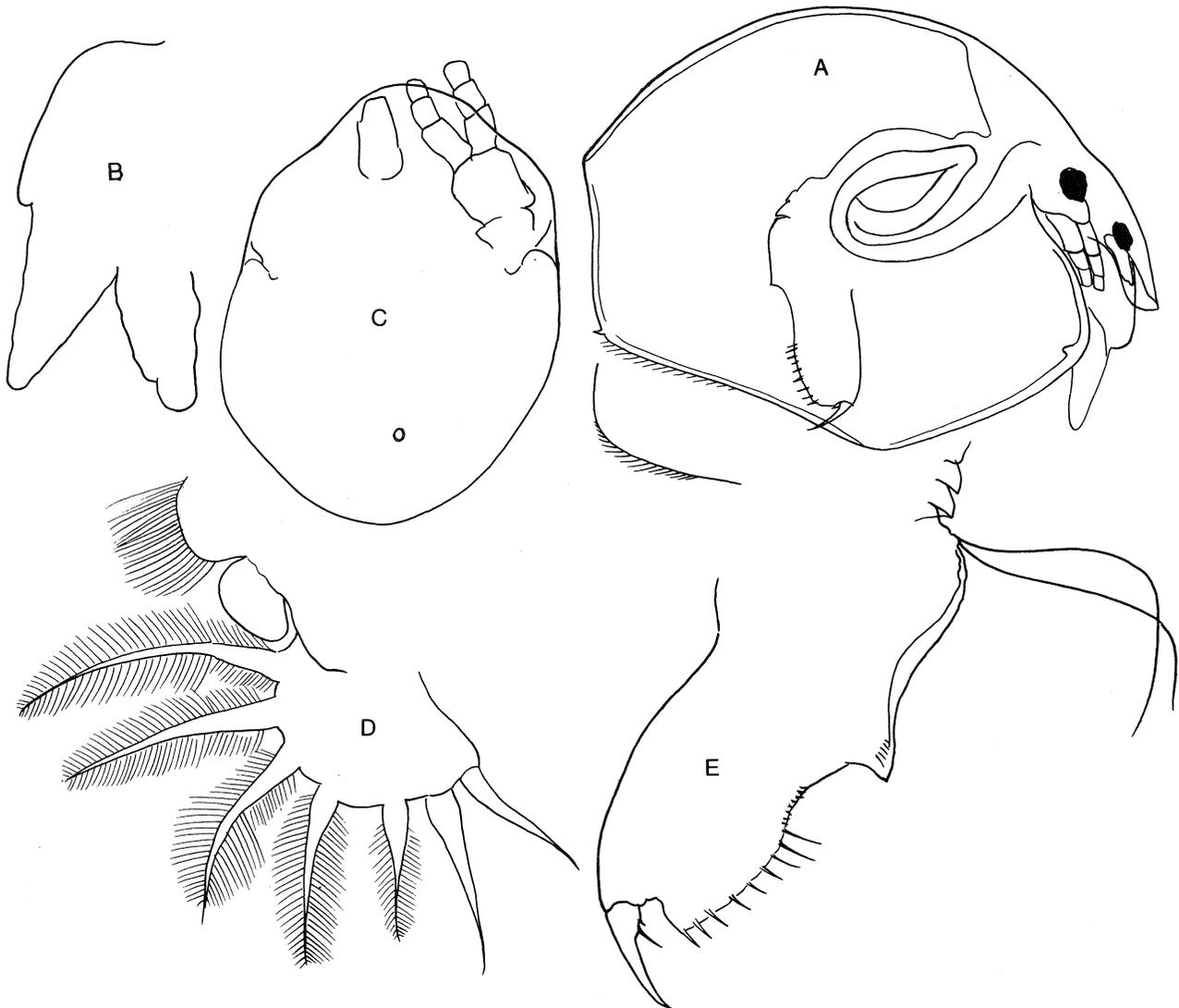


Fig. 27. *Rak obtusus* ♀, swamp near Sugar Point, The Broadwater, Myall Lakes, N.S.W., 13.iv.75. A, lateral view of whole animal, length 0.26 mm, slide 2841; B, labrum, slide 2848; C, head shield, slide 2849; D, limb IV, slide 2848; E, postabdomen, slide 2850.

along its edge. Rostrum blunt. Ocellus situated between eye and tip of rostrum. Posterior end of head shield rounded. One head pore. Shell sculpture hardly visible.

Lamella of labrum unusual: apex blunt and a blunt indentation in middle of its front margin. Above this indentation, labrum noticeably more chitinized than below, where a lateral keel reaches to front edge of labral lamella. Antennule thick and short, not reaching to tip of rostrum. Exopodite of thoracic limb IV with 7 setae. Epipodites of legs I-IV lack outgrowths.

Postabdomen not elongated; its ventral margin convex, with anal edge concave, so that preanal angle protrudes noticeably. Distal side of postabdomen with a depression near base of claw.

Anal edge with small setae. About 9 anal teeth, which increase in size proximally.

Intestine convoluted.

Length. 0.26 mm (Holotype P27698).

Male. Unknown.

Ecology. *R. obtusus* lives amongst dense emergent vegetation in acid lakes on coastal sand dunes. It is active, swimming often from place to place. While on substrata all thoracic limbs move, otherwise they do not. It often simulates death.

Type locality. A dune swamp just inland from Sugar Point, The Broadwater, Myall Lakes National Park, N.S.W.

Distribution. In coastal dune lakes of north-eastern N.S.W.; isolated in W.A.

Differential diagnosis. The labral lamella has a blunt apex and a blunt indentation on the middle of its anterior edge. The setae of the ventral margin of the valve are all situated on its edge. There is one head pore. Adult size is relatively small (c. 0.26 mm).

***Rak labrosus* n. sp.**

Fig. 28

Material. Vic.: 204. Tas.: 314. S.A.: 372, 374. W.A.: 412.

Holotype. AM ♀ P27697.

Paratypes. MGU ♀ 2970, ZIN ♀ 2971.

Slide. MGU ♀ 2973.

Female. Body globular. Denticle on ventro-posterior corner of valves not always present—in paratype 2970 it is absent on the left valve, but present on the right; in holotype ♀ P27697 and ♀ 2973 both corners have a denticle, but in paratype ♀ 2971 only the left side has one. Setae of ventral border of valve situated along its edge, but at its end they pass, just slightly, onto the inner surface of valve. Rostrum blunt. One head pore.

Lamella of labrum large with an elongated, but blunt apex. No indentations on its edge. In the population from Loc. No. 374 the edge of the labral lamella is somewhat concave in the middle, while in the typical population (Loc. No. 372) it is evenly convex.

Postabdomen comparatively short, the preanal angle protruding.

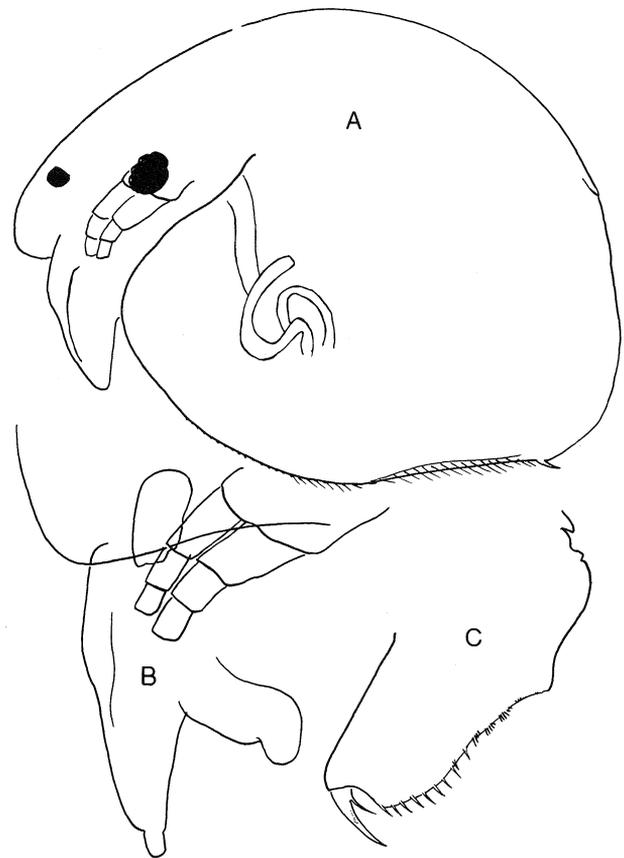


Fig. 28. *Rak labrosus* ♀, Edwards Lag., Kangaroo I., S.A., 8.i.76. A, lateral view of whole animal, length 0.27 mm, slide 2970, pond near Forrestdale, W.A., 17.viii.73; B, labrum, slide 2973; C, postabdomen, slide 2973.

Length. 0.27 mm (holotype P27897).

Male. Unknown.

Type locality. Edwards Lagoon, Kangaroo Island, S.A.

Distribution. Southern coastal areas of Vic., S.A., and W.A.; also in Tas.

Differential diagnosis. The labral lamella is large; it has an elongated blunt apex. There are no indentations on the edge of the labrum, but it may be concave at its middle. The setae on the posterior end of the ventral margin of the valve pass just slightly onto its inner surface. The postabdomen is comparatively short. Adult size is relatively small (c. 0.27 mm).

Genus *Chydorus* Leach, 1816

Chydorus Leach, 1816: 406.—Smirnov, 1971b: 277-79.

This and the following genera differ from *Pleuroxus*, *Alonella* and *Rak* in that the ventral setae of the valve are inserted on the inner surface of the valve in its posterior half instead of on its edge. As Fryer (1968) notes, the species of *Chydorus* exploit the globular form.

The status of *Chydorus* species has been recently described by Frey, 1980.

The type species is *Chydorus sphaericus* (O.F. Müller, 1785).

Key to Australian Species of *Chydorus*

1. Labrum indented 2
— Labrum not indented 3
- 2(1). Labrum with several denticles
(serrations) *C. barroisi* (Richard, 1894)
— Labrum with one big tooth
..... *C. hybridus* Daday, 1905
- 3(1). Apex of labrum rounded
..... *C. eurynotus* Sars, 1901
— Apex of labrum acute 4
- 4(3). Apex of labrum elongated 5
— Apex of labrum not elongated
..... *C. clelandi* Henry, 1919
- 5(4). Valves smooth or marked in polygons
with straight borders
..... *C. sphaericus* (O.F. Müller, 1785)
— Valves marked in polygons with sinuate
borders *C. herrmanni* Brehm, 1933

Chydorus sphaericus (O.F. Müller, 1785)

Fig. 29

Lynceus sphaericus O.F. Müller, 1785: 71-72, tab. IX, figs 7-9.
Chydorus sphaericus.—Baird, 1843: 89-90, pl. II, figs 11-13;
Smirnov, 1971b: 279-280.

Material. *Qld*: 56, 57, 58, 65, 66. *N.S.W.*: 77, 82, 85, 87, 102, 103, 104, 105, 106, 108, 109, 110, 111, 112, 113, 114, 115, 117, 121, 125, 128, 129, 132, 133, 142, 147, 148, 166, 168, 171, 172, 182, 184. *Vic.*: 201, 202, 204, 208, 218, 222, 227, 229, 232, 236, 237, 238, 241, 245, 249, 252, 255, 256, 257, 260, 261. *Tas.*: 292, 293, 294, 301, 302, 303, 305, 306, 307, 309, 310, 312, 313, 314, 315, 317, 324, 325, 328, 329, 330, 335, 339. *S.A.*: 362, 365, 366, 367, 369, 382, 383, 384, 388, 389, 391. *W.A.*: 406, 407, 411, 419.

Slides. AM ♀ P27713, MGU ♀ 1684, ZIN ♀ 574.

Comments. *Chydorus sphaericus* is polymorphic and a key to subspecies is available (Smirnov, 1971b). Although we have not delineated subspecies in this review, we report the presence of the distinctive form *Chydorus sphaericus alexandrovi* Poggenpol, 1874 from Locs Nos 117 and 369. This form is characterized by an expressed polygonal sculpture of the valves and by its small size (0.32 mm).

Length. Up to 0.6 mm.

Ecology. This species lives in a wide range of environmental conditions and is often the dominant littoral cladoceran. Its numbers fluctuate seasonally—in L. Purrumbete it is uncommon during late summer and autumn and blooms in spring–early summer (Timms, 1973). When it is common in the littoral it may appear

in the limnetic region, either clinging to algal filaments (Fryer, 1968), or swimming freely (Timms, 1973).

Distribution. Widespread in Australia, but apparently absent from tropical and adjacent areas.

Differential diagnosis. Body form is globular, with the ventro-posterior corner of the valve lacking denticles. The surface of the shell is smooth or has polygons with straight borders. The labrum is elongated and pointed; the labral lamella lacks serrations. The sensory papillae of the antennule are all placed at its end.

Chydorus herrmanni Brehm, 1933

Chydorus herrmanni Brehm, 1933: 759-761, figs 48-53.—Frey, 1980: 98-99.

Material. *Qld*: 56.

Distribution. Known only from one site in southern Qld, but it could occur in tropical Australia as it is known from warm areas elsewhere (Smirnov, 1971b).

Differential diagnosis. It is very similar to *C. sphaericus*, but differs in that the polygons of the shell have sinuate borders.

Chydorus eurynotus Sars, 1901

Chydorus eurynotus Sars, 1901: 70, pl. II, fig. 3a-c.—Paggi, 1972: 224-229.

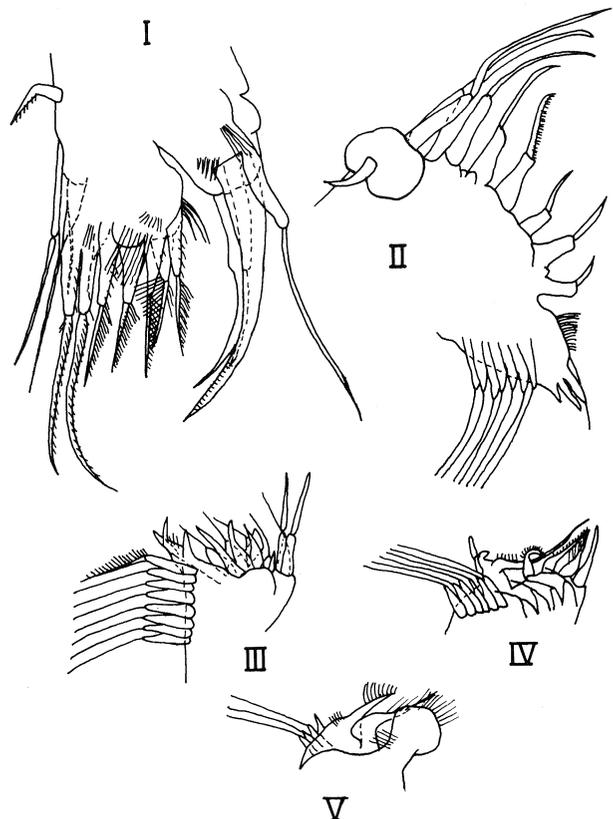


Fig. 29. *Chydorus sphaericus* ♀, thoracic limbs I-V, after Hann.

Comments. Petkovski (1973: 146-152, figs 28-30, 33-35) ascribes specimens of this taxon, found in Clybucca Swamp, via Kempsey, N.S.W., to *C. kallipigos* Brehm, 1934. However, *C. kallipigos* has a wide blunt labrum without a concave depression at its tip, whereas in *C. eurynotus* the blunt labrum is slightly concave at its tip. All our specimens are very similar to *C. eurynotus* described in detail by Paggi (1972).

Length. Up to 0.47 mm.

Differential diagnosis. Body form is globular, with the ventro-posterior corner of the valve lacking denticles. The labrum is blunt, slightly concave at its tip and with no serrations.

Key to Australian Subspecies of *Chydorus eurynotus*

1. Valve slightly reticulated, without depressions
 *C. eurynotus eurynotus* Sars, 1901
 — Valve with depressions
 *C. eurynotus caelatus* Smirnov, 1971

Chydorus eurynotus eurynotus Sars, 1901

Fig. 30

Chydorus eurynotus eurynotus Sars, 1901: 70, pl. 11, fig. 3a-c.

—Paggi, 1972: 224-226, Lam. I, II.

Chydorus denticulatus Gurney, 1927: 76-77, fig. 11.

Material. *Qld*: 4, 5, 10, 11, 12, 19, 20, 21, 23, 25, 27, 28, 29, 31, 33, 34, 35, 36, 37, 38, 40, 42, 43, 45, 51, 52, 54, 56, 57, 59, 62, 64. *N.S.W.*: 80, 87, 89, 90, 92, 93, 95, 112, 117, 119, 126, 127, 128, 131, 176. *Vic.*: 221, 222, 225, 249.

Slides. AM ♀ P27710, MGU ♀ 1578, ZIN ♀ 1579.

Ecology. Like *C. sphaericus*, *C. eurynotus* occurs in a variety of waters, but mainly in warmer localities. It has been studied in Borumba Dam (Qld), where it is most common between February and August and is absent in summer (Timms and Midgley, 1969). It also strays into the limnetic region (Timms, 1970b).

Distribution. Mainly in Qld and coastal N.S.W.; also in inland N.S.W. and Vic.

Differential diagnosis. The shell surface is slightly reticulated and with no depressions.

Chydorus eurynotus caelatus Smirnov, 1971b

Fig. 31

Chydorus eurynotus caelatus Smirnov, 1971b: 309, fig. 342.

Material. *Qld*: 13, 44.

Holotype. AM ♀ P27711.

Paratypes. MGU ♀ 1749, ZIN ♀ 1756.

Type locality. Farm dam near Gayndah, Qld.

Distribution. Qld.

Differential diagnosis. The shell has depressions.

Chydorus clelandi Henry, 1919

Chydorus clelandi Henry, 1919: 481-482, pl. XLII, figs 17, 18.

Material. Holotype N P:4335 (Kendall) in the Australian Museum.

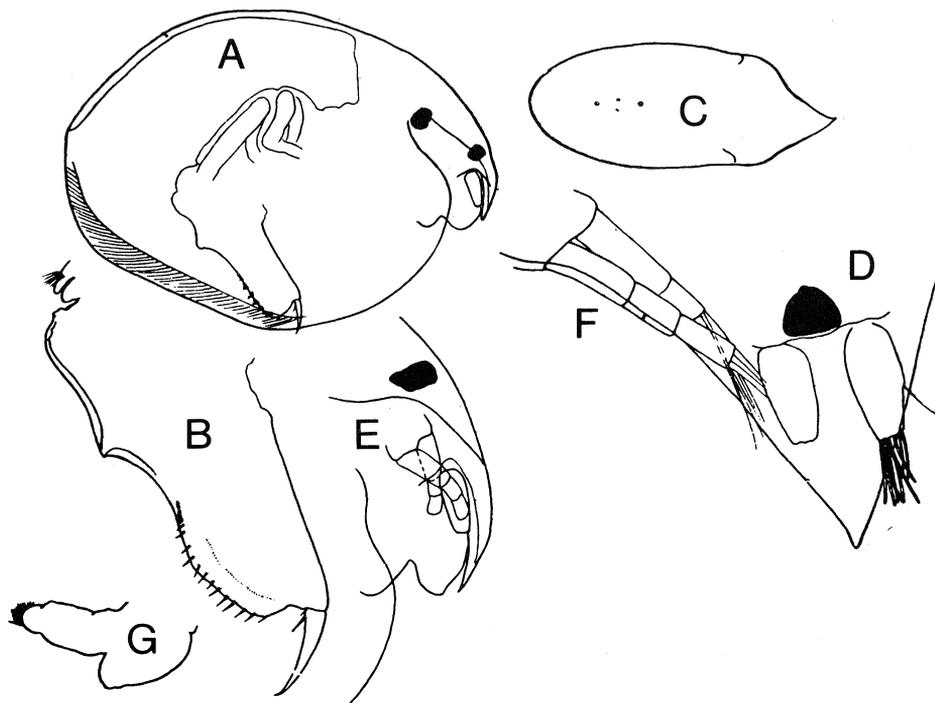


Fig. 30. *Chydorus eurynotus eurynotus* ♀, after Smirnov, 1971b. A, whole animal, length 0.3 mm; B, postabdomen; C, head shield; D, anterior view of rostrum; E, head; F, antennule; G, labrum.

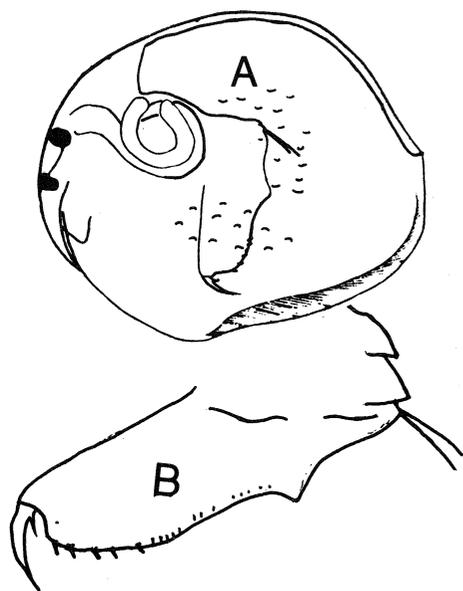


Fig. 31. *Chydorus eurynotus caelatus* ♀, after Smirnov, 1971b. A, whole animal, length 0.33 mm; B, postabdomen.

Male. Unknown.

Type locality. Ponds at Kendall, Sydney, Lett River, N.S.W.

Distribution. N.S.W.

Differential diagnosis. It differs by having a wide labrum with the apex not elongated, but with an angular point. The post-anal edge of the postabdomen is somewhat convex and possesses rather thin anal teeth.

Chydorus barroisi (Richard, 1894)

Pleuroxus barroisi Richard, 1894: 375-377, figs 9-12.

Chydorus barroisi.—Sars, 1895: 25-28, pl. 4, figs 9-13; Smirnov, 1971b: 298-301, figs 328-332.

Differential diagnosis. The ventro-posterior corner of the valve has a denticle, which, however, is sometimes absent. The labrum is serrated.

Key to Subspecies of *Chydorus barroisi*

1. Fore part of valve with lines parallel to its frontal margin *C. barroisi barroisi* (Richard, 1894)
- Fore part of valve lacking such lines (described from New Zealand and not yet found in Australia) *C. barroisi laevis* (Sars, 1904)

Chydorus barroisi barroisi (Richard, 1894)

Fig. 32

Chydorus barroisi barroisi Smirnov, 1971b, 301, figs 328-333.—Petkovski, 1973a: 145, figs 25-27.

Since this was written in 1978, *Chydorus barroisi* and related species have been removed to a new genus *Ephemeroporos*, Frey, 1982.

Material. Qld: 2, 12, 14, 15, 17, 18, 22, 24, 25, 27, 28, 29, 30, 33, 34, 37, 39, 40, 42, 44, 51, 52, 64. N.S.W.: 76, 79, 81, 83, 88, 96, 125, 170. Vic.: 226. S.A.: 372, 374. W.A.: 405, 406.

Slides. AM ♀ P27708, ♂ P27709, MGU ♀ 1344, 1766, 1447, ZIN ♀ 1343.

Length. Up to 0.4 mm.

Ecology. Judging from its distribution, *C. barroisi* is probably more eurythermic than *C. eurynotus*, but it is not successful in the colder areas of Australia, as *C. sphaericus* is. Although all three species are known to occur in markedly acid waters, *C. barroisi* is the one most likely to be found there. It is also planktonic at times of great abundance in the littoral (Timms and Midgley, 1969).

Distribution. Mainly in Qld and lowland N.S.W.; also in Vic., S.A., and W.A.

Differential diagnosis. The valve has polygons and lines; on the anterior part of the valve the latter are parallel to its frontal margin. The anal teeth of the postabdomen generally diminish gradually towards the anal aperture, but near it there are a few especially long teeth.

Chydorus hybridus Daday, 1905

Fig. 33

Chydorus hybridus Daday, 1905: 158-159, tab. X, figs 5-7.

Material. Qld: 33. N.S.W.: 140, 160, 182.

Slides. AM ♀ P27712, MGU ♀ 896, 1682, ZIN ♀ 1680.

Distribution. Inland areas of Qld and N.S.W.

Differential diagnosis. The shell is brown in Australian individuals. There is a denticle on the ventro-posterior corner of the valve. The labral lamella has a single tooth. As in *C. barroisi* there are a few especially long anal teeth in the region of the anal aperture.

Chydorus ovalis Kurz, 1874

This species is mentioned by Henry (1922), in addition to the above species of *Chydorus*, as occurring in N.S.W. However she gives no figure, no morphological details in the text, and there are no specimens in her collection in the Australian Museum. As this is a Holarctic species, and further, since we have not encountered it in our extensive N.S.W. samples, we consider that this taxon is almost certainly absent from Australia.

The distinctive feature of *C. ovalis* is that not all the sensory papillae are situated on the distal end of the antennule; one is at some distance from its end.

Incertae sedis

Chydorus leonardi Sars, 1896: 30-31, pl. V, 4, 5.

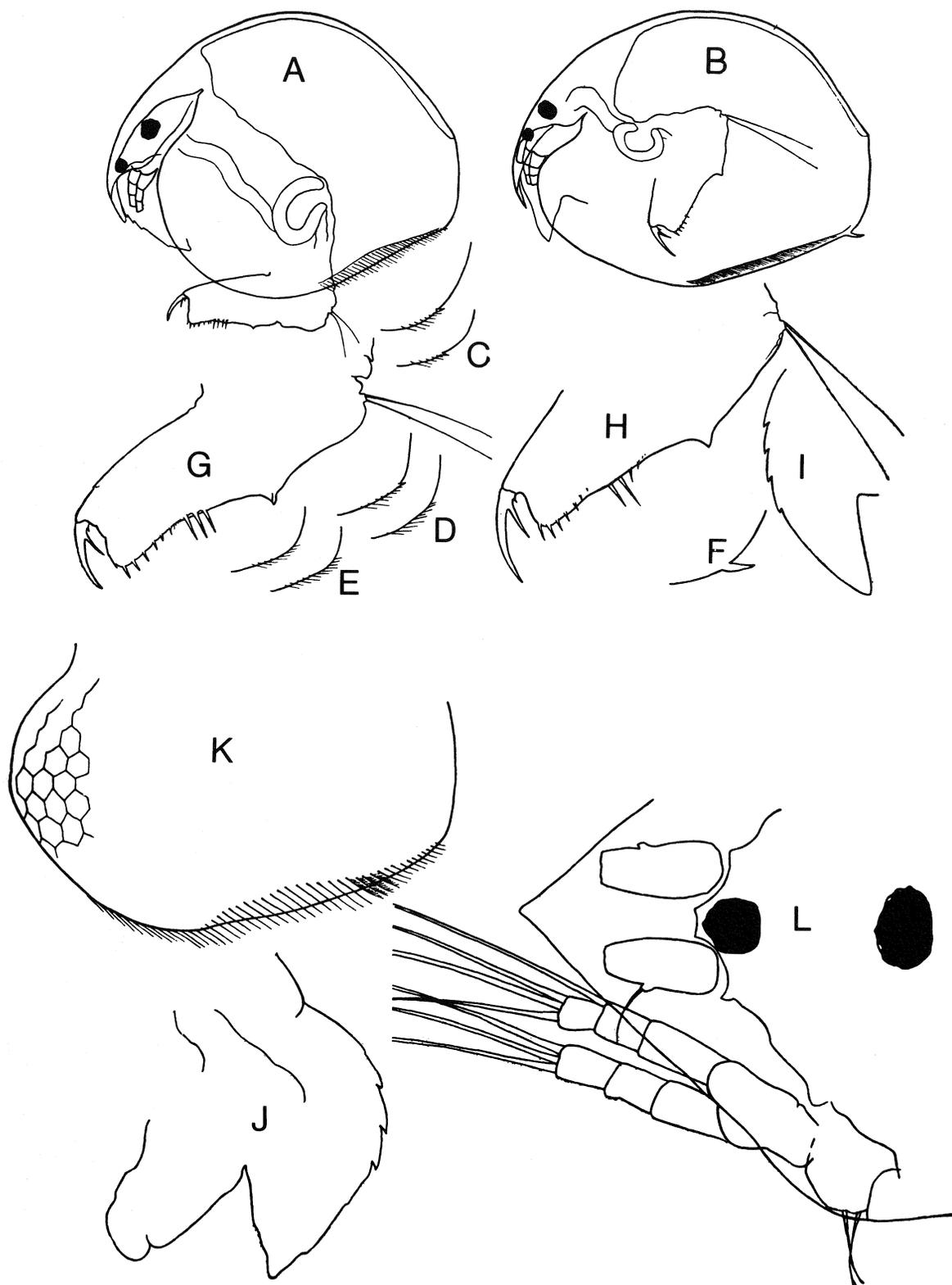


Fig. 32. *Chydorus barroisi* ♀, after Smirnov, 1971b. A & B, whole animals, length 0.3 mm; C, D, E, F: ventro-posterior corner of valve; G & H: postabdomens; I & J: labrum, K, carapace; L, rostrum.



Fig. 33. *Chydorus hybridus* ♀, labrum from Smirnov, 1971b.

Genus *Dunhevedia* King, 1853

Dunhevedia King, 1853b: 261.

Crepidocercus Birge, 1879: 24-25.

Landea Dybowski & Grochowski, 1894: 382.

The type species is *Dunhevedia crassa* King, 1853.

Dunhevedia crassa King, 1853

Fig. 34

Dunhevedia crassa King, 1853b:261, pl. VII F.—Sars, 1888: 42-46, pl. 5, figs 1-4; Henry, 1922: 44, pl. VI, figs 4, 4A; Brehm, 1953a: 68-69, fig. 8; Smirnov: 1971b: 319-320; Petkovski, 1973a: 143-145, figs 23, 24.

A number of forms have been described from Europe (Smirnov, 1971b), but only the typical subspecies has been found in Australia.

Dunhevedia crassa crassa King, 1853

Material. *Qld.*: 2, 8, 11, 12, 16, 18, 22, 23, 24, 32, 35, 37, 41, 43, 44, 52, 57, 64, 65, 66. *N.S.W.*: 82, 93, 97, 99, 104, 105, 111, 112, 114, 115, 117, 127, 129, 130, 133, 136, 140, 142, 156, 159, 164, 166, 168, 170, 174, 176. *Vic.*: 209, 224, 229, 230, 232, 237, 238, 245, 249. *Tas.*: 300, 312, 313, 319, 320, 321, 322, 324, 326, 327, 330, 332, 334. *S.A.*: 367, 369, 380, 382, 390, 391.

Slides. AM ♀ P27715, MGU ♀ 1791.

Length. 0.55 mm.

Ecology. *D. crassa* lives in a variety of habitats, but not in markedly acid waters. Seasonal peaks in numbers have been recorded between March and September in Borumba Reservoir (Timms and Midgley, 1969) and between March and April in L. Purrumbete (Timms, 1973). This species also sometimes strays into the limnetic zone.

Distribution. Widespread in eastern Australia; possibly also occurs in W.A.

Differential diagnosis. It is readily recognizable by its oval form, by the valve having a denticle below the ventro-posterior corner, by the oval postabdomen with the anal aperture on its functionally posterior side, and by the lack of serrations on the labral lamella.

Incertae sedis

Dunhevedia podagra King, 1853b: 261, pl. VII E, has not been confirmed by any subsequent authors, including Henry (1922:44). King's description and figures are unconvincing. Accordingly we consider this taxon of doubtful validity.

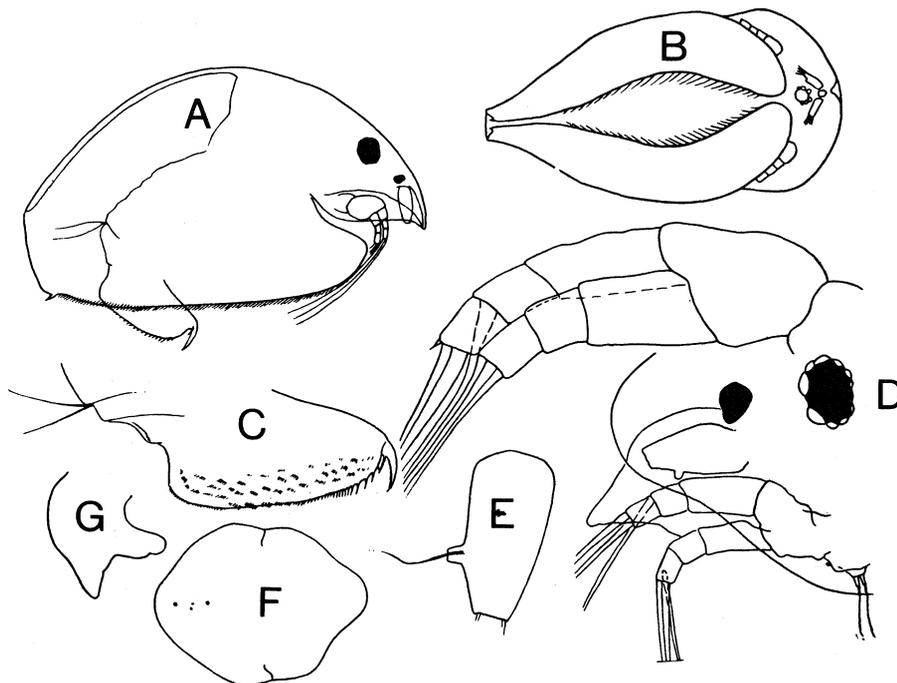


Fig. 34. *Dunhevedia crassa* ♀, after Smirnov, 1971b. A, lateral view of whole animal, length 0.44 mm; B, ventral view of whole animal; C, postabdomen; D, rostrum and antenna; E, antennule; F, head shield; G, labrum.

Genus *Dadaya* Sars, 1901

Dadaya Sars, 1901: 73.—Smirnov, 1971b: 324-325.
Alona Daday, 1898: 38.

The type species is *Dadaya macrops* (Daday, 1898).

***Dadaya macrops* (Daday, 1898)**

Fig. 35

Alona macrops Daday, 1898: 38-39, fig. 17.
Dadaya macrops.—Sars, 1901: 73-74, pl. XI, figs 5a, 5b;
 Smirnov, 1971b: 324-325.

Material. Qld: 2, 12, 14, 44, 48. N.S.W.: 82.

Slides. AM ♀ P27714, MGU ♀ 1737, head shield 1748,
 ZIN ♀ 2747.

Length. Up to 0.41 mm.

Ecology. Hyponeustonic (Fryer, 1968).

Distribution. Qld and northern N.S.W.

Differential diagnosis. It is dark brown. The antennule protrudes well beyond the tip of the rostrum. The eye and ocellus are very large.

Genus *Monope* new name

Monoporus Smirnov, 1977: 124-125. This name is a junior homonym of *Monoporus* Graff, 1891 (Turbellaria), so a new generic name is proposed.

Exopodite of thoracic limb IV with 7 setae. One major head pore. Head shield with a rounded posterior margin and an elongated rostral part. Antennule not reaching tip to rostrum. Labrum with a large lamellar outgrowth. Mandibular articulation of Chydorinae type.

The type species is *Monope reticulata* (Henry, 1922).

***Monope reticulata* (Henry, 1922)**

Fig. 36

Pleuroxus reticulatus Henry, 1922: pl. VII, figs 2, 2A.
 Non *Pleuroxus reticulatus* Henry, 1919: 478-479, pl. XLII, figs 13, 14.
Monoporus henryae Smirnov, 1977: 125-126, fig 8.

Material. N.S.W.: 81, 82, 83, 96, 97, 98, 99, 100, 118, 142, Henry's slide in the Australian Museum "P.4333 *Pleuroxus reticulatus* Henry, Holotype, Pt. Stephens."

Holotype. Henry's slide in the Australian Museum "P.4333 *Pleuroxus reticulatus* Henry, Holotype, Pt. Stephens". The type locality was mistakenly given as Myall Lakes in Smirnov, 1977.

Slides. AM ♀ P27719, MGU ♀ 1981, 1938, ZIN ♀ 1944, BM ♀ 1974:126.

Female. Body oval in lateral view. Dorso-posterior corner of shell weakly developed and ventro-posterior corner with a blunt denticle. Valve covered with lines, which anastomose on its lower part to form elongated polygons. Ventral border of valve somewhat concave anterior to its midpoint; posteriorly setae of ventral margin of valve situated at some distance from its margin. Rostrum long and sharp. Ocellus situated closer to eye than to tip of rostrum.

Labral lamella well developed, protruding slightly beyond tip of rostrum and with a shallow depression on its apex. Both antennule and antenna not reaching to tip of rostrum; antennule narrows distally and antenna segments lack spines. Exopodite of thoracic limb IV with 7 setae.

Postabdomen elongated, its distal margin concave. Preanal angle blunt, not protruding. Anal teeth diminish

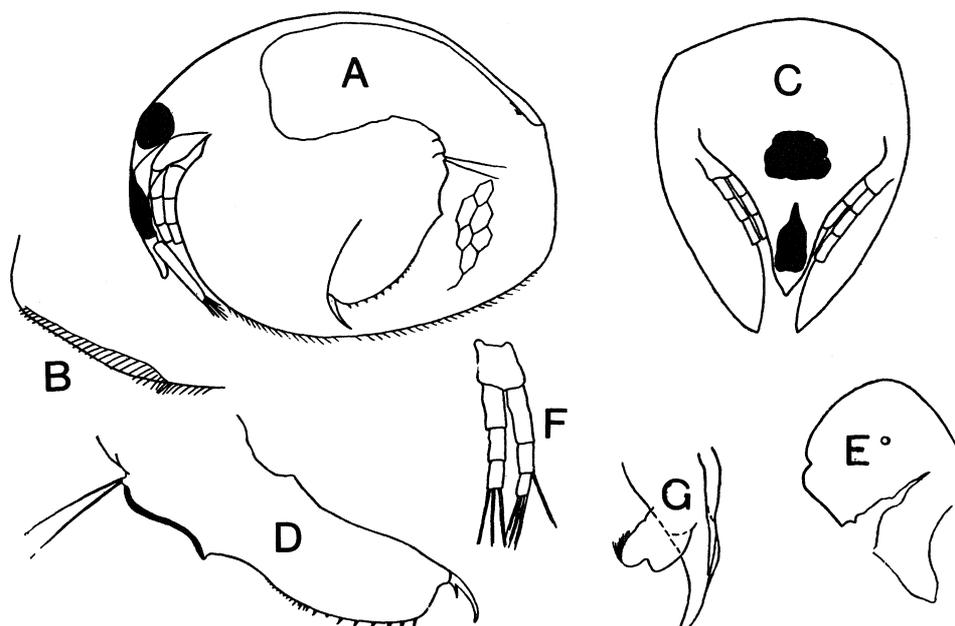


Fig. 35. *Dadaya macrops* ♀, after Smirnov, 1971b. A, lateral view of whole animal, length 0.35 mm; B, edge of valve; C, frontal view of animal; D, postabdomen; E, head shield; F, antenna; G, labrum.

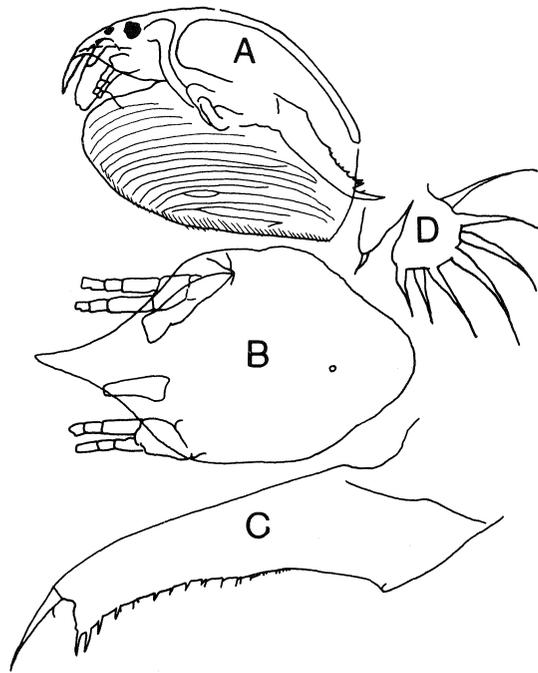


Fig. 36. *Monope reticulata* ♀, after Smirnov, 1977; A, whole animal, length 0.45 mm; B, head with bases of antennule and antenna; C, postabdomen; D, thoracic limb.

proximally and change from a regular to a clumped arrangement. Some of larger distal anal teeth attended by small denticles. About 14 anal teeth and groups of denticles.

Intestine convoluted.

Length. 0.45 mm.

Male. Unknown.

Ecology. Usually found in acid waters amongst emergent vegetation.

Distribution. Coastal N.S.W.

Differential diagnosis. The postabdomen is greatly elongated. The head shield possesses one major head pore, a round posterior border, and its rostral part is elongated. The exopodite of thoracic limb IV has 7 setae. The antennule does not reach the tip of the rostrum.

Genus *Pseudochydorus* Fryer, 1968

Pseudochydorus Fryer, 1968: 323-324.—Smirnov, 1971b: 328-329.

The type species is *Pseudochydorus globosus* (Baird, 1843).

Pseudochydorus globosus (Baird, 1843)

Fig. 37

Chydorus globosus Baird, 1843: 90, tab. III, figs 1-4.—Sars, 1896: 31, pl. 5, figs 6, 7; Henry, 1919: 482; 1922: 46, pl. VII, figs 6, 6A.

Pseudochydorus globosus.—Fryer, 1968: 323-324; Smirnov, 1971b: 328-329.

Material. Qld: 4, 48, 52, 64, 66. N.S.W.: 81, 127, 182, slide in the Australian Museum "P: 5911 *Chydorus globosus*

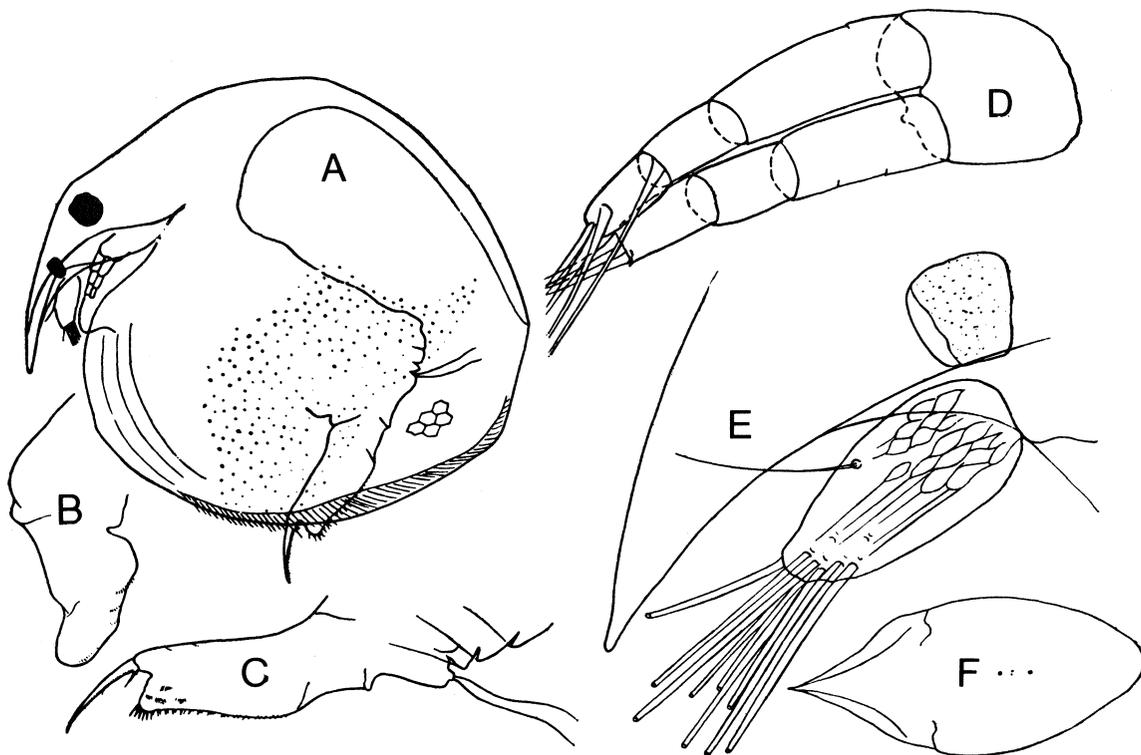


Fig. 37. *Pseudochydorus globosus* ♀, after Smirnov, 1971b. A, whole animal, length 0.72 mm; B, labrum; C, postabdomen; D, antenna; E, rostrum and antennule; F, head shield.

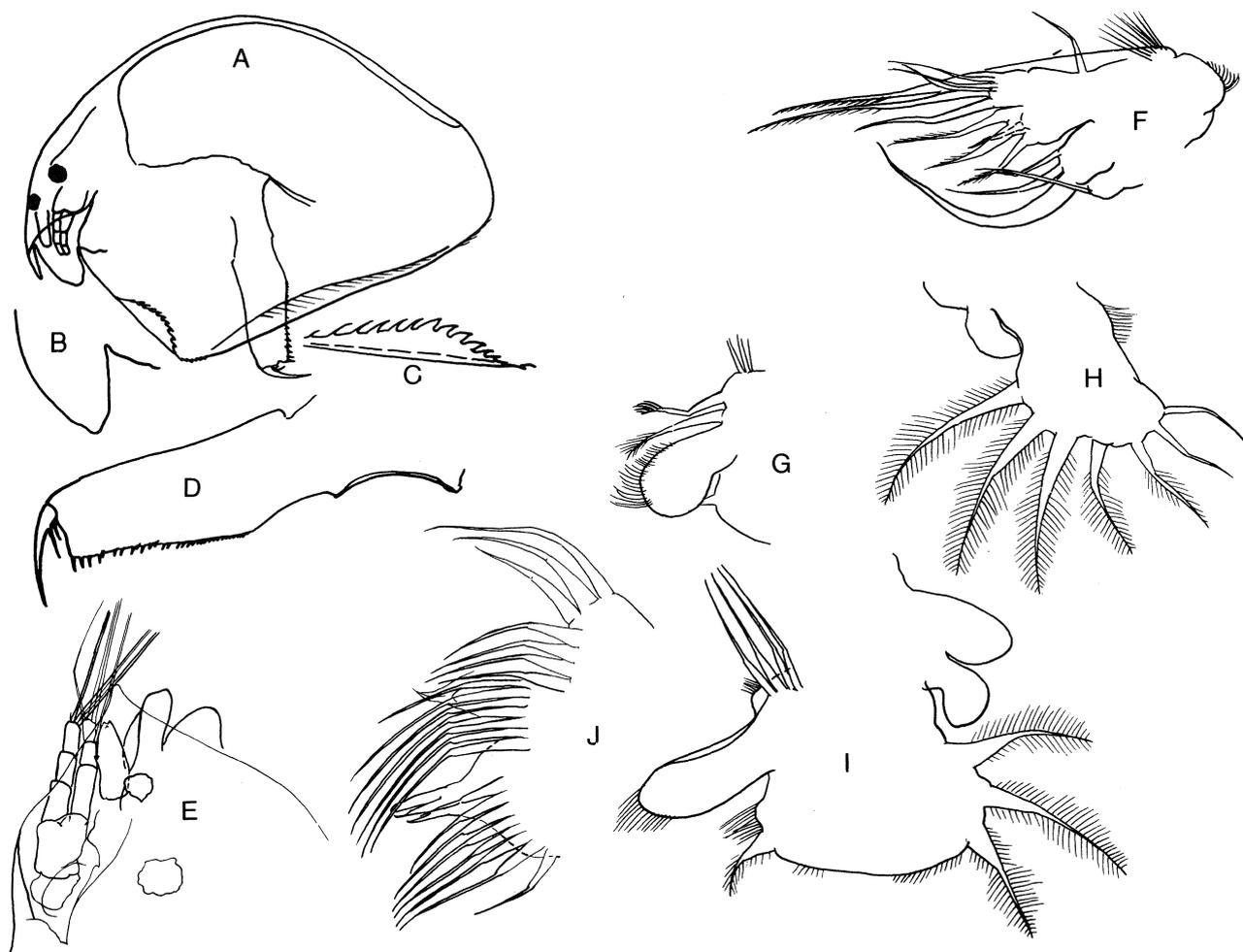


Fig. 38. *Australoichydorus aporus* ♀, L. Reeves, via Charters Towers, Qld, 19.vi.74. A, lateral view of whole animal, length 0.38 mm; B, labrum; C, ventro-anterior edge of valve; D, postabdomen. (A-D from slide AMP 27696; Nyngan Weir, N.S.W., 13.xii.73.) E, head from above, slide 2710; F, thoracic limb I; G, thoracic limb IV; H & I, thoracic limb V; J, gnathobases of thoracic limbs II and III. (F-J from slide 2712.)

Loc. Sydney". Vic.: 233, 238, 249, 255. Tas.: 301. S.A.: 362, 382.

Slides. AM ♀ P27724, MGU ♀ 1781.

Length. 0.65 mm.

Ecology. It is known from both weeded littoral areas and muddy sublittoral zones of lentic waters. In Borumba Reservoir, Qld, it is a winter species (Timms and Midgley, 1969), but in L. Purrumbete, Vic., it occurs almost exclusively during summer and autumn (Timms, 1973). It feeds on the bodies of dead cladocerans (Fryer, 1968).

Distribution. Widespread, but not common, throughout eastern and southern Australia; possibly in also in W.A.

Differential diagnosis. It is yellow, commonly with a brown spot on each side. The labrum is without a lamella and the postabdomen is elongated.

Incertae sedis

Chydorus augustus King, 1853b: 258, pl. VII B.

There is some possibility that this taxon belongs to *Pseudoichydorus* as the postabdomen has parallel edges and a chestnut colour is mentioned. King's figures are inadequate, so no definite conclusion is possible.

Genus *Australoichydorus* n. gen.

Exopodite of thoracic limb IV with 7 setae. Head shield with no head pores. Rostrum elongated. Labrum with a large lamellar outgrowth. Antennule not reaching tip of rostrum. Antennal setae 0-0-3/0-1-3, spines 0-0-1/0-0-0. Postabdomen elongated. Anterior part of ventral border of valve with a semicircular serrated lobe directed inwards. Along posterior part of valve setae originate from inner surface at some distance from

ventral margin (a characteristic of *Chydorus*, *Pseudochydorus*, *Monope* group of genera). Mandibular articulation of Chydorinae type.

The type species is *Australochydorus aporus* n. sp.

Australochydorus aporus n. sp.

Fig. 38

Material. Qld: 17, 25. N.S.W.: 176.

Holotype. AM ♀ P27696.

Paratypes. MGU ♀ 2740, ZIN ♀ 2746, BM ♀ 1980.359, DF ♀ 2742, MNHB ♀ 2745.

Slides. MGU ♀ 2710, 2711, 2712.

Female. Body in lateral view approximately oval, but with posterior part noticeably narrower. Dorso-posterior and ventro-posterior corners of valve broadly rounded. Ventral border of valve with a peculiar serrated infolded lobe in anterior part, the serrations continuing onto adjacent part of valve; posterior to this setae located on inner surface of valve, but near ventro-posterior corner of valve they arise from edge. Rostrum elongated and acute, but its narrow apex truncated. No obvious sculpturing on shell.

Lamella of labrum large, protruding well beyond tip of rostrum. Shallow depressions on both sides of apex of labral lamella. Antennule not reaching tip of rostrum, narrowing distally, and with denticles on its apex. A spinule located lateral to base of antennular seta. Distance from antennule apex to tip of rostrum larger in type population, from L. Reeves, than in population from Nyngan Reservoir (Loc. No. 176). Ends of antennal rami not reaching tip of rostrum. The spine on one of terminal segments of antennal rami small.

Postabdomen elongated, narrowing distally. Its preanal angle protruding a little. Anal teeth small, numerous, and diminishing proximally into small thin denticles. Claw with two long basal spines, proximal one the shorter. Ocellus situated somewhat closer to eye than to tip of rostrum.

Exopodite of limb IV with 7 setae, that of limb V with 4 setae. Epipodites of these limbs without long outgrowths. External lobe of endite of leg I with 3 setae, each of different length; largest with a long tapering end. Gnathobases of thoracic limbs with fans of long setae, numbering 8 in limb II and 4 in limb V.

Length. 0.38 mm.

Male. Unknown.

Type locality. Lake Reeves (via Charters Towers, Qld) (Loc. No. 17).

Distribution. Inland Qld and N.S.W.

Differential diagnosis. The ventral margin of the valve has a peculiar serrated infolded lobe in the anterior part and setae originating from the inside of the valve in its posterior part. The ventro-posterior corner of the valve is widely rounded, without denticles. The rostrum is acute. The labral lamella is large, reaching well beyond the tip of the rostrum. There are shallow depressions on both sides of the tip of the labral lamella. The

postabdomen is elongated, narrowing a little at its end. The claw has two long basal spines.

Genus *Rhynchochydorus* n. gen.

General body form elongated; height of valve greatest posteriorly. Rostrum very long and reflexed posteriorly. Setae of ventral margin of valve situated along its edge; a few posterior setae very long. Labrum with a peculiar small rounded outgrowth. Exopodite of thoracic limb IV with 7 setae. Ocellus smaller than eye.

This form is analogous to Holarctic *Rhynchotalona* but belongs to a different subfamily.

The type species is *Rhynchochydorus australiensis* n. sp.

Rhynchochydorus australiensis n. sp.

Fig. 39

Material. N.S.W. 96, 100.

Holotype. AM ♀ P27761.

Paratypes. MGU ♀ 2829, ZIN ♀ 2830, BM ♀ 1980.367

Slide. MGU ♀ 2833.

Female. Valve highest posteriorly and marked with widely spaced longitudinal lines. Rostrum very long and reflexed posteriorly. Dorso-posterior corner of shell just visible and blunt, while ventro-posterior corner broadly rounded and lacking denticles. Postabdomen elongated with parallel dorsal and ventral edges. Side bearing anal aperture much depressed, so that preanal angle is rectangular and prominent. Numerous anal teeth diminishing proximally and finally continuing into groups of small denticles. Claw with one small basal spine. Intestine convoluted.

Length. 0.3 mm (holotype ♀ P27761).

Ecology. This species is known only from acid dune swamps, where it lives amongst decaying leaves and the stems of *Lepironia articulata* (Retzius) (Cyperaceae). Observations on living females revealed that the exopodites of thoracic limbs IV and V make continuous undulatory movements. This behaviour and the structure of the limbs suggest it is a secondary filter feeder, i.e. a chydorid collecting its food from substrata and subsequently using filtration.

Type locality. A swamp inland from Sugar Point on The Broadwater, Myall Lakes National Park (Loc. No. 100).

Distribution. North coast of N.S.W.

Differential diagnosis. It is easily recognized by its long rostrum, reflexed posteriorly. The shell is highest posteriorly. The setae of the ventral margin of the valve are situated along its edge; a few most posterior setae are very long. The ventro-posterior corner is broadly rounded, lacking denticles. The postabdomen is elongated, with parallel dorsal and ventral edges. Its anal teeth are well developed, diminishing proximally. The labrum has a peculiar small outgrowth.

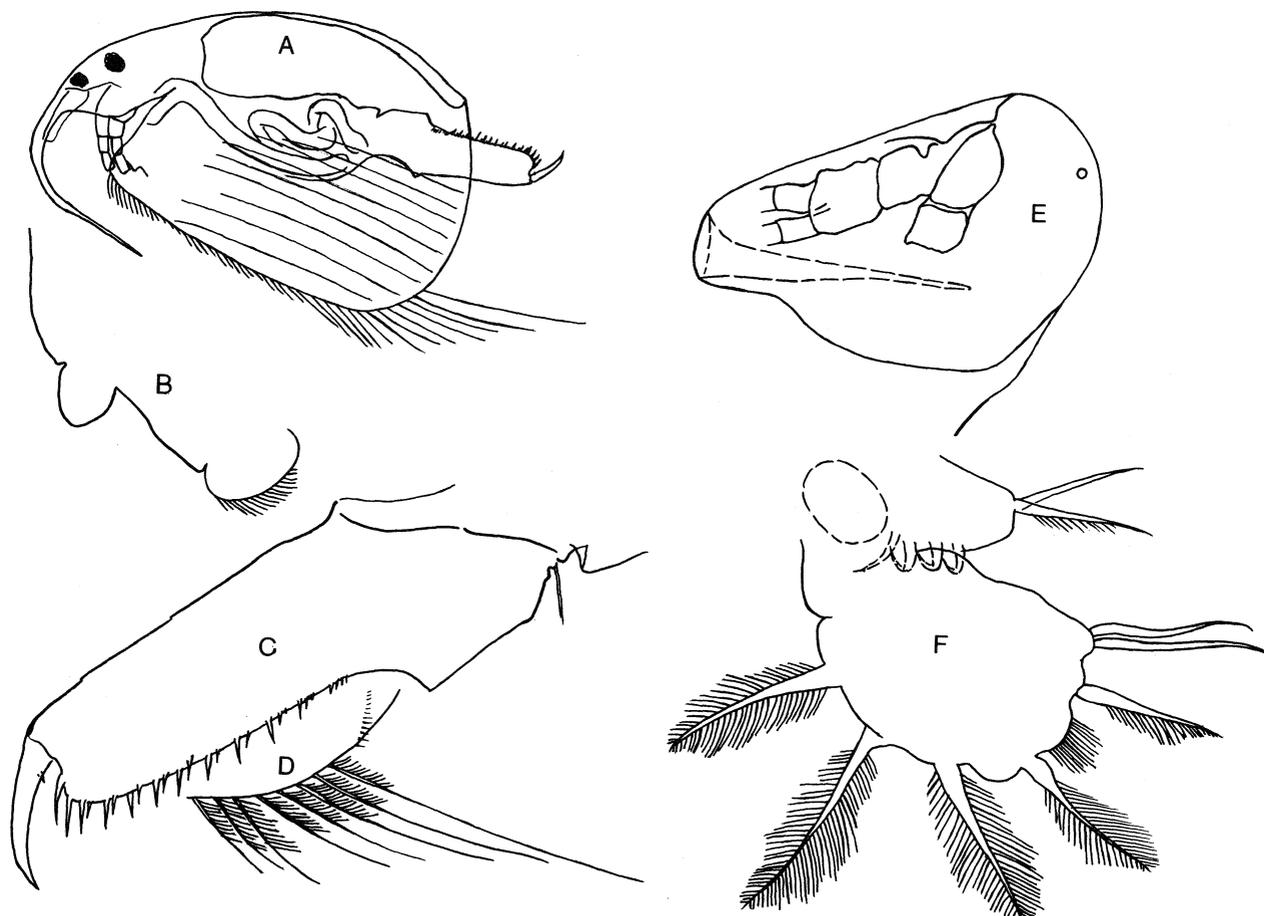


Fig. 39. *Rhynchochydorus australiensis* ♀, swamp near Sugar Point, the Broadwater, Myall Lakes, N.S.W., 13.v.75. A, lateral view of whole animal, length 0.33 mm from slide 2829; B, labrum from slide 2830; C, postabdomen from slide 2829; D, ventro-posterior corner of valve from slide 2829; E, head shield from slide 2833; F, thoracic limb IV from slide 2833.

Subfamily ALONINAE Frey, 1967

Aloninae Frey, 1967: 36.—Smirnov, 1971b: 326-327.

The type genus is *Alona* Baird, 1843.

Key to All Genera of Aloninae

1. Rostrum very long and reflexed 14
- Rostrum comparatively short and not reflexed 2
- 2(1). Only an ocellus (i.e. no compound eye) *Monospilus* Sars, 1862
- Ocellus and compound eye present 3
- 3(2). Head shield with three major head pores 4
- Head shield with two or one major head pore 10
- 4(3). Lateral setae of postabdomen extremely large. Anal teeth very small *Leydigia* Kurz, 1875
- Lateral setae of postabdomen not very large 5
- 5(4). Anterior margin of head shield broadly rounded and protruding (in lateral view). Ventral outline of valve straight. Postabdomen short *Graptoleberis* Sars, 1862

- Anterior margin of head shield not broadly rounded and not protruding
(in lateral view) 6
- 6(5). Postabdomen long and narrow 7
- Postabdomen of various forms, but not narrow or very long *Alona* Baird, 1843
- 7(6). Postabdomen straight with parallel dorsal and ventral
margins *Acroperus* Baird, 1843
- Postabdomen narrows distally 8
- 8(7). Rostrum somewhat elongated. Legs III and IV noticeably
different *Kurzia* Dybowski & Grochowski, 1894
- Rostrum not elongated. Legs III and IV superficially similar 9
- 9(8). Postabdomen very long. Most species with a dorsal keel on
carapace *Camptocercus* Baird, 1843
- Postabdomen of moderate length (length:width is not more than 4.3).
No cephalic or dorsal keel (Endemic to
L. Baikal) *Kozhowia* Vasiljeva & Smirnov, 1969
- 10(3). Head shield with two major head pores 11
- Head shield with one major head pore 13
- 11(10). Major head pores separate *Oxyurella* Dybowski & Grochowski, 1894
- Major head pores connected 12
- 12(11). Narrow connection between major head pores *Biapertura* Smirnov, 1971
- Wide connection between major head pores (Palearctic, South Africa)
..... *Tretocephala* Frey, 1971
- 13(10). Body length considerably exceeds its height *Euryalona* Sars, 1901
- Body length only just exceeds its height (India, but recently found near Darwin
by BVT) *Indialona* Petkovski, 1966
- 14(1). Rostrum very long and strongly reflexed backwards. Few anal teeth,
the distal ones especially large (Holarctic) *Rhynchotalona* Norman, 1903
- Rostrum elongated and weakly reflexed backwards. Numerous anal
teeth on a wide and oval postabdomen (Neotropical) *Leydigiopsis* Sars, 1901

Incertae sedis

Eurycercus spinosus King, 1853b: 257, pl. VIID.
—Sars, 1888: 69.

This problematic form is too vaguely figured by King
for a generic assignment, but it seems to belong within
the Aloninae.

Genus *Alona* Baird, 1843

Subgenus *Alona*.—Baird, 1843: 92.
Alona.—Smirnov, 1971b: 337-8.

Of the great variety of species that were once assigned
to this genus only the forms having three major head
pores are now placed here (Smirnov, 1971a).

The type species is *Alona quadrangularis* (Müller,
1785).

Key to Australian Species of *Alona*

1. Postabdomen somewhat elongated, dorsal and ventral edges parallel 2
- Postabdomen not elongated, dorsal and ventral edges not parallel 5
- 2(1). Lateral setae of postabdomen arranged singly 3
- Lateral setae of postabdomen grouped 4

- 3(2). Claw with a very large basal spine. Ocellus larger than eye ... *A. macracantha* n. sp.
 — Claw with a small basal spine. Eye larger than ocellus *A. archeri* Sars, 1888
- 4(2). Valve completely smooth *A. laevissima* Sars, 1888
 — Valve granulated *A. pulchella* King, 1853
- 5(1). Distal and dorsal edges of postabdomen widely rounded 6
 — Distal edge of postabdomen truncated 11
- 6(5). Postabdomen narrows distally 7
 — Postabdomen does not narrow distally 8
- 7(6). Anal teeth of postabdomen extremely small *A. investis* n. sp.
 — Anal teeth normal-sized *A. davidi* Richard, 1895
- 8(6). Distal part of postabdomen bearing anal teeth comparatively longer than proximal part without teeth; about 18 anal teeth ... *A. quadrangularis* (Müller, 1785)
 — Distal part of postabdomen comparatively shorter with <18 anal teeth 9
- 9(8). Anal teeth rather large, distinctly grouped. Most distal seta in each lateral fascicle reaching beyond dorsal margin of postabdomen *A. poppei* Richard, 1897
 — Anal teeth small. Most distal seta in each lateral fascicle reaching, at most, to margin of postabdomen 10
- 10(9). Major head pores connected. About 9 anal teeth *A. rectangula* Sars, 1862
 — Major head pores separate. >10 anal teeth *A. setuloides* n. sp.
- 11(5). Anal teeth gradually diminish proximally 12
 — Four distal anal teeth much larger and longer than proximal ones *A. inreticulata* Shen *et al.*, 1964
- 12(11). Anal teeth long 13
 — Anal teeth short *A. clathrata* Sars, 1888
- 13(12). Anal teeth >10 14
 — Anal teeth normally <10; anal margin of postabdomen deep so that preanal angle protrudes *A. guttata* Sars, 1862
- 14(13). Valve marked with longitudinal lines. Minor head pores transverse. Anal margin of postabdomen shallow so that preanal angle wide and protruding little *A. costata* Sars, 1862
 — Valves marked with polygons with granules ... *A. cambouei* Guerne & Richard, 1893

Alona quadrangularis (Müller, 1785)

Fig. 40

Lynceus quadrangularis O.F. Müller, 1785: 72-3, tab. IX, figs 1-3.

Alona quadrangularis.—Smirnov, 1971b: 340-1, figs 382-6.

Material. Vic.: 263. W.A.: 422.

Slides. AM ♀ 31306, 31308, MGU ♀ 3022, ZIN ♀ 3023.

Length. 0.52 mm (slide 3022).

Distribution. Sparse in southern Victoria and in south-western W.A., possibly in other states.

Differential diagnosis. Externally it is very similar

to *Biapertura affinis*. However the head shield has three major head pores, which are connected, and the external branch of the endite of thoracic limb I has three setae, one of them being small and not hook-like. The valves of the females in the studied population have sparsely spaced longitudinal lines.

Alona davidi Richard, 1895

Alona davidi Richard, 1895: 192-5, figs 5-8.—Smirnov, 1971b: 368-71.

Alona diaphana King, 1853b: 260, pl. VIII C.

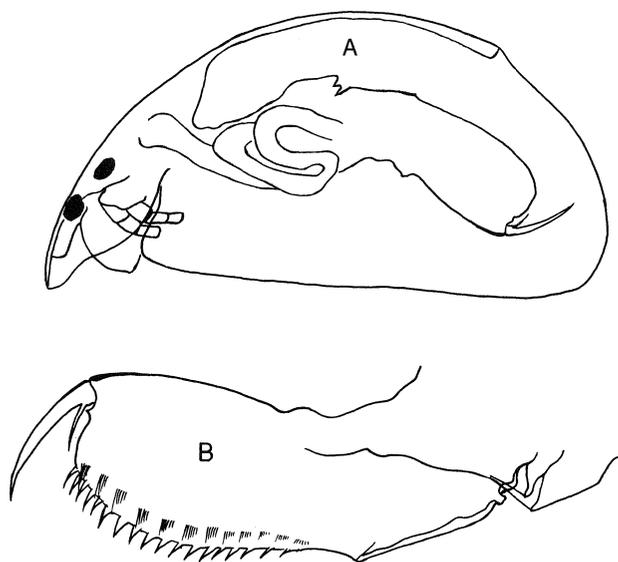


Fig. 40. *Alona quadrangularis* ♀, a swamp near Shannon, W.A., 8.vii.76. A, lateral view of whole animal, length 0.52 mm; B, postabdomen. (Both from slide 3022.)

Material. Qld: 9, 11, 15, 21, 23, 31, 32, 35, 59, 61, 65, 66. N.S.W.: 92, 112, 116, 123, 127, 128, 129, 130, 131, 132, 138, 139, 142, 152, 156, 160, 161, 166, 167, 172, 181. Vic.: 224, 225, 229, 238, 257. Tas.: 314, 334. S.A.: 362, 372, 380. W.A.: 401, 412, 415.

Distribution. Widespread in Australia.

Differential diagnosis. The body is comparatively high, with both dorsal and ventral sides convex. The rostrum is blunt. The postabdomen narrows distally.

The known forms may be identified by the following key.

Key to Subspecies of *Alona davidi*

1. Valve with polygons, but no granules; anal teeth of postabdomen in subgroups of 2-4 arranged in 10-11 groups *A. davidi davidi* Richard, 1895
 - Valve granulated or lineated 2
- 2(1). Valve granulated (polygons sometimes present) *A. davidi punctata* Daday, 1898
 - Valve with longitudinal lines 3
- 3(2). Longitudinal lines on valve sparse *A. davidi iheringi* Richard, 1897
 - Longitudinal lines on valve fine and densely arranged *A. davidi vermiculata* n. ssp.

Alona davidi punctata Daday, 1898

Alona davidi punctata Daday, 1898: 39-41, fig. 18.

Material. Qld: 66. Vic.: 240.

Distribution. Eastern Australia; World: Ethiopic and Neotropical regions.

Alona davidi iheringi Richard, 1897

Fig. 41

Alona davidi iheringi Richard, 1897: 294-296, figs 42-43.
Alonella diaphana Sars, 1888: 47-50, pl. 5, figs 5-7.

Material. Qld: 59, 64. N.S.W.: 166, 172, Vic.: 238. S.A.: 372, 374, 380.

Slides. AM ♀ P27686, MGU ♀ 1581, ZIN ♀ 1024.

Female. Valve with longitudinal lines, sparsely arranged. Lineation of valves very noticeable in specimens from locality No. 238.

Length. Up to 0.49 mm.

Distribution. Australia: eastern parts; World: Ethiopic and Neotropical regions and south of U.S.S.R.

Alona davidi vermiculata n. ssp.

Material. N.S.W.: 136, 139, 152.

Slides. AM ♀ P27687, MGU ♀ 2892, ZIN ♀ 2891.

Female. Longitudinal striations of valve very closely spaced leaving no free space. Thus when the valve is viewed in reflected light there is an iridescent reflection.

Distribution. Monaro region of southern N.S.W.

Alona costata Sars, 1862

Alona costata Sars, 1862b: 286.—Smirnov, 1971b: 371-373.

Material. N.S.W.: 115, 117, Vic.: 201, 253. Tas.: 315. S.A.: 388.

Length. Up to 0.6 mm.

Distribution. Sparse in south-eastern Australia.

Differential diagnosis. The postabdomen is truncated, its anal teeth gradually diminishing proximally. The margin of the anal aperture is slightly concave. The valve is longitudinally lineated. This species is very similar externally to *Biapertura setigera* but there are three major head pores.

Alona cambouei Guerne & Richard, 1893

Fig. 42

Alona cambouei Guerne & Richard, 1893: 242-244, figs 10-11.—Henry, 1919: 477; 1922: 42; Smirnov, 1971b: 377, figs 444-446.

Material. Qld: 8, 9, 10, 13, 17, 18, 19, 26, 30, 31, 35, 37, 41, 42, 43, 56. N.S.W.: 87, 93, 110, 137, 139, 156, 160, 169, 171, 181, 182, 184, 187. Vic.: 207, 236, 240, 245. S.A.: 359, 382, 384, 387.

Slides. AM ♀ P27685, MGU ♀ 1279, ZIN ♀ 1538.

Length. 0.47 mm.

Ecology. Besides inhabiting the weeded littoral regions of a variety of waters, this species may sometimes be limnetic. The same applies for a number of other species of *Alona*, including *A. guttata* and *A. rectangula*.

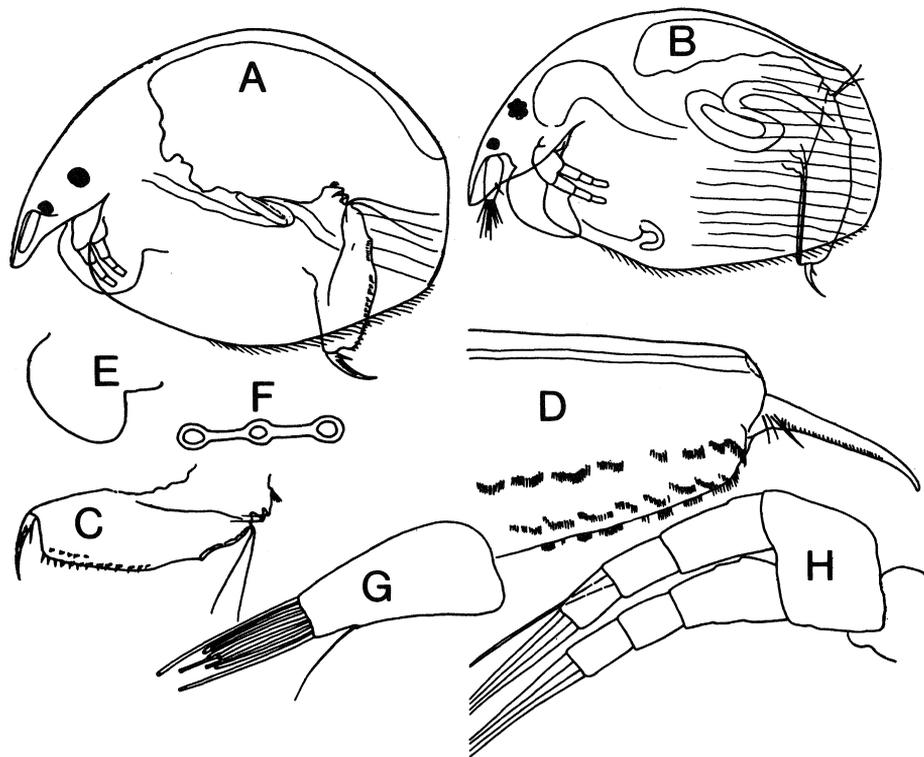


Fig. 41. *Alona davidi iheringi* ♀, after Smirnov, 1971b. A & B, whole animals, length 0.42 mm; C & D, postabdomens; E, labrum; F, head pores; G, antennule; H, antenna.

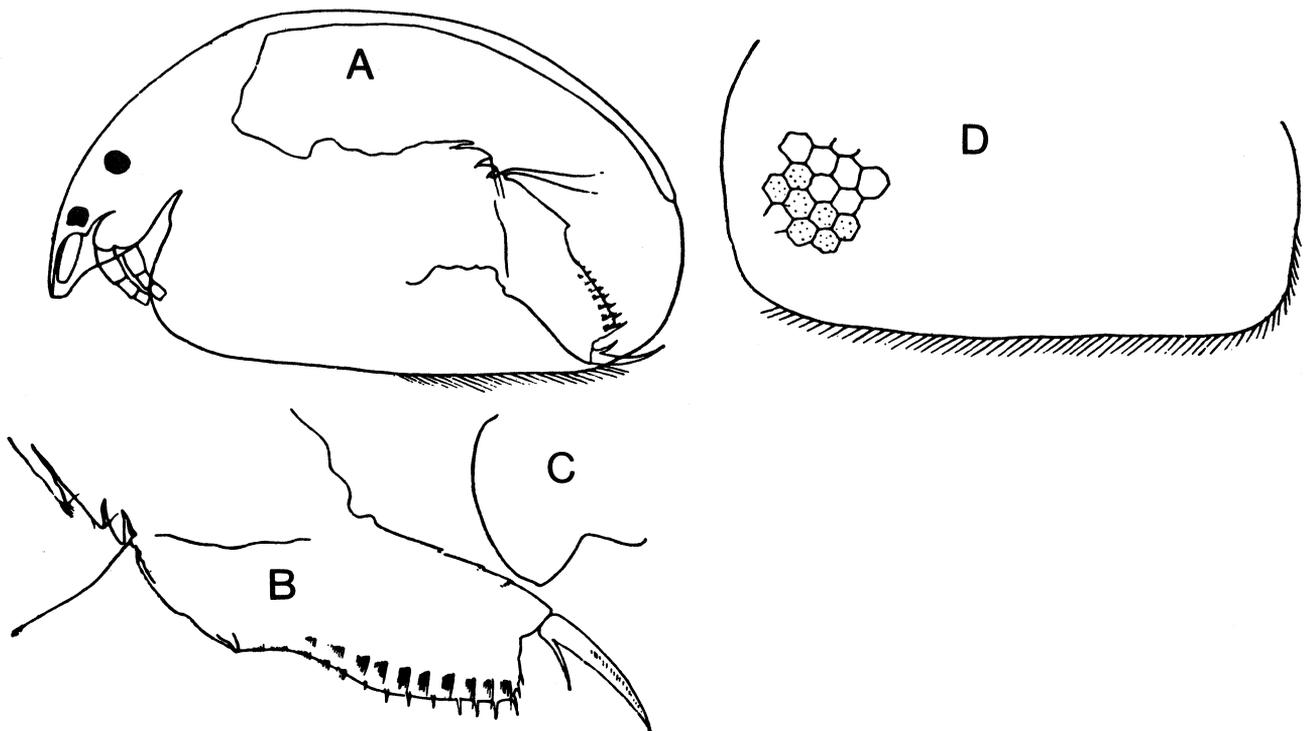


Fig. 42. *Alona cambouei* ♀, after Smirnov, 1971b. A, whole animal, length 0.47 mm; B, postabdomen; C, labrum; D, carapace.

Distribution. Eastern mainland Australia.

Differential diagnosis. The valve is marked in polygons which are distinctly granulated. The labrum has no serrations. The postabdomen of the female narrows slightly distally; its dorsal edge is convex, and distal edge truncated. The anal teeth and fascicles of lateral setae are well developed; the anal teeth gradually diminish proximally.

Alona inreticulata Shen Chia-jui *et al.*, 1964

Fig. 43

Alona inreticulata Shen Chia-jui, Sung Ta-hsiang & Chen Kuo-hsiao, 1964: 215, 223-224, figs 9-12.

Material. Vic.: 211. Tas.: 324.

Slides. AM ♀ 31305, MGU ♀ 2942, 2950, ZIN ♀ 2943.

Female. Three major head pores. Antennule not reaching tip of rostrum. Antennal setae 0-0-3/1-1-3, and spines 1-0-1/0-0-1. Thoracic limb I with three setae (one short, two long) on external branch of endite. The long setae feathered differently—one on its distal half, the other at the tip.

Length. 0.62 mm.

Distribution. Sparse in southern Australia.

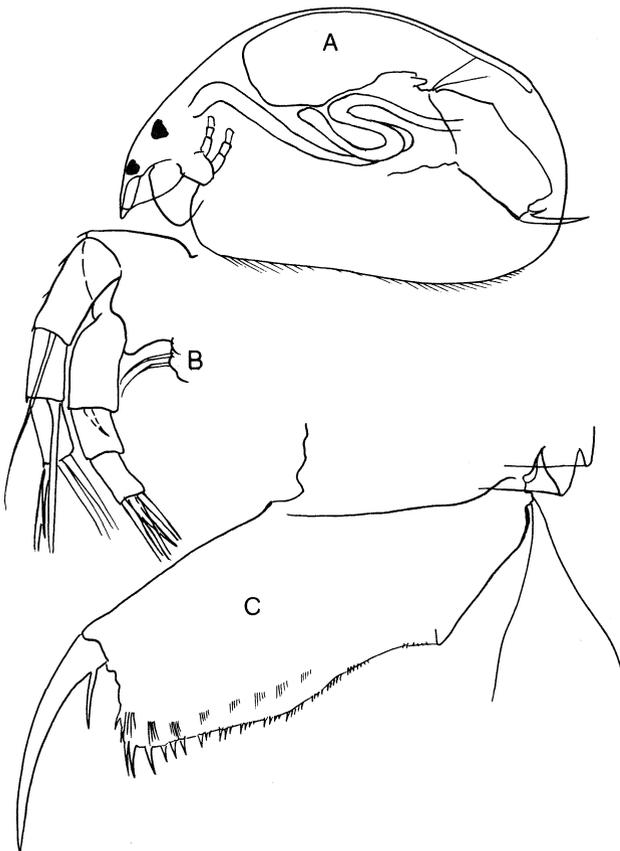


Fig. 43. *Alona inreticulata* ♀, farm dam, Cape Liptrap, Vic., 8.ix.74. A, lateral view of whole animal, length 0.62 mm, slide 2942; B, antennae, slide 2950; C, postabdomen, slide 2942.

Differential diagnosis. The postabdomen of the female narrows slightly distally and is truncated. The preanal angle is wide and noticeable. The anal teeth are well developed, the four distal ones being much larger than the proximal teeth.

Alona guttata Sars, 1862

Alona guttata Sars, 1862b: 287-289.—Smirnov, 1971b: 379-382.

Alona microtata Henry, 1922 n. syn., Henry, 1922: 41-42, pl. VIII, figs 4, 4A. An examination of the type slide in the Australian Museum (P: 5890 *Alona microtata* Henry (type) Loc. Orange) showed it contained only *Alona guttata* and *Chydorus* sp. Judging from Henry's inadequate figures this specimen of *Alona* must have been considered by her to be *Alona microtata*. We consider that *Alona microtata* is identical to *Alona guttata*, and hence it is a synonym to it.

Material. Qld: 44, 53. N.S.W.: 38, 107, 124, 171. Vic.: 230, 232, 249. Tas.: 312.

Length. 0.4 mm.

Ecology. *Alona guttata* occurs throughout the year in L. Purrumbete, where it is most common in *Scirpus* weedbeds (Timms, 1973).

Distribution. Sparsely distributed in eastern Australia.

Differential diagnosis. The postabdomen is truncated. Its anal teeth diminish gradually proximally. The margin of the anal aperture is deeply concave, so that the preanal angle protrudes.

A number of subspecies of *A. guttata* are known, but only *A. guttata guttata* has so far been recorded in Australia.

Alona guttata guttata Sars, 1862

Fig. 44

Material. N.S.W.: 87, 107, 124.

Slides. AM ♀ P27688, MGU ♀ 1155, ZIN ♀ 3012.

Female. Three major head pores present, as visible in the female from Loc. No. 124 (Slide ZIN ♀ 3012). In this population the antennule does not reach the apex of the rostrum and the valve is covered with small granules (there are no lines or distinguishable polygons). Sars (1862b: 287) notes of his typical *Alona guttata*: "Testa striata, striis longitudinalibus parum distinctis et postice infra areolis pluribus parvis lucidis et obscuris alternatim notata." Thus strictly the forms from Loc. No. 124 differ from the typical form, namely in the absence of lines and polygons on the valve and the presence of granulations instead. No other differences were noted so this form is considered to be within the range of variations possible.

Alona rectangula Sars, 1862

Alona rectangula Sars, 1862a: 160.—Smirnov, 1971b: 376-348.

Material. Qld: 12, 19, 24, 25, 44, 56, 66. N.S.W.: 87, 93, 100, 112, 114, 116, 117, 120. Vic.: 220, 225, 232, 235, 237,

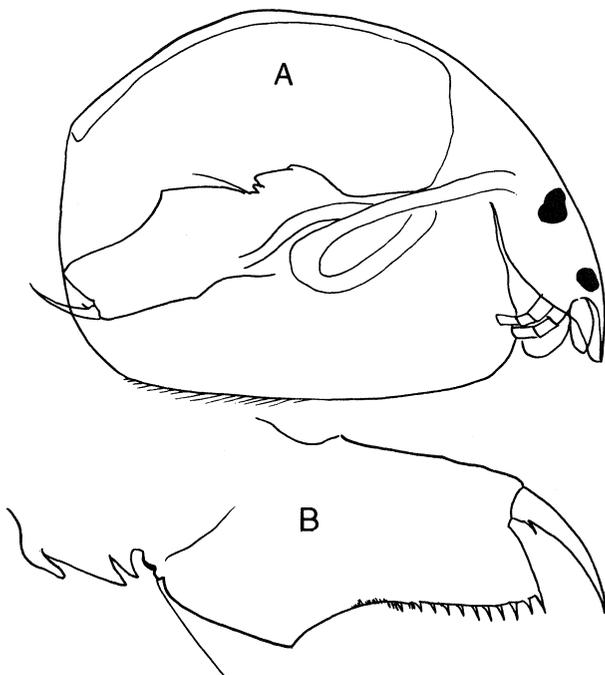


Fig. 44. *Alona guttata guttata* ♀, Doughboy Ck, N.S.W., 8.viii.65. A, lateral view of whole animal, length 0.4 mm; B, postabdomen. (Both from slide 1155.)

254, 258, 259. *Tas.*: 326, 339. *S.A.*: 354, 355, 367, 376, 383, 384, 388, 389, 390, 392. *W.A.*: 405, 414.

Comment. This taxon at present is an assemblage of rather diverse forms needing critical study. A number of subspecies have been described and those found in Australia are discussed below.

Ecology. In a study on the University Pond, Brisbane, Timms (1967) reported this species to occur throughout the year with blooms in spring and autumn.

Distribution. Widespread in Australia.

Differential diagnosis. The postabdomen is short; its distal end is slightly widened and rounded. The postabdominal anal teeth may be grouped or rounded. Length of females does not exceed 0.5 mm.

Key to Subspecies of *Alona rectangula*

1. Carapace with hollows
..... *A. rectangula pulchra* Hellich, 1874
- Carapace without dimples 2
- 2(1). Lateral setae of postabdomen
arranged singly
... *A. rectangula novae-zealandiae* Sars, 1904
- Lateral setae grouped or absent 3
- 3(2). Ratio of the distance between the
preanal angle and base of claw to the
greatest width of postabdomen <1.7
..... *A. rectangula rectangula* Sars, 1862
- This ratio >1.7
..... *A. rectangula richardi* Stingelin, 1895

Alona rectangula rectangula Sars, 1862

Alona rectangula rectangula Sars, 1862a: 160.

Material. *Qld.*: 44. *Vic.*: 225.

Slides. MGU ♀ 3016, ZIN ♀ 3017, AM ♀ P31304.

Female. Sars (1862a: 160) referring to the postabdomen of his new taxon *Alona rectangula*, notes: "Postabdomen breve, margine posteriore ad angulum inferiorem rotundato aculeis parvis et tenuibus obsita postice et medio processum acuminatum formante." This gives only a very general description of the postabdomen. If the typical female had not been photographed by D.G. Frey (reproduced in Smirnov, 1971b, fig 391), it would have been impossible to differentiate the typical form from the many variations subsequently described.

Population from Loc. No. 225 has females with their valves characteristically striated (about 17 lines). Three interconnected major head pores. Antenna has setae 0-0-3/0-1-3, spines 1-0-1/0-0-1 (slide 3016). Ratio of distance between preanal angle of postabdomen and base of claw to greatest width of postabdomen about 1.5. About 9 small anal teeth and about 5 groups of lateral setae on postabdomen.

Length. 0.39 mm (Slide 3016).

Alona rectangula richardi Stingelin, 1895

Fig. 45

Material. *Vic.*: 231.

Slide. MGU ♀ 3011.

Female. Rostrum blunt. Major head pores triple and connected. Valve with longitudinal sparse lines and no teeth. Postabdomen elongated; ratio of length between its preanal angle and base of claw to greatest width of postabdomen 1.94. Anal denticles and lateral setae of postabdomen grouped.

Length. 0.43 mm.

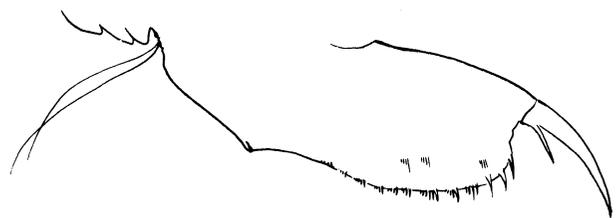


Fig. 45. *Alona rectangula richardi* ♀, Goulburn Billabong, Alexandra, Vic., 11.viii.76. Postabdomen, slide 3011.

Alona rectangula novae-zealandiae Sars, 1904

Figs 46, 47

Alona rectangula novae-zealandiae Sars, 1904b: 634-635, tab. XXXV, figs 7, 7a, 6b.—Smirnov, 1971b; 352, figs 401-403.

Material. *S.A.*: 388, 390, 392.

Slides. AM ♀ P27690, MGU ♀ 1575, ephippial ♀ 1595, ephippium 1547, ♂ 1550, ZIN ♀ 53873 (1577).

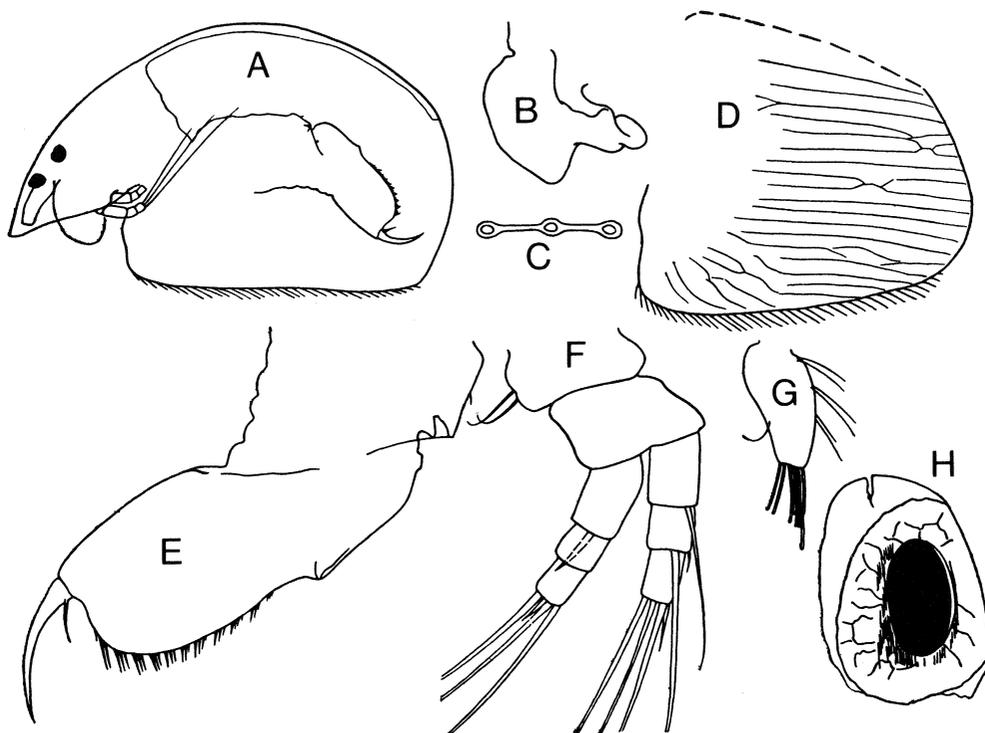


Fig. 46. *Alona rectangularis novae-zealandiae* ♀, after Smirnov, 1971b. A, whole animal, length 0.39 mm; B, labrum; C, head pores; D, carapace; E, postabdomen; F, antenna; G, antennule; H, ehippial egg.

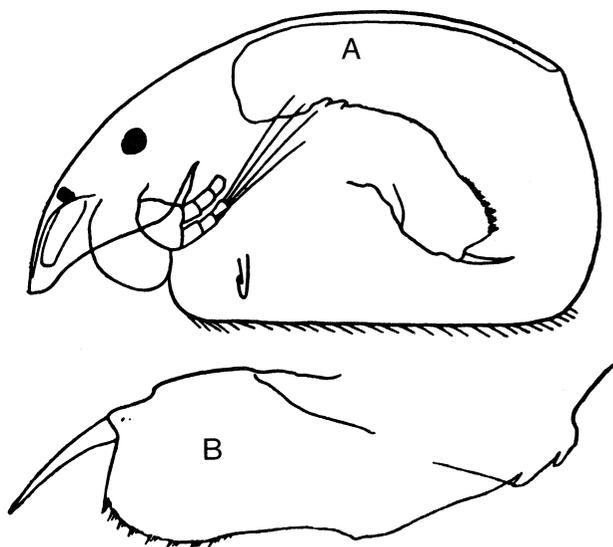


Fig. 47. *Alona rectangularis novae-zealandiae* ♂, after Smirnov, 1971b. A, whole animal, length 0.3 mm; B, postabdomen.

Female. Shell surface without depressions. Lateral setae of postabdomen solitary.

Length. Up to 0.39 mm.

Alona rectangularis pulchra Hellich, 1874

Fig. 48

Alona rectangularis pulchra Hellich, 1874: 219; 1877, fig. 51 (*lineata* partim).—Smirnov, 1971b: 452-453, fig. 404.

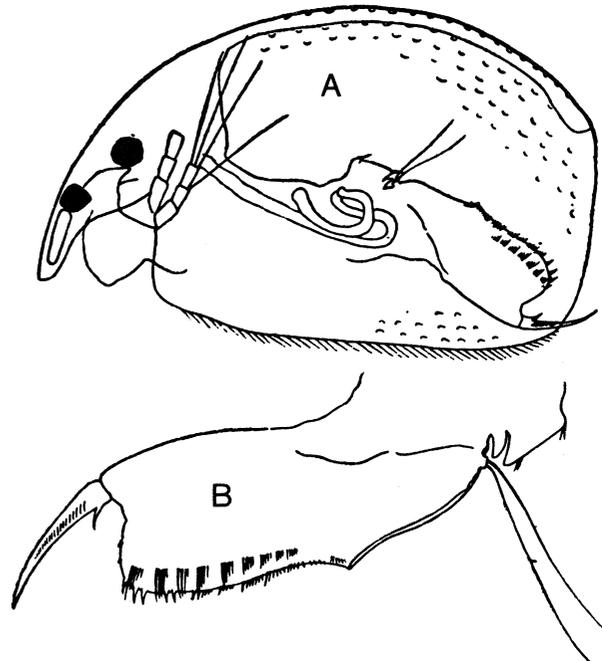


Fig. 48. *Alona rectangularis pulchra* ♀, after Smirnov, 1971b. A, whole animal, length 0.34 mm; B, postabdomen.

Material. Qld: 56. N.S.W.: 100.

Slides. AM ♀ P27691, MGU ♀ 406, 1378, ZIN ♀ 53877 (415).

Female. Surface of shell with depressions.

Length. 0.43 mm.

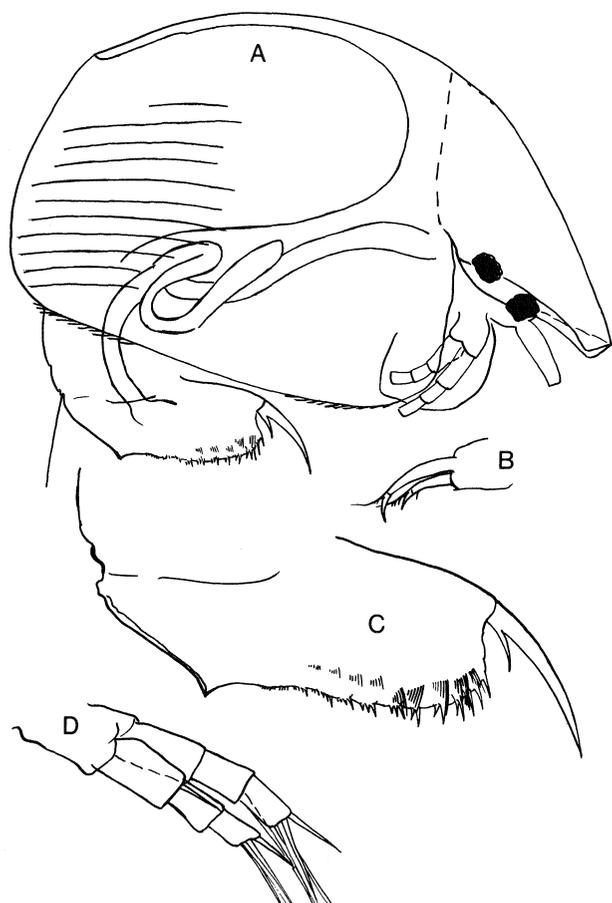


Fig. 49. *Alona poppei* ♀, L. Cullulleraine, Vic., 8.ix.78 (slide 3076). A, lateral view of whole animal, length 0.44 mm; B, large setae of external branch of endite of thoracic limb I; C, postabdomen; D, left antenna.

Alona poppei Richard, 1897

Fig. 49

Alona poppei Richard, 1897: 290-292, figs 37, 38.

Material. Vic.: 234a.

Slide. AM ♀ P31307.

Female. The general facies and form of the postabdomen essentially conform to Richard's description. Valve with longitudinal lines (about 16 in studied ♀), as noted by Richard (1897: 291) "Les valves présentent des stries assez espacées, peu visibles."

Antennal setae 0-0-3/0-1-3, spines 1-0-1/0-0-1. Two setae of external branch of endite of thoracic limb I transformed into hooks by enlargement of their proximal setules.

Richard (1897: 291) notes concerning the lateral setae of the postabdomen: "Les faces latérales du postabdomen présentent chacune 9 peignes de spinules dont la première seul (la distale de chaque groupe) est bien distinct mais n'atteint pas le bord dorsal du postabdomen" Contrary to Richard's indication, the large distal setae of the distal groups of the lateral setae project beyond the dorsal margin of the postabdomen in the studied female.

The exact form of the rostrum presents a taxonomic problem. It is blunt, i.e. truncated, in the Australian female studied. Richard did not describe or depict it as his specimen was in bad condition and an exact figure could not be drawn. Delachaux's (1919) description and figures of an American specimen are not helpful as the form of the rostral part of the head is not shown.

Length. 0.44 mm (slide 3076).

Distribution. Australia: Lower Murray-Darling system. Originally described from Lunache, Chile.

Differential diagnosis. It differs by the characteristic form and armature of the postabdomen. Species with a similarly elongated rounded postanal part of the postabdomen have been described from southern Africa (*Alona bukobensis* Weltner, 1896 in Sars, 1916, *Alona harpularia* Sars, 1916, and *Alona capensis* Rühle, 1921) but these differ in the armature of the postabdomen.

Alona setuloides n. sp.

Figs 50, 51

Material. W.A.: 403.

Holotype. AM ♀ P27692.

Paratypes. MGU ♀ 2925, ♀, ephippial ♀, ♂ 2929, ♀, ephippial ♀, ♂, head shield 2930, ♀, ♂, head shield 2931; ZIN ♀ 2926, BM ♀ 1980.357.

Female. Body oblong, ventral side being almost straight and bearing setae. Posterior corner of valves rounded, without denticles. Anterior and posterior sides of head shield widely rounded. Three major head pores, separate; minor head pores located well away from them. Antennule not reaching tip of rostrum. Antennal setae 0-0-3/1-1-3, spines 1-0-1/0-0-1.

Thoracic limb I with three setae, one being small, on external branch of endite. Postabdomen rather wide with both its margins slightly convex. Postabdomen with numerous small anal teeth and large fascicles of lateral setae; in most of the latter the posterior setae is largest; reaching margin of postabdomen. Anal margin only slightly depressed so that preanal corner is wide and not protruding. Claw with a long basal spine.

Intestine convoluted. Ocellus larger than eye.

Length. 0.68 mm (Holotype P27692).

Male. Ventral side of valve slightly depressed anteriorly. Antennule not reaching tip of rostrum. Postabdomen with very small anal teeth and large fascicles of lateral setae. Vasa deferentia open at end of postabdomen, ventrally from base of claw. Claw with a large basal spine.

Length. 0.51 mm.

Type locality. A roadside pond 640 km north of Perth.

Distribution. North-western W.A.

Etymology. The specific name is derived from *Alona setula* Megard, 1967, because of similarity in external appearance.

Differential diagnosis. The postabdomen has numerous small anal teeth. The three major head pores

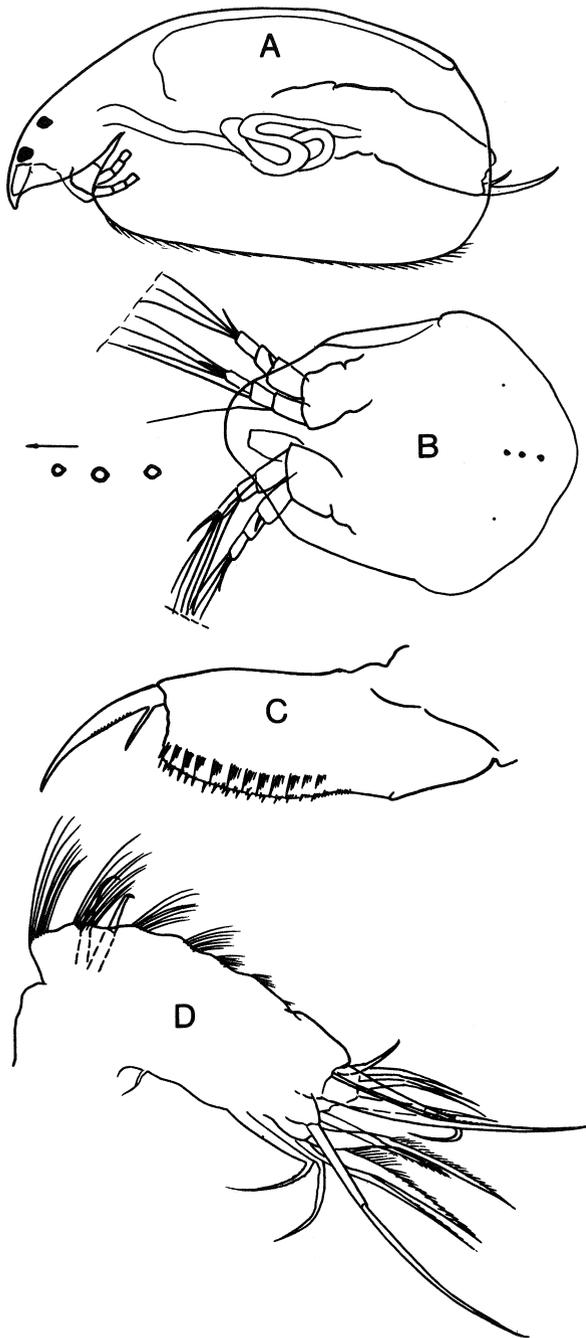


Fig. 50. *Alona setuloides* ♀, pond 60 km N of Perth, W.A., 22.viii.73. A, lateral view of whole animal, length 0.68 mm; B, head shield and head pores; C, postabdomen; D, thoracic limb I (A and C from slide 2925, B and D from slide 2930).

are separated. The ocellus is larger than the eye. *Alona setuloides* n. sp. is similar to *Alona setula* Megard, 1967 in that both have separate major head pores and the dentition of the postabdomen and the form of the male is similar in each. However, *A. setuloides* n. sp. is different because the major head pores are completely separate and the distal part of the postabdomen is comparatively longer and has more anal teeth and groups of lateral setae. It is also larger.

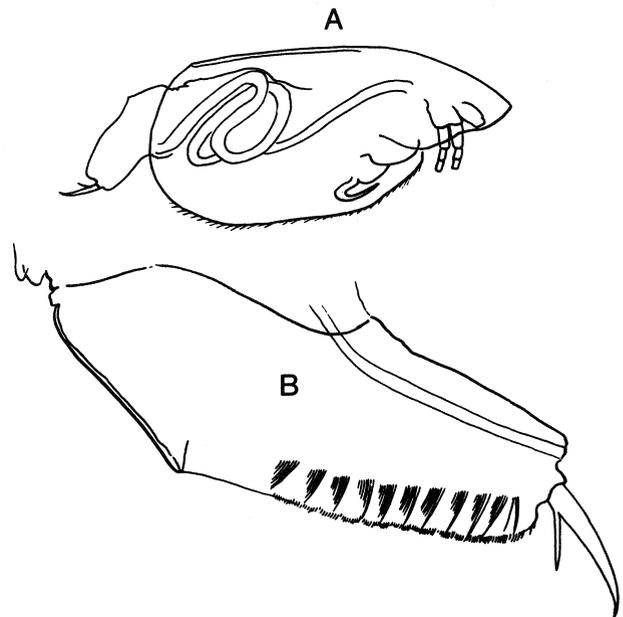


Fig. 51. *Alona setuloides* ♂, pond 60 km N of Perth, W.A., 22.viii.73. A, lateral view of whole animal, length 0.51 mm; B, postabdomen; both from slide 2931.

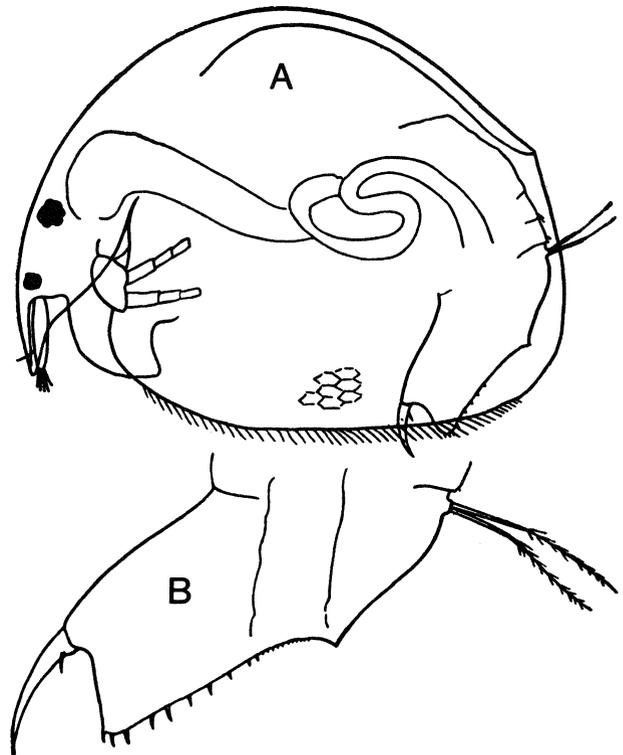


Fig. 52. *Alona clathrata* ♀, after Smirnov, 1971b. A, whole animal, length 0.28 mm; B, postabdomen.

Alona clathrata Sars, 1888

Fig. 52

Alona clathrata Sars, 1888: 62-65, pl. 6, figs 7-10.—Henry, 1922: 41; Smirnov, 1971b: 382, figs 459, 460.

Material. N.S.W.: 96.

Length. 0.38 mm.

Type locality. Crescent Lag., 3 km from Rockhampton, Qld.

Distribution. Sparsely distributed in coastal Qld and N.S.W.

Differential diagnosis. The valve is reticulated. The postabdomen is truncated and has a noticeable preanal angle. The anal teeth are small; there are no lateral setae on the postabdomen.

Alona archeri Sars, 1888

Fig. 53

Alona archeri Sars, 1888: 53-59, pl. 6, figs 1-4.—Smirnov, 1971b: 389-390, fig. 466.

Material. Qld: 64. N.S.W.: 107. Tas.: 326.

Length. 0.5 mm.

Type locality. A water body 32 km from Rockhampton, Qld.

Distribution. Sparsely distributed in coastal eastern Australia.

Differential diagnosis. *Alona archeri* is easily recognized by the elongated postabdomen with parallel dorsal and ventral margins and solitary large lateral setae. There are 12 anal teeth gradually diminishing

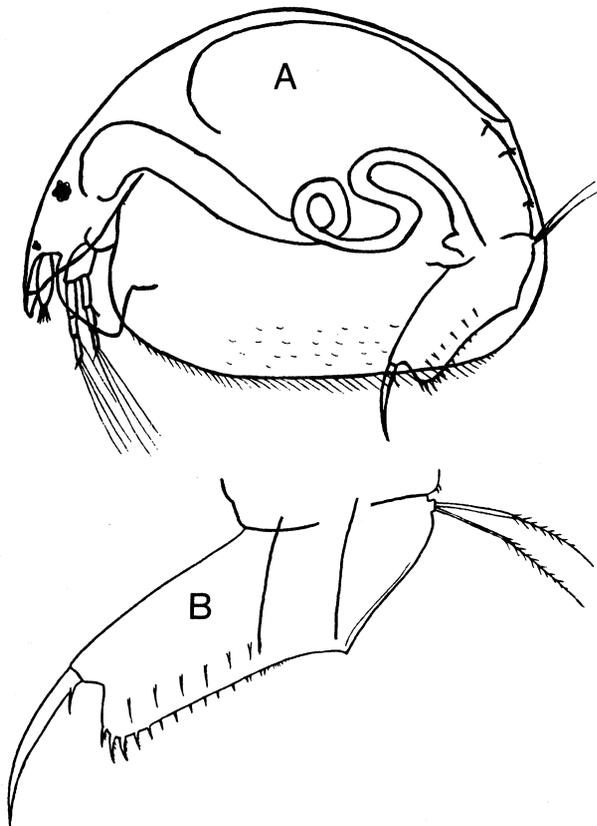


Fig. 53. *Alona archeri* ♀, from Smirnov, 1971b. A, whole animal, length 0.5 mm; B, postabdomen.

proximally. The valve lacks denticles on its ventro-posterior corner. According to Sars (1888: 53) "Surface of shell (is) sculptured with small depressed pits arranged in longitudinal rows."

Alona macracantha n. sp.

Fig. 54

Material. N.S.W.: 188.

Holotype. AM ♀ P31298.

Paratypes. MGU ♀ 3095, ZIN ♀ 3096.

Slides. MGU ♀ exuvium 3101.

Female. Body generally oval in lateral view. Posterior corners of valve rounded; no denticles on ventro-posterior corner. Head shield widely rounded posteriorly, its anterior end elongated into a blunt rostrum. Three major head pores narrowly connected. Minor head pores situated well away from major pores. Antennule reaching tip of rostrum. Antennal setae 0-0-3/1-1-3, spines 1-0-1/0-0-1.

Thoracic limb I with three setae on external branch of its endite, one very short. Postabdomen rather elongated; its preanal angle noticeable, but not prominent, and distal upper angle rounded, narrowing distally. Postanal margin with solitary anal teeth and solitary lateral setae. Claw with a large basal spine.

Intestine convoluted. Ocellus larger than eye, and situated closer to eye than to tip of rostrum.

Length. 0.5 mm (holotype).

Male. Unknown.

Etymology. The specific name refers to the very large basal spine of the claw.

Type locality. L. Menindee, N.S.W.

Distribution. Lower Murray-Darling System.

Differential diagnosis. This is a large *Alona*, well differentiated by the form of its postabdomen. The basal spine of its claw is very large. The ocellus is larger than the eye.

Alona investis n. sp.

Fig. 55

Material. Vic.: 262.

Holotype. AM ♀ P31297.

Female. Body generally oval in lateral view. Posterior corners of valves rounded; no denticles on ventro-posterior corner. Antennule reaches tip of rostrum. Lamella of labrum with a blunt apex.

Postabdomen short. Its postanal margin with groups of very small spines. Preanal angle prominent. Ocellus smaller than eye and situated closer to eye than to tip of rostrum.

The head pores could not be discerned, so the generic placement is tentative.

Length. 0.39 mm.

Male. Unknown.

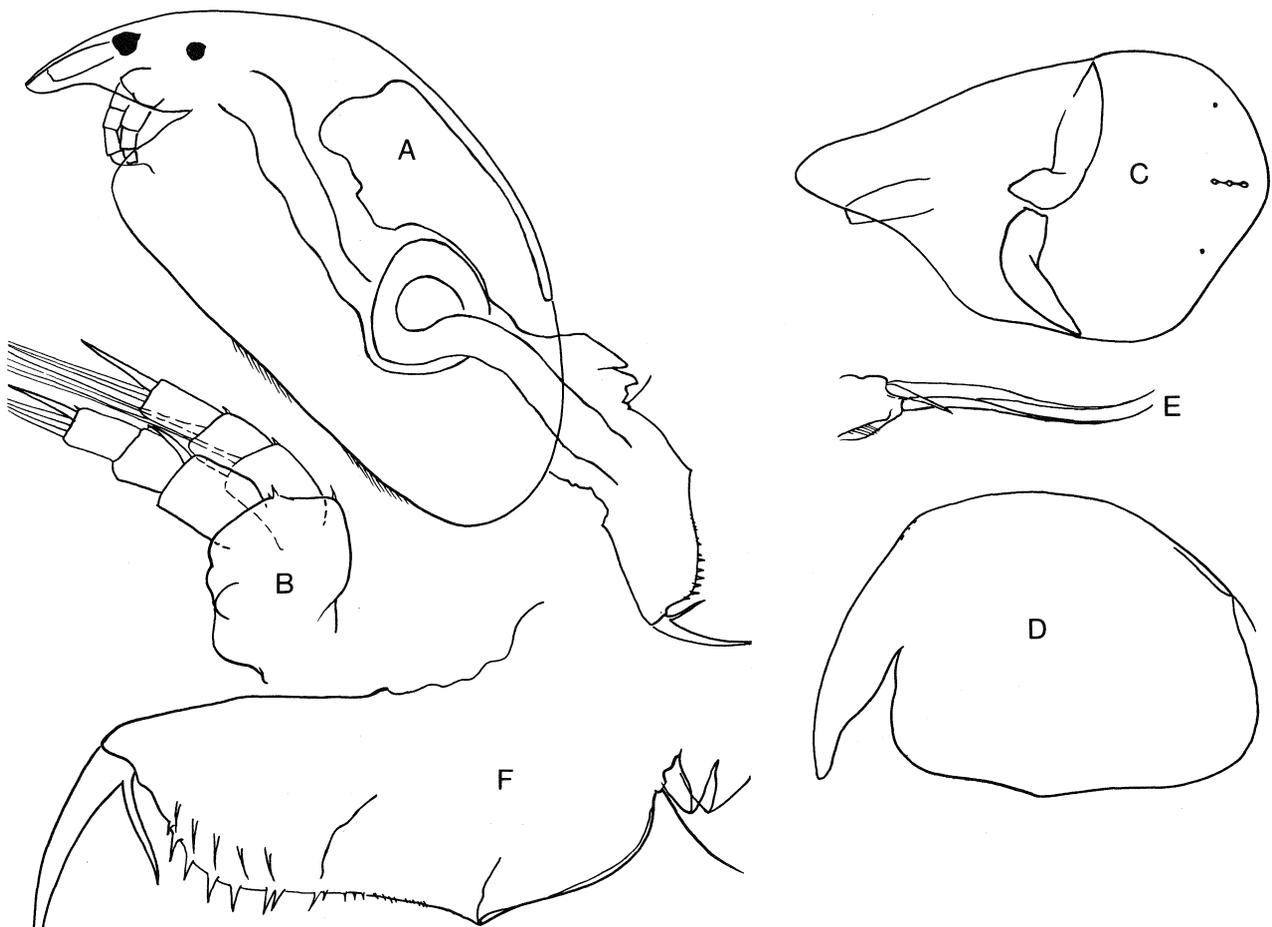


Fig. 54. *Alona macracantha* ♀, Lake Cawandilla, Menindee Lakes, N.S.W., 22.v.78. A, lateral view of whole animal, length 0.5 mm; B, left antenna from above; C, head shield; D, shell of less distorted specimen; E, external branch of endite of thoracic limb I; F, postabdomen. (A from holotype slide P31298; B, F from slide 3094; C, E from slide 3091; D from slide 3095.)

Etymology. The specific name is motivated by the absence of any large spines or setae on the postabdomen.

Differential diagnosis. A postabdomen with very little armature is almost unique among the Chydoridae, the sole exception being *Alona inermis* Pesta, 1928. This species differs from *A. investis* in the general shape of the postabdomen.

Alona pulchella King, 1853

Fig. 56

Alona pulchella King, 1853b: 260, pl. VIII B.—Sars, 1896: 37-40, pl. 6, figs 3, 4; Smirnov, 1971b: 373, 376, fig. 442.

Material. Qld: 15, 39, 52, 64. N.S.W.: 86, 105, 176. S.A.: 352.

Slides. AM ♀ P27689, MGU ♀ 1585, ZIN ♀ 53841 (1776).

Length. 0.39 mm.

Ecology. In Borumba Res. (Loc. No. 52) it was present in samples only from July to September (Timms and Midgley, 1969).

Type locality. Varroville (near Denham Court), St. Leonards (in Sydney).

Distribution. Qld, N.S.W., north-eastern S.A.

Differential diagnosis. The valve has granulations, but no polygons. The ventro-posterior corner of the valve lacks denticles. The labrum edge lacks serrations. The postabdomen is elongated, with parallel dorsal and ventral edges. There are about 10 anal teeth. The lateral setae of the postabdomen are arranged in fascicles.

Alona laevissima Sars, 1888

Fig. 57

Alona laevissima Sars, 1888: 59-62, pl. 6, figs 5, 6.—Henry, 1922: 42-43, pl. VIII, figs 3, 3A.

Material. Literature.

Length. 0.48 mm.

Type locality. Near Gracemere, Qld.

Distribution. Qld, N.S.W.

Differential diagnosis. The carapace is oval in shape and has a smooth surface. There are no denticles on the

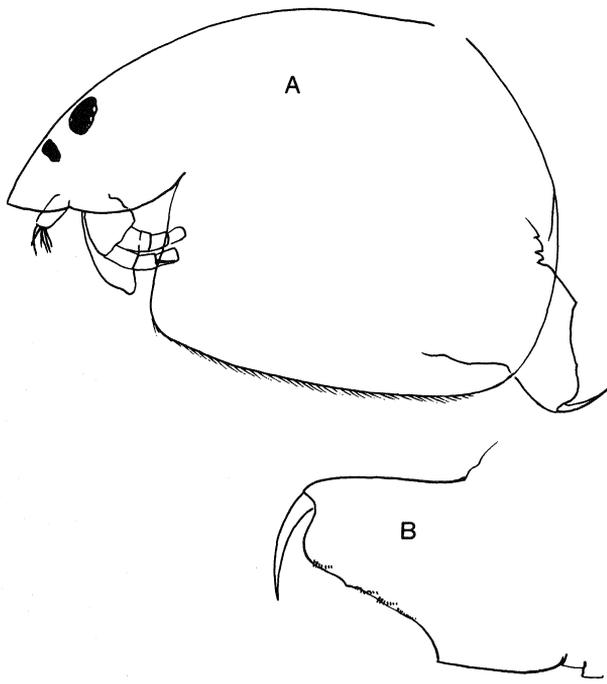


Fig. 55. *Alona investis* ♀, L. Mulwala, via Yarrawonga, Vic., 20.v.77. A, lateral view; B, postabdomen from slide AM ♀ P31297.

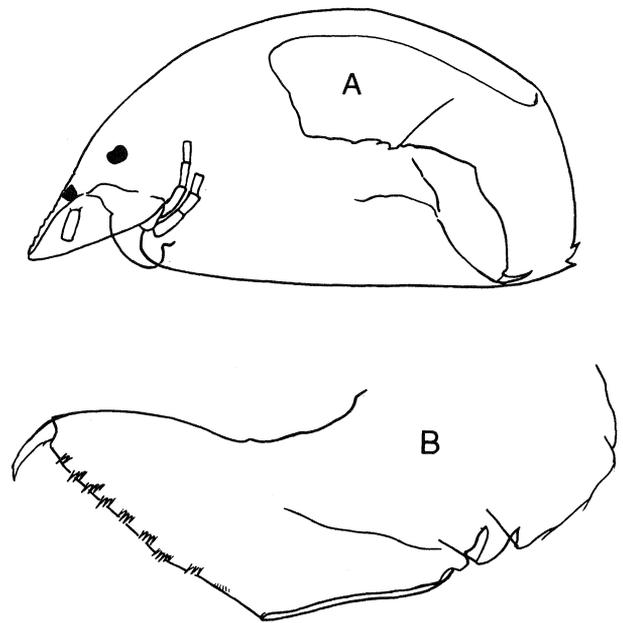


Fig. 58. *Graptoleberis testudinaria occidentalis* ♀, Ellalong Lag., via Cessnock, N.S.W., 11.ix.66. A, lateral view of whole animal, length 0.5 mm; B, postabdomen. (Both from slide 2148.)

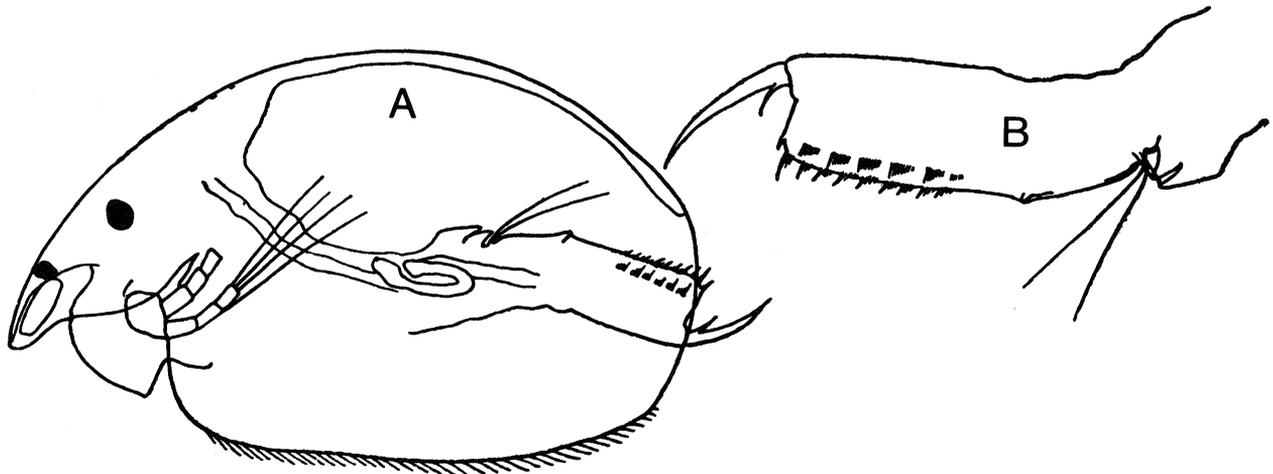


Fig. 56. *Alona pulchella* ♀, after Smirnov, 1971b. A, whole animal, length 0.39 mm; B, postabdomen.

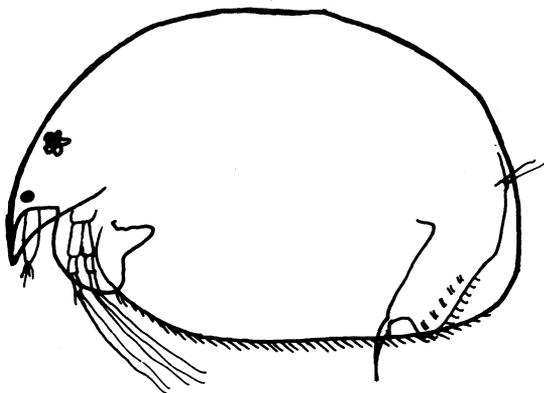


Fig. 57. *Alona laevisissima* ♀, after Sars, 1888.

ventro-posterior corner of the valve. The postabdomen is truncated. The preanal angle projects slightly. The anal teeth are small; there are 5 groups of lateral setae.

Incertae sedis

Alona bairdii King, 1853b: 259, pl. VIIIA.—Sars, 1888, 69.

Alona karua King, 1853b: 260, pl. VIIID.

Alona mascula King, 1853b: 261–262; pl. VIIIE.—Sars, 1888: 70; Smirnov 1966: 121 (erroneously considered to be comparable to *Alonopsis*).

Genus *Graptoleberis* Sars, 1862

Graptoleberis Sars, 1862: 41.—Smirnov, 1971b: 443.

Chydorids with ventral surface of valve straight in lateral view and with denticles at its ventro-posterior corner. Front margin of head shield in dorsal view widely rounded. Shell with expressed polygons. Postabdomen and its claw short.

It is a monotypic genus with type species *Graptoleberis testudinaria* (Fischer, 1851).

***Graptoleberis testudinaria* (Fischer, 1851)**

Fig. 58

Lynceus testudinarius Fischer, 1851: 191, Taf. IX, fig. 12.
Graptoleberis testudinaria.—Stingelin, 1895: 252; Smirnov, 1971b: 443–449.

Material. *Qld*: 12, 51. *N.S.W.*: 82, 87, 96, 116, 117, 133, 166, 168, 186. *Vic.*: 224, 229, 230, 232, 238, 256, 257. *Tas.*: 312, 314, 317, 320, 332. *W.A.*: 405, 406.

Distribution. Australia-wide, but particularly the south-east.

Several subspecies have been described, of which two are known for Australia.

***Graptoleberis testudinaria testudinaria* (Fischer, 1851)**

Lynceus testudinarius Fischer, 1851: 191, Taf. IX, fig. 12.
Graptoleberis testudinaria testudinaria.—Smirnov, 1971b: 444, figs 545–549.

Material. *Qld*: 12.

Female. Postabdomen narrows distally. Claw with one small basal spine. Denticles of ventro-posterior corner of valve large (8–14 μm).

***Graptoleberis testudinaria occidentalis* Sars, 1901**

Graptoleberis testudinaria var. *occidentalis* Sars, 1901: 66, pl. X, figs 8, 8a, 8b.

Graptoleberis testudinaria occidentalis.—Smirnov, 1971b: 446, figs 550, 553.

Material. *N.S.W.*: 96, 116, 133, 166, 186. *Vic.*: 230, 232, 238. *Tas.*: 312, 317.

Slides. AM ♀ P27716, MGU ♀ 2137, 2138, 2148, 2153, ZIN ♀ 2142.

Female. Postabdomen narrows distally. Claw with one basal spine. Denticles of ventro-posterior corner of valve small (7–10 μm). Anal teeth in groups of 3 or 4.

Genus *Acroperus* Baird, 1843

Acroperus Baird, 1843: 91 (subgenus *Acroperus*).—Smirnov, 1971b: 400–402.

Body form oval and compressed. Postabdomen moderately elongated, with parallel dorsal and ventral edges. The Australian species differ only in the proportions of parts of the head and its appendages.

All four species of *Acroperus* known from Australia are uncommon. As a group they are restricted to coastal areas of southern Qld and northern N.S.W., often in markedly acid waters.

The type species is *Acroperus harpae* (Baird, 1834).

Key to Australian Species of *Acroperus*

1. Antennule protrudes beyond tip of rostrum *A. sinuatus* Henry, 1919
— Antennule does not protrude beyond tip of rostrum 2
- 2(1). Antennule reaches to tip of rostrum *A. neglectus* Lilljeborg, 1900
— Antennule does not reach to tip of rostrum 3
- 3(2). Head keel wider than eye
..... *A. harpae* (Baird, 1834)
— Head keel narrower than eye
..... *A. alonoides* Hudendorff, 1876

***Acroperus harpae* (Baird, 1834)**

Lynceus harpae Baird, 1834: 100, pl. II, fig. 17.

Acroperus harpae.—Baird, 1843: 91–92, pl. III, fig. 7; Smirnov, 1971b: 403–406, figs 483–489.

Material. *N.S.W.*: 81.

Length. 0.58 mm.

Distribution. Known only from one locality in coastal northern N.S.W.

Differential diagnosis. Body height is 64% of length. There is a head keel, its width exceeding the diameter of the eye. The antennule does not reach the tip of the rostrum.

***Acroperus alonoides* Hudendorff, 1876**

Figs 59, 60

Acroperus alonoides Hudendorff, 1876: 51–52, Taf. II, fig. 4.—Smirnov, 1971b: 409, 413, figs 496–499.

Acroperus harpae var. *frigida* Ekman, 1904: 23–24, figs A, B.

Material. *Qld*: 50, 51. *N.S.W.*: 77.

Slides. AM ♀ P27683, MGU ♀ 1097, ♂ 160, ZIN ♀ 157.

Length. 0.85 mm.

Distribution. Coastal region of southern Qld and northern N.S.W.

Differential diagnosis. The width of the head keel is less than the width of the eye. The antennule does not reach the tip of the rostrum.

***Acroperus neglectus* Lilljeborg, 1900**

Acroperus neglectus Lilljeborg, 1900: 425–428, tab. LXIV, figs 11–21.

Acroperus avirostris Henry, 1919: 469–470, pl. XL, figs 3, 4; 1922: 39, pl. VI, figs 2, 2A., n. syn.

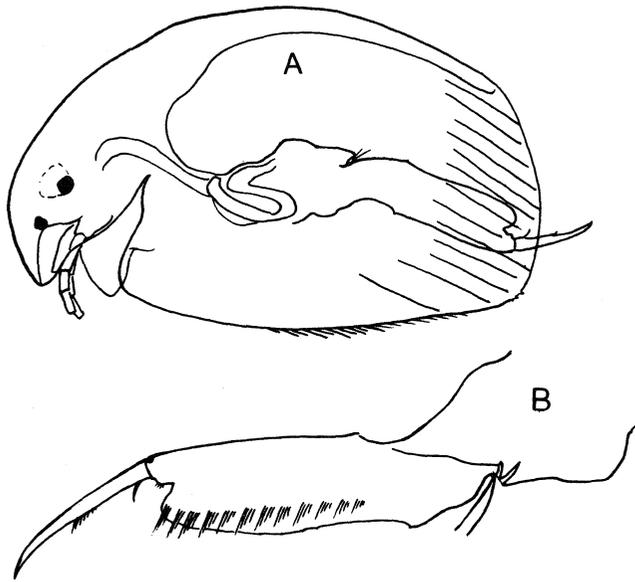


Fig. 59. *Acroperus alonoides* ♀, Emigrant Ck near Ballina, N.S.W., 18.vii.65. A, lateral view of whole animal, length 0.85 mm; B, postabdomen. (Both from slide 1097.)

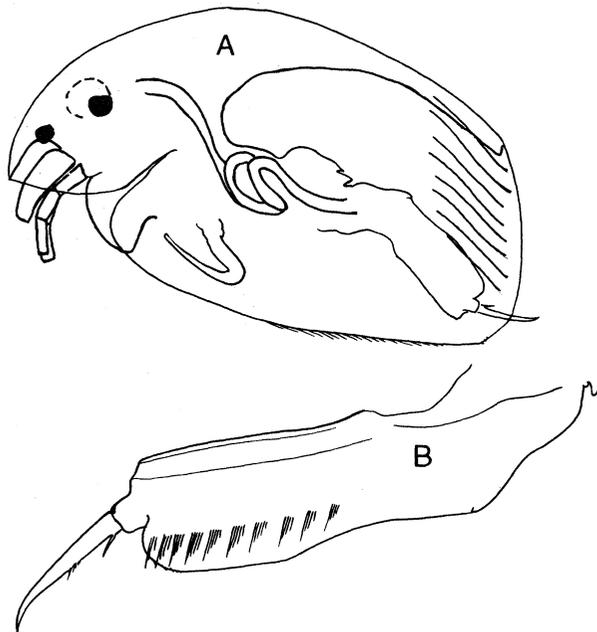


Fig. 60. *Acroperus alonoides* ♂, Emigrant Ck near Ballina, N.S.W., 18.vii.65. A, lateral view of whole animal; B, postabdomen. (Both from slide 160.)

Material. N.S.W.: 78, 99, Henry's slides in the Australian Museum: "P:4328 *Acroperus avirostris*, Henry, Holotype, Kendall"; "P:5901 *Acroperus avirostris* Loc. Kendall."

Female. In holotype slide P:4328 the antennule reaches the tip of the rostrum. The ratio of body height to length is 65% (not 60% as noted by Henry). The female on slide P:5901 is very similar.

Length. Up to 0.63 mm. Lilljeborg (1900) indicates a length of 0.7–0.78 mm.

Differential diagnosis. The antennule almost reaches the tip of the rostrum which is comparatively blunt. The height is 60–65% of length.

Acroperus sinuatus Henry, 1919

Acroperus sinuatus Henry, 1919: 471-472, pl. XL, figs 5, 6; 1922: 39.

Material. Holotype in the Australian Museum "P:4329 *Acroperus sinuatus* Henry, Holotype, Kendall."

Length. 0.59 mm.

Type locality. Kendall, N.S.W.

Distribution. Known only from type locality on mid-north coast of N.S.W.

Differential diagnosis. The antennule protrudes beyond the tip of the rostrum.

Genus *Kurzia* Dybowski & Grochowski, 1894

Kurzia Dybowski & Grochowski, 1894: 380.—Smirnov, 1971b: 395.

Pseudalona Sars, 1901: 85.

Body relatively high and oval in shape. Postabdomen elongated and narrowing distally. Rostrum long.

The species of *Kurzia* are rarely encountered in Australia.

The type species is *Kurzia latissima* (Kurz, 1875).

Key to *Kurzia* Species

1. Antennule almost reaches to tip of rostrum. Distal angle of postabdomen not protruding *K. latissima* (Kurz, 1875)
— Antennule reaches to middle of rostrum. Distal angle of postabdomen protruding *K. longirostris* (Daday, 1898)

Kurzia latissima (Kurz, 1875)

Fig. 61

Alonopsis latissima Kurz, 1875: 46-47, pl. II, figs 13-15.
Kurzia latissima.—Behning, 1941: 261-263, fig. 108.—
Smirnov, 1971b: 397-398, figs 476-478.

Material. Vic.: 225, 231.

Slides: MGU ♀ 2714, 3020.

Length. 0.6 mm.

Distribution. Australia: central and northern Victoria. World: Holarctic and Neotropical regions.

Differential diagnosis. The antennule of the female reaches the tip of the rostrum. The upper distal angle of the postabdomen does not protrude.

Kurzia longirostris (Daday, 1898)

Fig. 62

Alona longirostris Daday, 1898: 34, fig. 14.
Kurzia longirostris.—Harding, 1957: 73, fig. 15; Smirnov, 1971b: 398-400, figs 480-482.

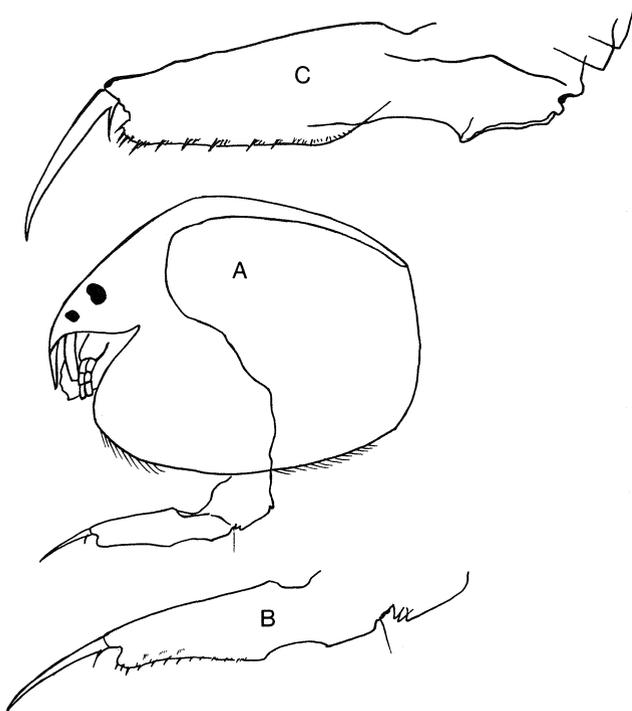


Fig. 61. *Kurzia latissima* ♀, Snowdons Lag., via Wodonga, Vic., 11.viii.76. A, lateral view of whole animal, length 0.6 mm, slide 2714; B, postabdomen, slide 2714; C, postabdomen from abnormal parthenogenetic ♀, slide 3020.

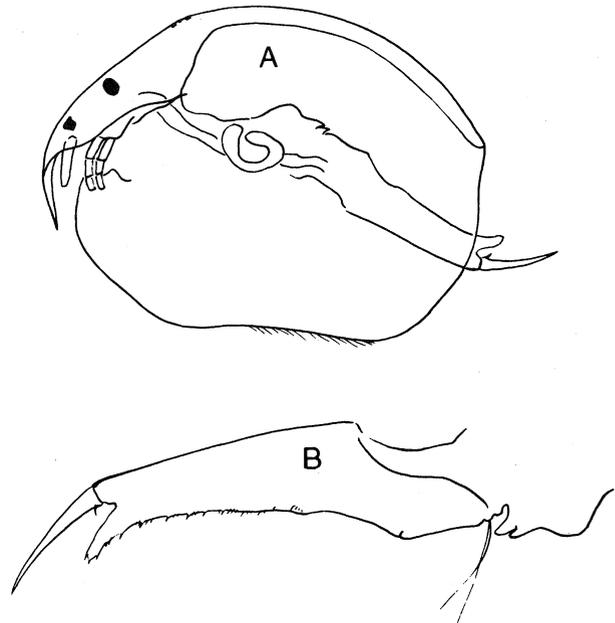


Fig. 62. *Kurzia longirostris* ♀, Toomba swamp, via Charters Towers, Qld, 13.vi.74. A, lateral view of whole animal, length 0.57 mm; B, postabdomen. (Both from slide 2784.)

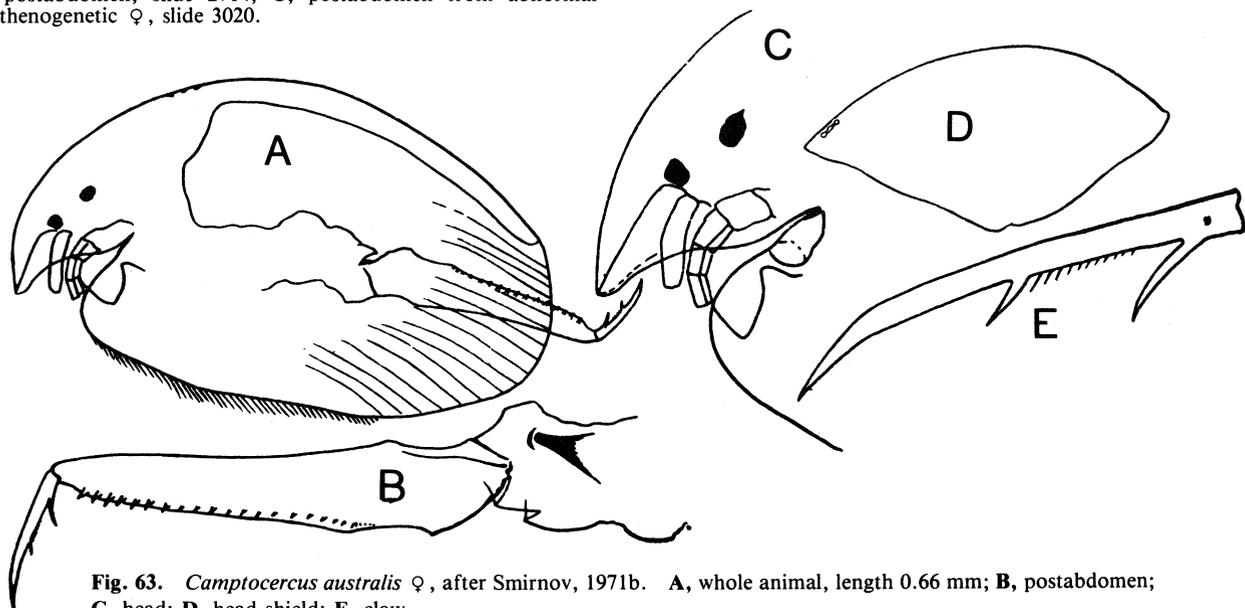


Fig. 63. *Camptocercus australis* ♀, after Smirnov, 1971b. A, whole animal, length 0.66 mm; B, postabdomen; C, head; D, head shield; E, claw.

Material. Qld: 16. N.S.W.: 96, 176.

Slides. AM ♀ P27717, MGU ♀ 2784, ZIN ♀ 2749.

Length. 0.46 mm.

Distribution. Australia: isolated in Qld, and northern N.S.W. World: a pantropical species in Ethiopic, Neotropical, Indo-Malayan regions, also New Guinea.

Differential diagnosis. The antennule of the female reaches the middle of the rostrum. The upper distal angle of the postabdomen is variously protruding.

Genus *Camptocercus* Baird, 1843

Camptocercus Baird, 91 (subgenus *Camptocercus*).—Smirnov, 1971b: 429.

Shell, trunk, and postabdomen elongated. Thoracic limbs III and IV superficially similar.

The type species is *Camptocercus rectirostris* Schoedler, 1862.

Only one species has been recorded from Australia.

Camptocercus australis Sars, 1896

Fig. 63

Camptocercus australis Sars, 1896: 45-47, pl. 6, figs 9, 10.
—Henry, 1922: 39, pl. VI, figs 3, 3A; Smirnov, 1971b: 436, fig. 531; 1972: 393-409, fig. 3G.

Material. *Qld*: 12, 15, 23, 51, 66. *N.S.W.*: 82, 96, 122, 132. *Vic.*: 226, 232, 233, 242, 257, 259, 260. *Tas.*: 300, 309, 310, 312, 313, 332, 335.

Slides. AM ♀ P27707, MGU ♀ 1788, ZIN ♀ 2897.

Length. 0.83 mm.

Type locality. Centennial Park, Sydney.

Distribution. Eastern Australia.

Differential diagnosis. The species is readily recognizable by its elongated body form and very elongated postabdomen. The ventro-posterior corner of valve is rounded and lacks denticles. The external branch of the endite of thoracic limb I has 3 setae possessing setules which gradually increase in length proximally.

Genus *Leydigia* Kurz, 1875

Leydigia Kurz, 1875: 57; Smirnov, 1971b: 449-450.

Body high. Postabdomen widely rounded, with very large lateral setae, and very small, almost inconspicuous, anal teeth. Some antennal segments with groups of spines. Ocellus commonly larger than eye.

Five species occur in Australia, but each is uncommon. They live in the surface layer of mud (Sars, 1885; Fryer, 1968), a microhabitat noted for *L. australis* in *L. Purrumbete*, *L. ciliata* in Atkinsons Lag., and *L. leydigi* in two shallow lakes on the Monaro Tableland, N.S.W. Our other records of *Leydigia* spp. are from vegetated littoral regions, but in each case the net probably sampled bottom mud.

The type species is *Leydigia leydigi* (Schoedler, 1863).

Key to Australian Species of *Leydigia*

1. Claw with a basal spine
..... *L. leydigi* (Schoedler, 1863)
- Claw without a basal spine 2
- 2(1). Postabdomen widest in its middle part
and narrowing a little distally
..... *L. australis* Sars, 1885
- Postabdomen widest distally 3
- 3(2). Each group of lateral setae composed
of more than two setae 4
- Only two setae in such groups; eye
a little smaller than ocellus
..... *L. acanthocercoides* (Fischer, 1854)
- 4(3). Longitudinal rows of granules on
valve *L. ciliata* Gauthier, 1939
- Valve punctate *L. laevis* Gurney, 1927

Leydigia leydigi (Schoedler, 1863)

Alona leydigii Schoedler, 1863: 27.

Leydigia leydigi.—Daday, 1902: 265-266, tab. 6, fig. 1.—Smirnov, 1971b: 450-454, figs 554-558.

Material. *N.S.W.*: 145, 149, 152, 155. *S.A.*: 362, 363.

Length. 0.7 mm.

Distribution. Limited areas of N.S.W. (Monaro Tableland) and S.A. (near Adelaide).

Differential diagnosis. The claw has a small basal spine. The edge of the labrum is smoothly convex and has short hairs. The ocellus is slightly larger than the eye.

Leydigia ciliata Gauthier, 1939

Fig. 64

Leydigia propinqua var. *ciliata* Gauthier, 1939 (January): 169-173, fig. 9 a-g.

Leydigia striata Biraben, 1939 (May): 661-663, figs 14-16.

Leydigia ciliata.—Harding, 1955: 242-243, figs 50-60; Smirnov, 1971b: 454, fig. 563.

Material. *Qld*: 64. *N.S.W.*: 113, 158.

Slides. AM ♀ P27718, MGU ♀ 1769, 2098, ZIN ♀ 2102.

Length. Up to 0.97 mm.

Distribution. Isolated areas of eastern Qld and N.S.W.

Differential diagnosis. The claw has no basal spine or a very small one. The postabdomen is widest distally and the distal groups of lateral setae on it contain more than two setae. There are longitudinal rows of granules on the valves.

Leydigia acanthocercoides (Fischer, 1854)

Lynceus acanthocercoides Fischer, 1854: 431-433, tab. III, figs 21-23.

Leydigia acanthocercoides.—Sars, 1895: 18-22, pl. 4, figs 1-4; Smirnov, 1971b: 458-460, figs 569-570.

Material. *Qld*: 39. *N.S.W.*: 113, 158.

Length. Up to 1 mm.

Distribution. Isolated areas of eastern Qld and N.S.W.

Differential diagnosis. The claw has no basal spines. The postabdomen is widest distally and the distal groups of lateral setae on it contain two setae. The valve is longitudinally lineated. The eye is slightly smaller than the ocellus.

Leydigia australis Sars, 1885

Leydigia australis Sars, 1885: 35-43, pls 7, 8.

Material. *Vic.*: 249.

Distribution. Isolated areas of Qld and Vic.

Of the two subspecies known, only the typical form is found in Australia.

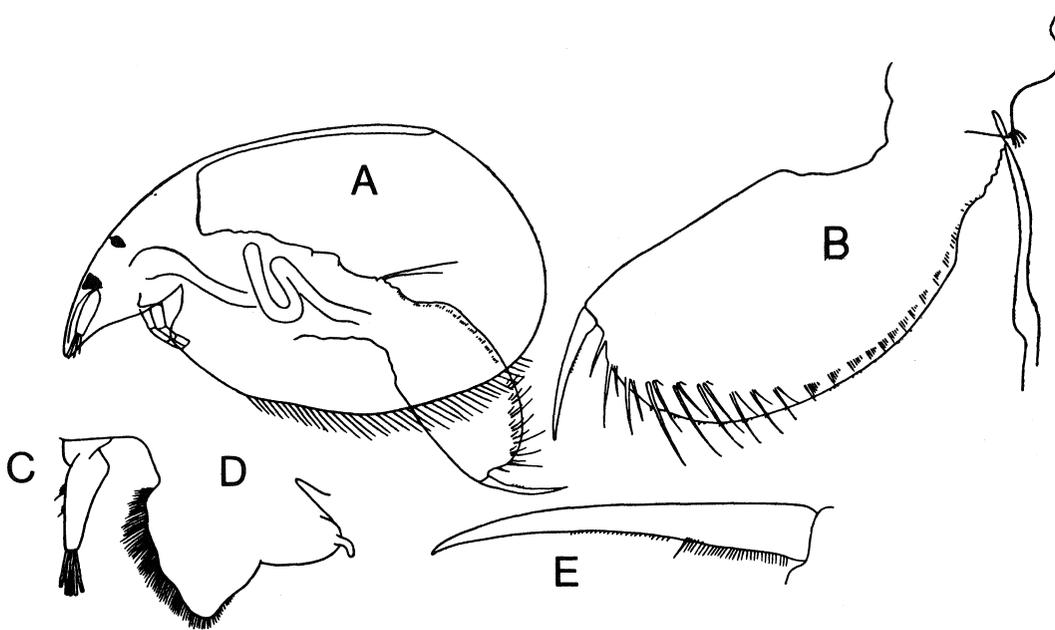


Fig. 64. *Leydigia ciliata* ♀, after Smirnov, 1971b. A, whole animal, length 0.62 mm; B, postabdomen; C, antennule; D, labrum; E, claw.

Leydigia australis australis Sars, 1885

Material. Vic.: 249.

Slides. MGU ♀ 2488, ZIN ♀ 2487.

Length. 0.84 mm.

Type locality. Gracemere Lag., 10 km west of Rockhampton, Qld.

Differential diagnosis. The claw has no basal spine. The postabdomen narrows slightly distally so that it is widest in its middle part. The edge of the labrum is smoothly convex with short hairs. The valve has no longitudinal lines. The ocellus is much larger than the eye.

Leydigia laevis Gurney, 1927

Fig. 65

Leydigia laevis Gurney, 1927: 73-75, fig. 9.—Smirnov, 1971b: 458, fig. 568.

Material. Literature.

Length. 0.6 mm.

Type locality. Longreach, Qld.

Distribution. Known only from the type locality in western Qld.

Differential diagnosis. The claw has no spine. the postabdomen is widest distally and the distal groups of lateral setae on it contain more than two setae. The valve is punctate and sometimes has faint polygons. The labrum is smoothly convex and has small hairs along its edge. The eye and ocellus are equal in size.

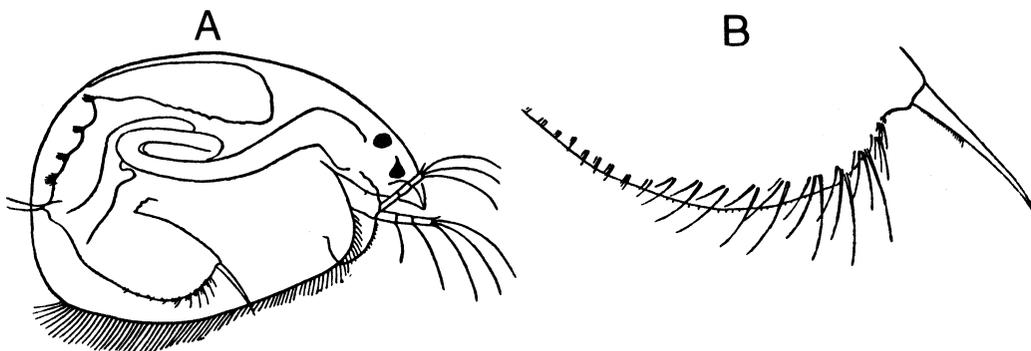


Fig. 65. *Leydigia laevis* ♀ after Smirnov, 1971b. A, whole animal, length 0.3 mm; B, postabdomen.

Genus *Biapertura* Smirnov, 1971

Biapertura Smirnov, 1971b: 466.

The genus was erected for those Aloninae possessing two narrowly connected major head pores, in contrast to forms having three major head pores, or two major head pores with a wide connection, or unconnected major head pores. Harding (1972) and Petkovski (1973a) note that head pores should not be overstressed as a character. Harding further notes that species attributed to *Biapertura* are not unified by other characters. However, before these species were removed from *Alona*, the latter was an even more heterogeneous assembly, almost without any common characters.

Key to Australian Species of *Biapertura*

- | | | |
|--------|--|--|
| 1. | Labrum with a small notch or angle on its edge | 2 |
| — | No notch on labrum | 4 |
| 2(1). | Some antennal setae in the form of long spines | 3 |
| — | Antennal segments without long spines; antenna comparatively short | <i>B. abbreviata</i> (Sars, 1896) n. comb. |
| 3(2). | Ventro-posterior corner of valve rounded, lacking denticles | |
| — | Ventro-posterior corner of valve with denticles | |
| — | | <i>B. duodonta</i> (Henry, 1922) n. comb. |
| 4(1). | Separate denticles on ventro-posterior corner of valve | <i>B. karua</i> (Sars, 1888) |
| — | No denticles on ventro-posterior corner of valve | 5 |
| 5(4). | Length of preanal margin of postabdomen equals distance from preanal angle to base of claw | <i>B. rigidicaudis</i> Smirnov, 1971 |
| — | Preanal margin of postabdomen short | 6 |
| 6(5). | Postabdomen dilated distally; lateral setae reaching beyond edge of postabdomen | <i>B. intermedia</i> (Sars, 1862) |
| — | Postabdomen not dilated distally | 7 |
| 7(6). | Anal denticles large | 8 |
| — | Anal denticles small; dorsal and ventral edges of postabdomen parallel | <i>B. longinqua</i> Smirnov, 1971 |
| 8(7). | Dorsal margin of postabdomen convex; its dorso-posterior corner not protruding beyond base of claw | 9 |
| — | Dorsal margin of postabdomen straight or slightly concave; its dorso-posterior corner protruding beyond base of claw | 10 |
| 9(8). | Anal denticles with setules along their functionally posterior side; no spinule at border between first and second joints of distal swimming setae of antennae | <i>B. kendallensis</i> (Henry, 1919) |
| — | Anal denticles without setules along their functionally posterior side; spinule present at border between first and second joints of distal swimming setae of antennae | <i>B. affinis</i> (Leydig, 1860) |
| 10(8). | Dorsal edge of postabdomen straight; its distal edge truncated | |
| — | Dorsal edge of postabdomen slightly concave; its distal edge protruding noticeably beyond base of claw, and its apex rounded | <i>B. setigera</i> (Brehm, 1931) n. comb. |
| — | Dorsal edge of postabdomen slightly concave; its distal edge protruding noticeably beyond base of claw, and its apex rounded | <i>B. rusticoides</i> n. sp. |

Biapertura affinis (Leydig, 1860)

Lynceus affinis Leydig, 1860; 223, Taf. IX, figs 68, 69.
Alona oblonga P.E. Muller, 1867: 175-176, tab. III, figs 22-23, tab. IV, figs 1, 2.
Alona whiteleggii Sars, 1896: 35-37, pl. 6, figs 1, 2.—Henry, 1922: 40-41.
Alona affinis.—Sars, 1901: 48-49, pl. IX, figs 1, 1 a-d; Henry, 1922: 40-41.
Alona longirostris Henry, 1919: 474-476, pl. xli, figs 11, 12.—Henry, 1922: 40-41, n. syn.
Biapertura affinis.—Smirnov, 1971b: 467-474, figs 582-587.

Material. Qld: 6, 54, 60, 66. N.S.W.: 77, 93, 133, 148, a slide in the Australian Museum "P:4332 *Alona affinis* Leydig, Byron Bay". Vic.: 203, 224, 225, 230, 232, 239. Tas.: 303. W.A.: 419.

Comment. The holotype slide of *Alona longirostris* in the Australian Museum—"P:4332 *Alona longirostris* Henry, Holotype, Byron Bay"—contains *Biapertura affinis*, *B. setigera*, *Moinodaphnia macleayi* and *Simocephalus* sp. Obviously *Biapertura affinis* was noted by Henry as *Alona longirostris*.

Female. A number of subspecies are known (Smirnov, 1971b). The typical form is found in material from Loc. No. 77. Females from the population of the littoral of Loc. No. 133 have round depressions in the head shields. These forms correspond to "tuberculata" or "caelata" forms known for many species (e.g. *Chydorus eurynotus caelatus*, *Alona rectangula pulchra*) and are commonly designated as a separate taxon, in distinction to smooth forms. However the true nature of the tuberculated forms is not known. Harmsworth (1968) notes that tuberculated forms are present in acid peaty (bog) waters. Therefore in the present case this form is noted here but not named.

Length. 0.84 mm.

Ecology. Unlike most other chydorids, *B. affinis* was often found in Australia living amongst vegetation in flowing water.

Distribution. Probably Australia-wide, but most common in southern Qld, eastern N.S.W. and Vic.

Differential diagnosis. The anal denticles of the postabdomen are large but not wide and have no setulations along its functionally posterior side. The postabdomen is not dilated distally. There is a spinule at the border of the first and second segments of the distal setae of the antennae. The outgrowths of the epipodites of legs IV and V are short.

Biapertura affinis affinis (Leydig, 1860)

Material. N.S.W.: 77.

Slide. MGU ♀ 598.

Biapertura kendallensis (Henry, 1919)

Fig. 66

Alona kendallensis Henry, 1919: 474-475, pl. xli, figs 9, 10; 1922: 41, pl. VIII, fig. 7.

Biapertura kendallensis.—Smirnov, 1971b: 474, figs 591-592.

Material. Qld: 66. N.S.W.: 92, 133, holotype slide in Australian Museum "P:4331 *Alona kendallensis*. Holotype. Kendall". Vic.: 203, 232, 257.

Slides. AM ♀ P27701, MGU ♀ 1770, ZIN ♀ 2267.

Female. The two major head pores connected in the holotype specimen. Postabdomen with wide anal teeth, the latter with additional indentations. Thoracic limb I with a hook-like seta on external branch of endite. It was impossible to distinguish the antennal setae on the holotype.

Length. Up to 1 mm.

Ecology. Found mainly in acid waters (pH 6.0-7.0).

Type locality. Kendall, N.S.W.

Distribution. Uncommon in southern Qld, coastal N.S.W. and southern Vic.

Differential diagnosis. The anal teeth of the postabdomen are large and have setulations along their functionally posterior side. The postabdomen is not dilated distally. Its dorsal edge is convex and its distal edge rounded. There is no spinule at the border of the first and second joints of the distal swimming setae of the antenna. The outgrowths of the epipodites of legs IV and V are long. *Biapertura kendallensis* and *B. affinis* are very similar in size and form, but as shown above they can be distinguished by the structure of the anal teeth and antennal setae.

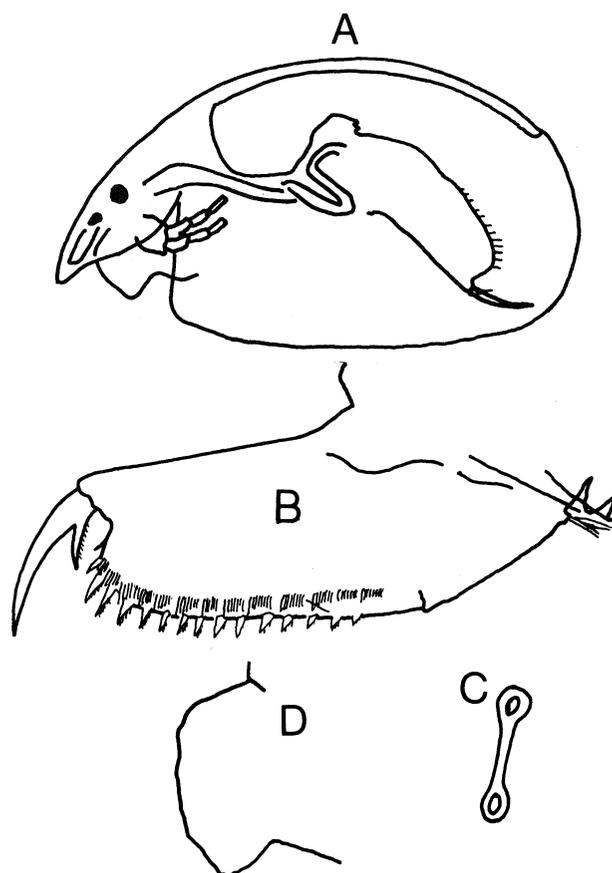


Fig. 66. *Biapertura kendallensis* ♀, after Smirnov, 1971b. A, whole animal, length 1.06 mm; B, postabdomen; C, head pores; D, labrum.

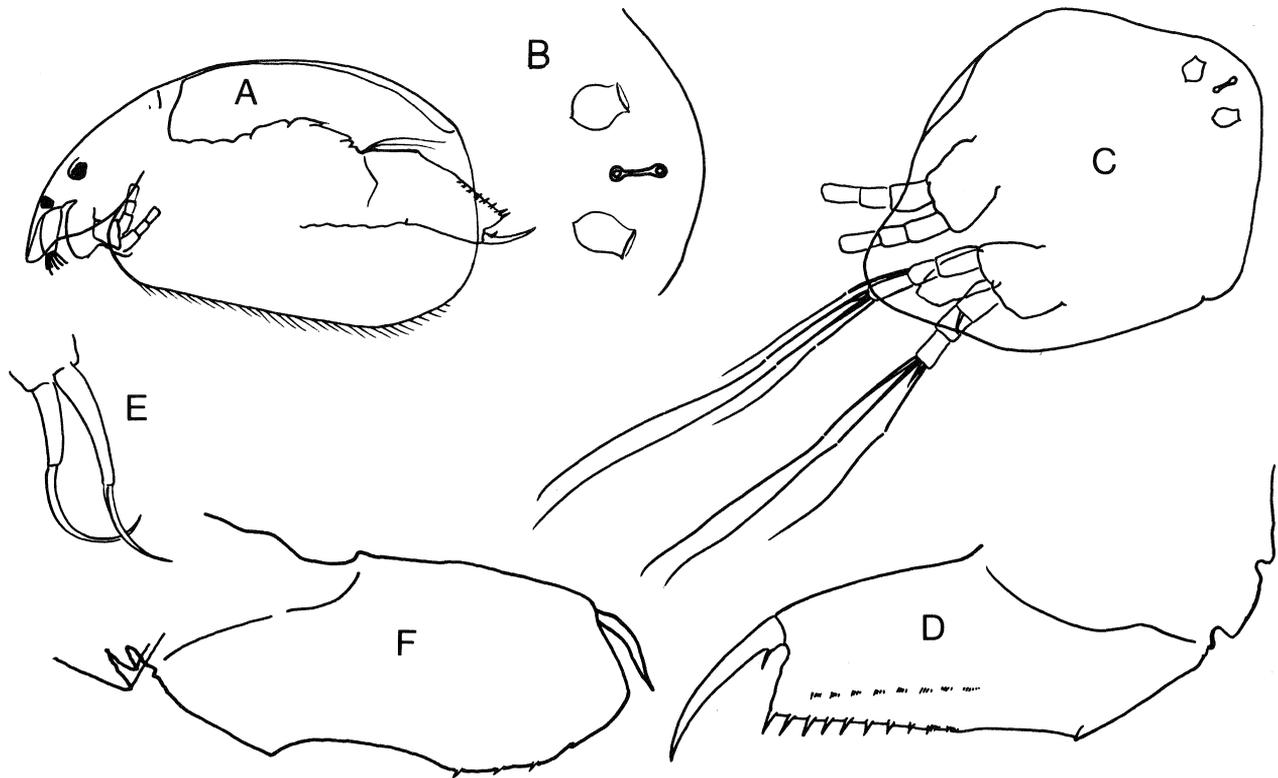


Fig. 67. *Biapertura setigera* ♀, Main Bridgewater L., via Portland, Vic., 18.ii.72. A, lateral view of whole animal, length 0.5 mm, slide AMP 27706; B & C: head shield, slide 1482; D, postabdomen, slide AMP 27706; E, large setae of external branch of endite of limb I, slide AMP 27706; F, abnormal postabdomen of a specimen from L. Freshwater, Cooloola, Qld, 16.vii.76, slide 2866.

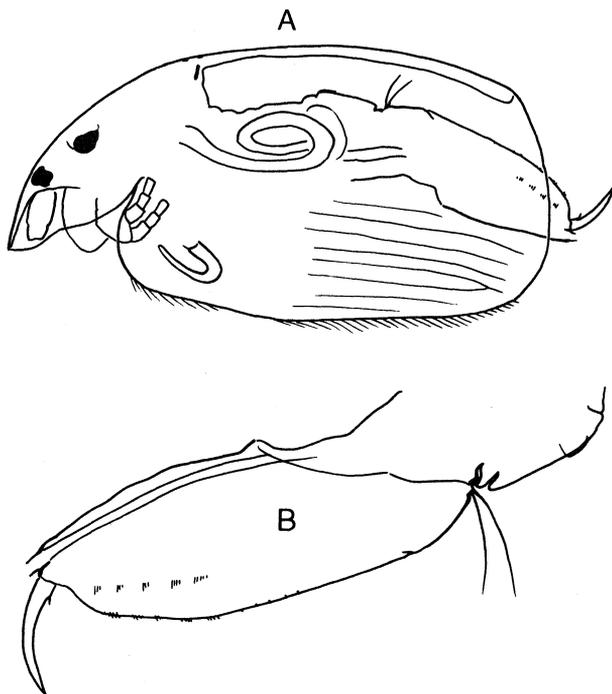


Fig. 68. *Biapertura setigera* ♂, Emigrant Ck, near Ballina, N.S.W., 18.viii.65. A, lateral view of whole animal, length 0.3 mm; B, postabdomen. (Both from slide 1589.)

***Biapertura setigera* (Brehm, 1931) n. comb.**

Figs 67, 68

Alona guttata var. *setigera* Brehm, 1931: 499-501, figs 7-9.

Alona setigera Petkovski, 1973a: 140-143, figs 19-22.

Alona archeroides Brehm, 1933: 724-725, figs 28-30.

We agree with Petkovski (1973a) that there is some uncertainty in the identity of Brehm's *Alona guttata* var. *setigera* and *Alona archeroides*. Brehm's *A. setigera* has the antennule reaching the tip of the rostrum. His figure shows that the preanal angle of the postabdomen is wide and just projecting, so that the anal edge is weakly concave.

Material. Qld: 5, 12, 48. N.S.W.: 77, 87, 96, 100, 118, 125, 146, 147, 171. Vic.: 202, 221, 225, 232, 252, 256, 257. Tas.: 305, 316, 326. S.A.: 362, 369, 370, 374, 388. Also slides in the Australian Museum "P:5910 *Alona cambouei* Richard, Loc. Pt. Stephens" (two major head pores are present) and "P:5891 *Alona laevissima* Sars, Loc. Kendall" are *Biapertura setigera*.

Slides. AM ♀ P27706, MGU ♀ 1482, 2866, ♂ 1589, ZIN ♀ 595, BM ♀ 1980.361.

Female. This form is superficially similar to *Alona guttata*, but is distinguished by the presence of two major head pores, narrowly connected.

Length. Up to 0.5 mm.

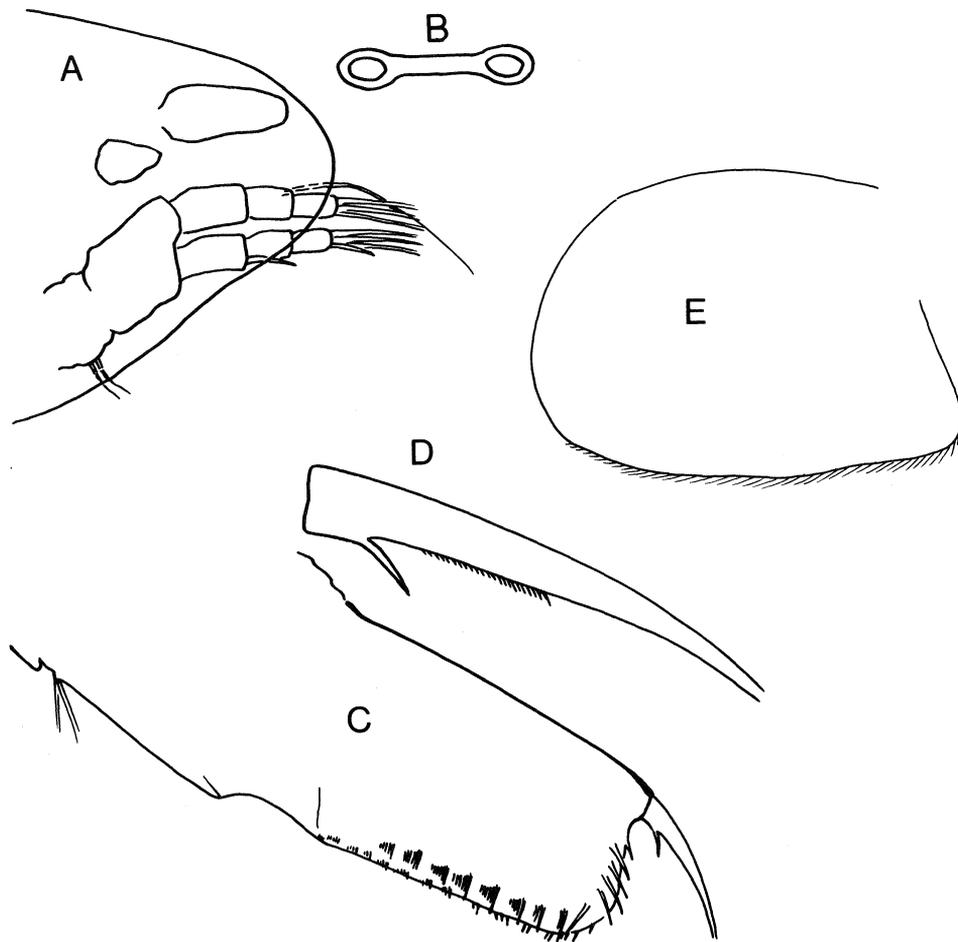


Fig. 69. *Biapertura longinqua* ♀, after Smirnov, 1971b. A, dorsal aspect of anterior of head showing antenna; B, head pores; C, postabdomen; D, claw; E, carapace.

Male. Brehm (1931) notes that the valve is longitudinally lineated and that there is no basal spinule on the claw.

Length. 0.3 mm.

Ecology. Found in a variety of waters including acid coastal lakes.

Distribution. Australia: eastern and southern parts. World: New Zealand and also recently identified by N.N. Smirnov from the Volga Delta.

Differential diagnosis. The postabdomen is not dilated distally, the dorsal edge being straight and the distal edge truncated. The anal denticles on it are large. The minor (lateral) head pores are transverse and obvious.

Biapertura longinqua Smirnov, 1971

Fig. 69

Biapertura longinqua Smirnov, 1971b: 474-475, fig. 593.

Material. N.S.W.: 81, 91, 97, 98, 100. Vic. 204, 215, S.A.: 361. W.A.: 424.

Holotype. MGU ♀ 676.

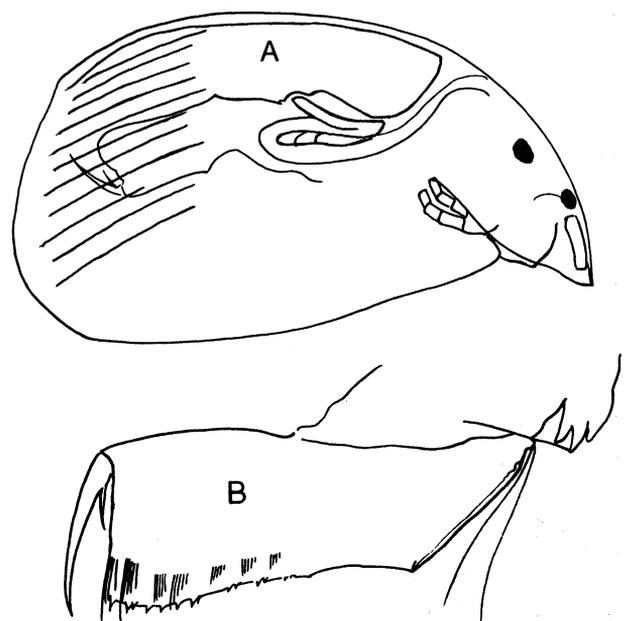


Fig. 70. *Biapertura intermedia intermedia* ♀, swamp in Myall Lakes area, N.S.W., 13.iv.75. A, lateral view of whole animal, length 0.31 mm, slide 2852; B, postabdomen, slide 2855.

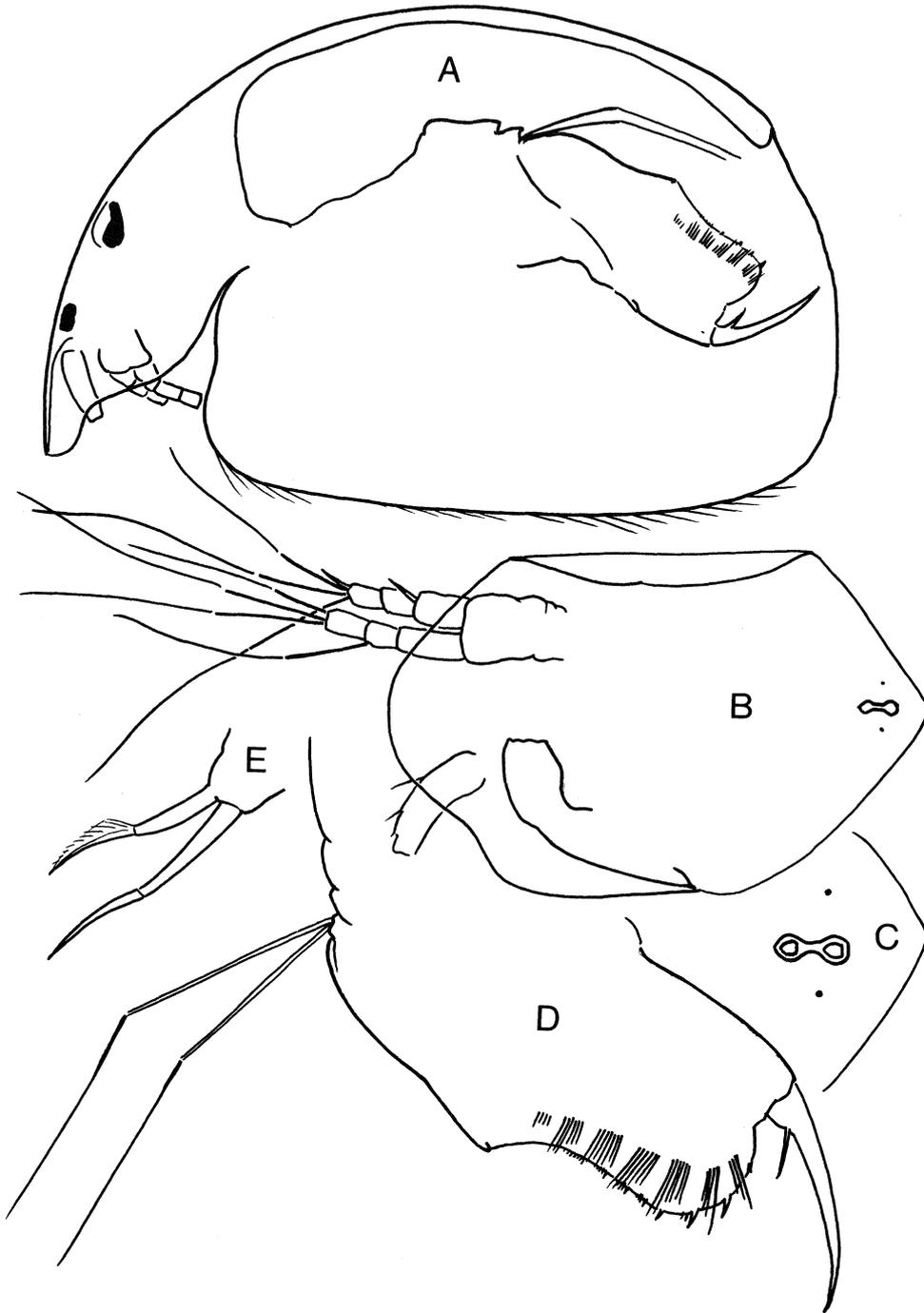


Fig. 71. *Biapertura rigidicaudis* ♀, Whites Lag., Tunbridge, Tas., 12.x.72. A, lateral view of whole animal, length 0.35 mm; B & C, head shields, D, postabdomen; E, large setae of external branch of endite of limb I. (All from slide 1873.)

Paratypes. AM ♀ P27702, ZIN postabdomen of a ♀ 54155 (954).

Length. 0.4 mm.

Ecology. Most of the known habitats are acid waters on sand. Females from the Myall Lakes area (N.S.W.) were reddish due to pigmented blood.

Type locality. Morisset Hospital Dam, via Newcastle, N.S.W.

Distribution. South-eastern Australia, particularly coastal N.S.W., and one isolated occurrence in W.A.

Differential diagnosis. The ventral and dorsal edges of the postabdomen are parallel. The anal denticles are small. There are lateral fascicles of setae on the postabdomen; its ventro-posterior angle is rounded and anal teeth are extended onto its distal margin.

Biapertura intermedia (Sars, 1862)

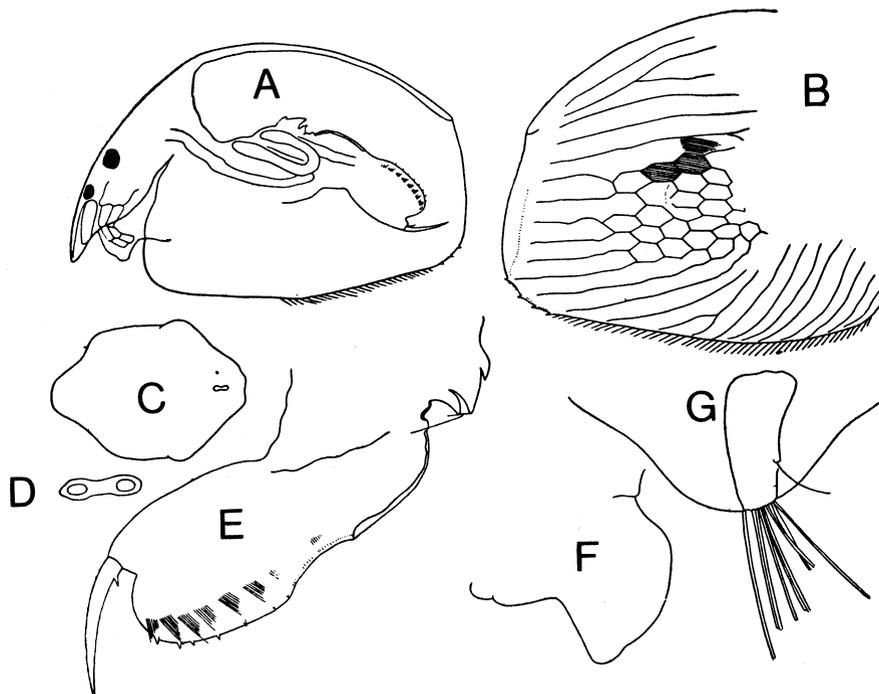
Fig. 70

Alona intermedia Sars, 1862b: 286-287.*Biapertura intermedia*.—Smirnov, 1971b: 475, figs 594-596.**Material.** Qld: 38. N.S.W.: 79, 96, 98, 125. W.A.: 423.**Slides.** AM ♀ P27699, MGU ♀ 2851, 2855, ZIN ♀ 2852.**Female.** Of the two subspecies known (Smirnov, 1971b) only the typical form occurs in Australia. A tuberculated form was found in the material from Loc. No. 423 (W.A.).**Length.** 0.45 mm.**Ecology.** All the N.S.W. records are from acid lakes on sand dunes or sandstone (pH c.5.0).**Distribution.** East coast and adjacent areas of Australia; also one isolated occurrence in W.A.**Differential diagnosis.** The postabdomen is dilated distally; its lateral setae reach beyond its edge.*Biapertura rigidicaudis* Smirnov, 1971

Fig. 71

Alona intermedia.—Gurney, 1927: 72, fig. 8E (misidentification).*Biapertura rigidicaudis* Smirnov, 1971b: 475, 479, figs 598, 599.**Material.** Qld: 32, 60, 62. N.S.W.: 83, 99, 107, 118, 139, 171, 173. Vic.: 204, 220, 232, 235, 256, 257, 258, 263. Tas.: 314, 319, 326. S.A.: 377, 378, 379, 385, 386, 387. W.A.: 405, 409.**Holotype.** MGU ♀ 1288.**Paratypes.** AM ♀ P27704, ZIN ♀ 53847 (1832).**Slides.** AM ♀ P31308, MGU ♀ 1873.**Female.** Antennal setae 0-0-3/0-1-3, spine 1-0-1/0-0-1. Postabdomen rather short and wide. Its preanal margin long and same length as distance from preanal angle to base of claw. Lateral setae of postabdomen long and anal teeth very short.In females from Loc. 107 the ocellus is noticeably smaller than the eye. Specimens from Loc. 263 are a little different from the holotype specimens from Loc. 107—there are very minute denticles on the ventro-posterior corner of the valve and the antennal spines are much longer. While individuals typically have smooth shells, those in Loc. 314 (Tas.) have depressions on the shell (see previous comment on *Biapertura affinis*).**Length.** 0.35 mm.**Ecology.** Lives in a variety of waters but rarely in acid dune lakes.**Type locality.** Doughboy creek, Ebor, N.S.W.**Distribution.** Widely distributed in Australia.**Differential diagnosis.** The length of the preanal margin of the postabdomen equals the distance from the preanal angle to the base of the claw. There are usually no denticles on the ventro-posterior angle of the valve.*Biapertura karua* (King, 1853)

Fig. 72

Alonella karua Sars, 1888: 50, pl. V, figs 8, 9.*Biapertura karua*.—Smirnov, 1971b: 479-480, figs 600-603.**Fig. 72.** *Biapertura karua* ♀, after Smirnov, 1971b. A, whole animal, length 0.29 mm; B, carapace showing surface markings; C, head shield; D, head pores; E, postabdomen; F, labrum; G, antennule.

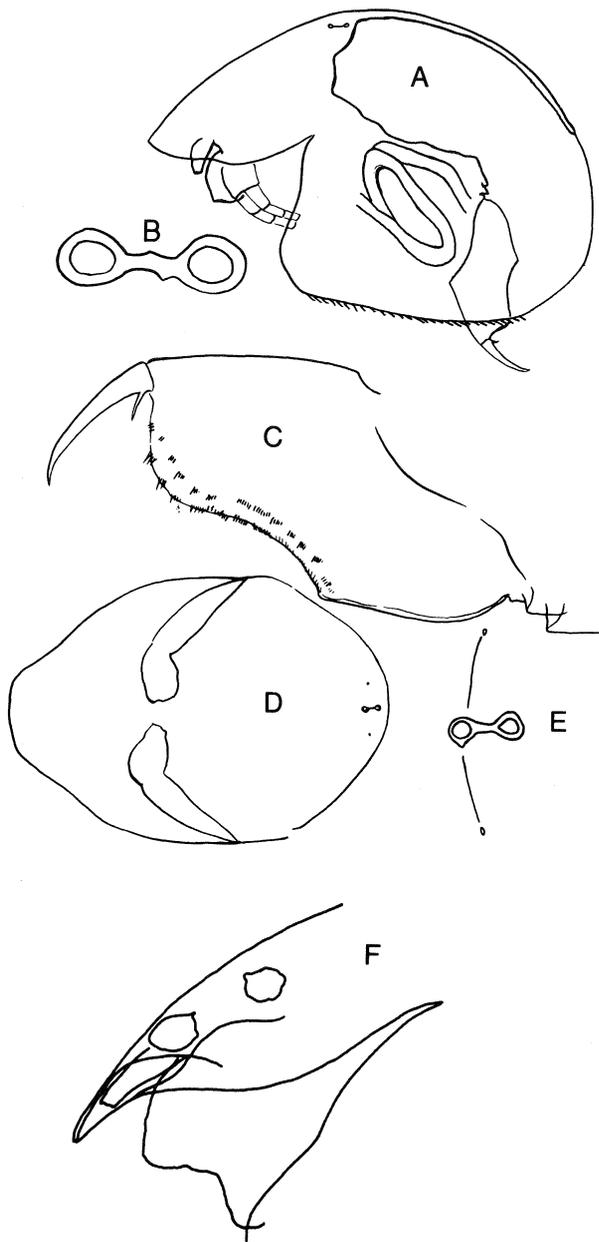


Fig. 73. *Biapertura macrocopa* ♀, pool, 11 km S of Northcliffe, W.A., 3.vi.77. A, lateral view of whole animal, length 0.61 mm; B, head pores; C, postabdomen. (A-C from slide 374). D, head shield; E, head pores. (D and E from slide 1140). F, head with eye and ocellus, from slide 687.

Material. Qld: 4, 11, 12, 15, 18, 27, 37, 39, 40, 41, 42, 43, 64. N.S.W.: 86, 93. Vic.: 232.

Slides. AM ♀ P27700, MGU ♀ 1496, ephippium 1741, ZIN ♀ 1030.

Length. 0.29 mm.

Ecology. Unlike other species of *Biapertura*, it is rarely found in acid waters and is not known from coastal dune lakes.

Type locality. Karua (now Karuah) River, Stroud, N.S.W.

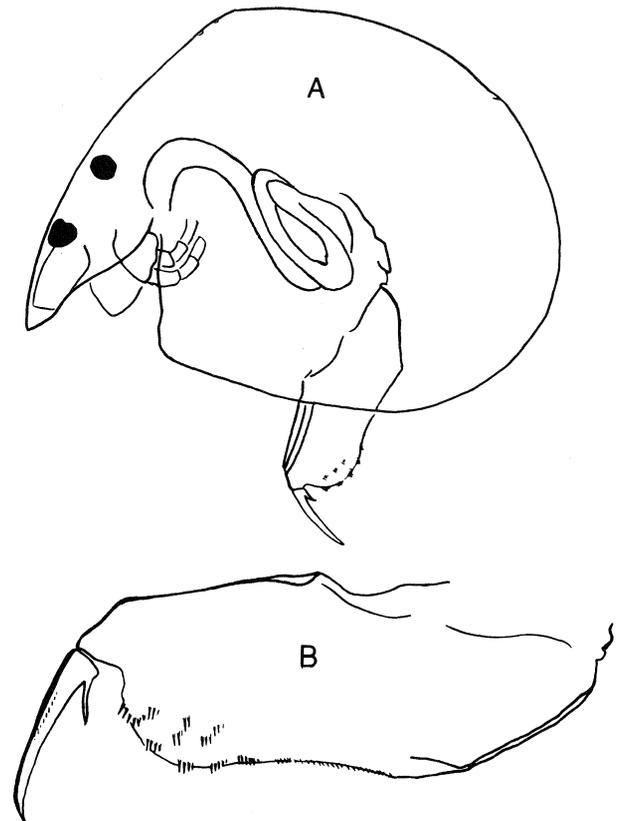


Fig. 74. *Biapertura macrocopa* ♂ juvenile, pool, 11 km S of Northcliffe W.A., 3.vi.1977. A, lateral view of whole animal, length 0.48 mm; B, postabdomen. (Both from slide 716.)

Distribution. Australia: widely distributed in Qld, localized in N.S.W., Vic., and W.A. (Brehm, 1953b). World: circumtropical.

Differential diagnosis. The postabdomen is rounded and has very small anal teeth. There are separate denticles on the ventro-posterior corner of the valve.

Biapertura macrocopa (Sars, 1895) n. comb.

Figs 73, 74

Alona macrocopa Sars, 1895: 20-23, pl. III, figs 11-15.

Alonella macrocopa.—Gurney, 1927: 75-76, fig. 10.

Material. Qld: 9, 12, 13. N.S.W.: 79, 96, 98. W.A.: 410, 426.

Slides. AM ♀ P27703, MGU ♀ 374, 1140, 1887, 2860, ♂ 716, ZIN ♀ 2862.

Female. Two interconnected head pores are present, so this species is transferred to the genus *Biapertura*. There is variation in some features among populations. In females from Loc. No. 427 (W.A.) labrum widely crenulated (i.e. wavy) in outline; ocellus larger than eye in both females and males; leg IV exopodite with 6 setae, but occasionally 7 present (as on left exopodite of leg IV in slide 1887). In the population from Loc. No. 98 (N.S.W.) labrum of females with a blunt apex and an evenly convex outline; ocellus smaller than the eye.

Females from Loc. No. 12 (Qld) have round depressions in the carapace (see comments on *Biapertura affinis*).

Length. Variable. Females 0.61 mm and males 0.49 mm in collection from Loc. No. 427 (W.A.) but females 0.26 mm in sample (slide 2860) from Loc. No. 98 (N.S.W.).

Ecology. It was noted in live specimens that when the thoracic limbs move the exopodites of limbs IV and V undulate, as they do in most Chydoridae.

Type locality. New Zealand.

Distribution. Localized in north Qld, north-eastern N.S.W., and south-western W.A.

Differential diagnosis. The antenna has spines 1-0-1/1-1-1. This species is distinguished by a large spine on the proximal joint of the antennal branches (exopodite); its length exceeds the length of the second joint. The latter also possesses a long spine, much exceeding the length of the terminal joint (this spine is probably a shortened and chitinized seta).

Biapertura rusticoides n. sp.

Fig. 75

Material. Tas.: 307, 312, 313, 314, 315, 320, 330, 332.

Holotype. AM ♀ P27705.

Paratypes. MGU ♀ 2913, ZIN ♀ 2918, BM ♀ 1980.360.

Female. Body oval in outline with ventral margin of valve only slightly convex and bearing setae. Two major head pores with a narrow interconnection.

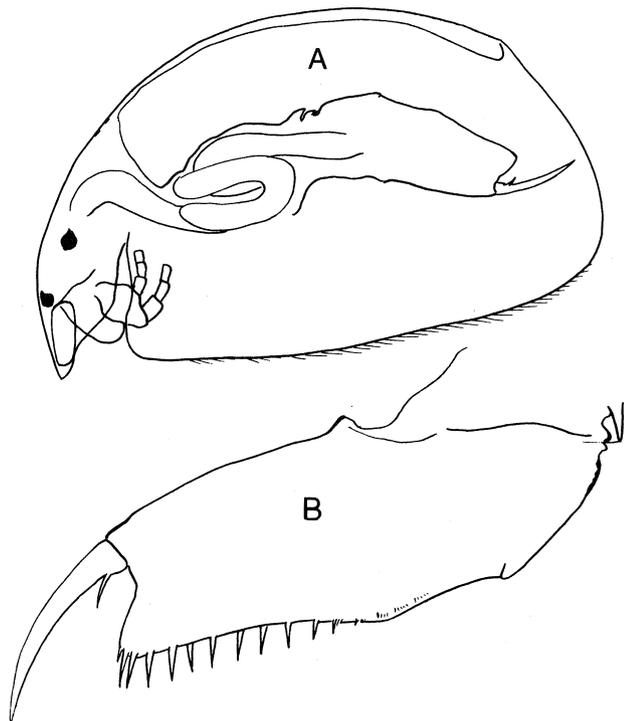


Fig. 75. *Biapertura rusticoides* ♀, pond near L. Echo, Tas., 20.viii.1974. A, lateral view of whole animal, length 0.49 mm; B, postabdomen. (Both from slide 2913.)

Antennule not reaching tip of rostrum. Postabdomen rather wide, its dorso-posterior corner protruding noticeably beyond base of claw. Anal margin only slightly depressed, so preanal corner hardly noticeable. Anal teeth large, gradually diminishing proximally. Claw with a small basal spine. Intestine convoluted.

Length. 0.49 mm (holotype P27705).

Male. Unknown.

Type locality. A pond near L. Echo, central Tasmania.

Etymology. The specific name alludes to its external similarity to *Alona rustica* Scott, 1895.

Differential diagnosis. The postabdomen is rather wide, with large anal teeth, gradually diminishing proximally; its dorso-posterior corner protrudes noticeably beyond the base of the claw.

Biapertura rusticoides is similar to *B. setigera*, its closest taxon, but differs in that the postanal margin of the postabdomen is concave, the dorso-posterior corner of the postabdomen is somewhat rounded and protrudes more beyond the base of the claw, and the sculpture of the valve is comparatively more expressed.

Biapertura rusticoides is also similar to *Alona rustica* but is readily distinguishable by having two major head pores, narrowly connected. *Alona rustica* has a wide geographical range including Europe and North and South America. In that information on head pores of South American populations is lacking (Frey, 1965) and as an externally similar form with two head pores has now been discovered in Australia, the specific status of the South American taxon might be doubted. However, examination of a female specimen of *A. rustica* from Rio Nhamundá (Brazil) kindly supplied by Prof. H. Sioli and Dr G.O. Brandorff showed it indeed has 3 major head pores, narrowly connected, and noticeable minor pores.

Biapertura abbreviata (Sars, 1896) n. comb.

Fig. 76

Alona abbreviata Sars, 1896: 40-42, pl. 6, figs 5, 6.—Henry, 1922: 42, pl. VIII, Fig. 8.

Alonella abbreviata [sic].—Gurney, 1927: 76.

Material. Literature.

Female. *Biapertura abbreviata* is very similar to *B. macrocopa*. However, Sars (1896) expressly notes that it differs in the comparatively small size of the antennule. Gurney (1927:76) writes "If it were not for the fact that Prof Sars definitely states that his *A. abbreviata* [sic] differs from *A. macrocopa* in not having strikingly large antennae it would be necessary to include this species also in the synonymy (of *Alonella macrocopa*).” We have however noted (in the key) the difference in the setation and size of the antennae. Hence it seems appropriate to retain the two species. Nevertheless there is still a problem as to which genus *abbreviata* belongs. We have not had the opportunity to study its head pores, so that its present inclusion in

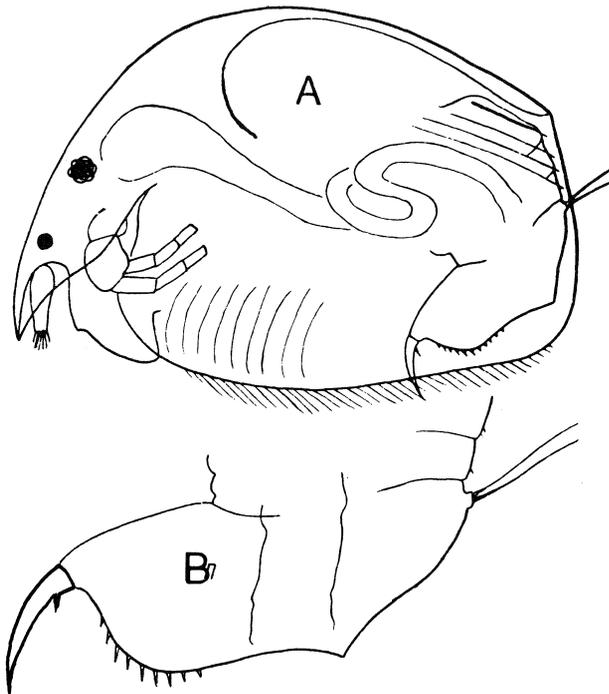


Fig. 76. *Biapertura abbreviata* ♀, after Smirnov, 1971b. A, whole animal, length 0.37 mm; B, postabdomen.

Biapertura is based on its similarity to *B. macrocopa*, which definitely belongs to *Biapertura*. Further study is needed.

Length. 0.37 mm.

Type locality. Sydney.

Distribution. N.S.W.

Differential diagnosis. The body is relatively high. There is a small notch on the labrum. The postabdomen is short and rounded. The valve is lineated, the lines according to Sars (1896:41) "appear somewhat flexuous thus forming an indistinct reticulation". The antenna is of moderate size and without long spines.

***Biapertura duodonta* (Henry, 1922) n. comb.**

Alonella duodonta Henry, 1922: 49, figs 1-4.

Material. N.S.W.: holotype slide in the Australian Museum "P:5888 *Alonella duodonta* Henry (Type) Loc. Manly". Tas.: 299. W.A. 415.

Female. According to Gurney (1927) *Alonella duodonta* Henry is synonymous with *Biapertura macrocopa* (*Alona macrocopa* Sars). However it is distinct as shown by the following features observed on the holotype slide: the labrum is notched, there are two major head pores which are connected, some antennal setae have the form of long spines and there are two denticles on the ventro-posterior corner of the valve.

The number of denticles on the valves varies, a feature common to many chydorids. In the population from Loc. No. 299 several females had 3 denticles on each valve and some had unequal numbers on the two

valves—2-3, 3-2, 4-3 on the left and right valves respectively.

Length. 0.35 mm.

Type locality. Manly, N.S.W.

Distribution. Localized in N.S.W., Tas., and W.A.

Differential diagnosis. Some antennal setae have the form of long spines. The body form is comparatively high. The postabdomen is short. There are denticles on the ventro-posterior corner of the valve. The labrum is notched.

Genus *Monospilus* Sars, 1862

Monospilus Sars, 1862a: 165-166.

Monospilus is mainly distinguished by the presence of an ocellus only, the eye being absent. The postabdomen is wide. In the type species (*M. dispar*) the postabdomen is short and wide and there is one large head pore. The latter does not apparently apply in the Australian species. They also differ from the Holarctic *M. dispar* by not retaining moulted valves.

The type species is *Monospilus dispar* Sars, 1862.

Key to Australian Species of *Monospilus*

1. Body short—ratio length: height about 1.4
Postabdomen wide and with a few small
anal teeth *M. diporus* n. sp.
- Body elongated—ratio length: height
about 2. Postabdomen elongated and with
long lateral setae reaching well beyond its
margin *M. elongatus* n. sp.

***Monospilus diporus* n. sp.**

Fig. 77

Material. N.S.W.: 188. S.A.: 394.

Holotype. AM ♀ P31299.

Paratypes. MGU ♀ 346, 3108, 3109, 3110, ZIN ♀ 3107, 3072.

Female. Body basically oval in lateral view. No denticles on ventro-posterior corner of valve. Ventral border of valve with setae. Shell with slightly expressed hexagons with fine granulations in them. Antennule short, not reaching tip of rostrum. Antennal setae 0-0-3/1-1-3, large spines 1-0-1/0-0-1. Two interconnected head pores.

Postabdomen short and wide. Preanal angle noticeable. A few small anal teeth located on postanal margin of postabdomen; lateral setae in fascicles. Claw with a short basal spine.

Intestine with a double convolution.

Length. 0.49 mm.

Male. Unknown.

Ecology. Known to occur over the temperature range 8.5-21.5°C., pH range 7.0-8.3, conductivity 365-600 μ S., and turbidities 80-135 NTU's (R. Shiel, personal communication).

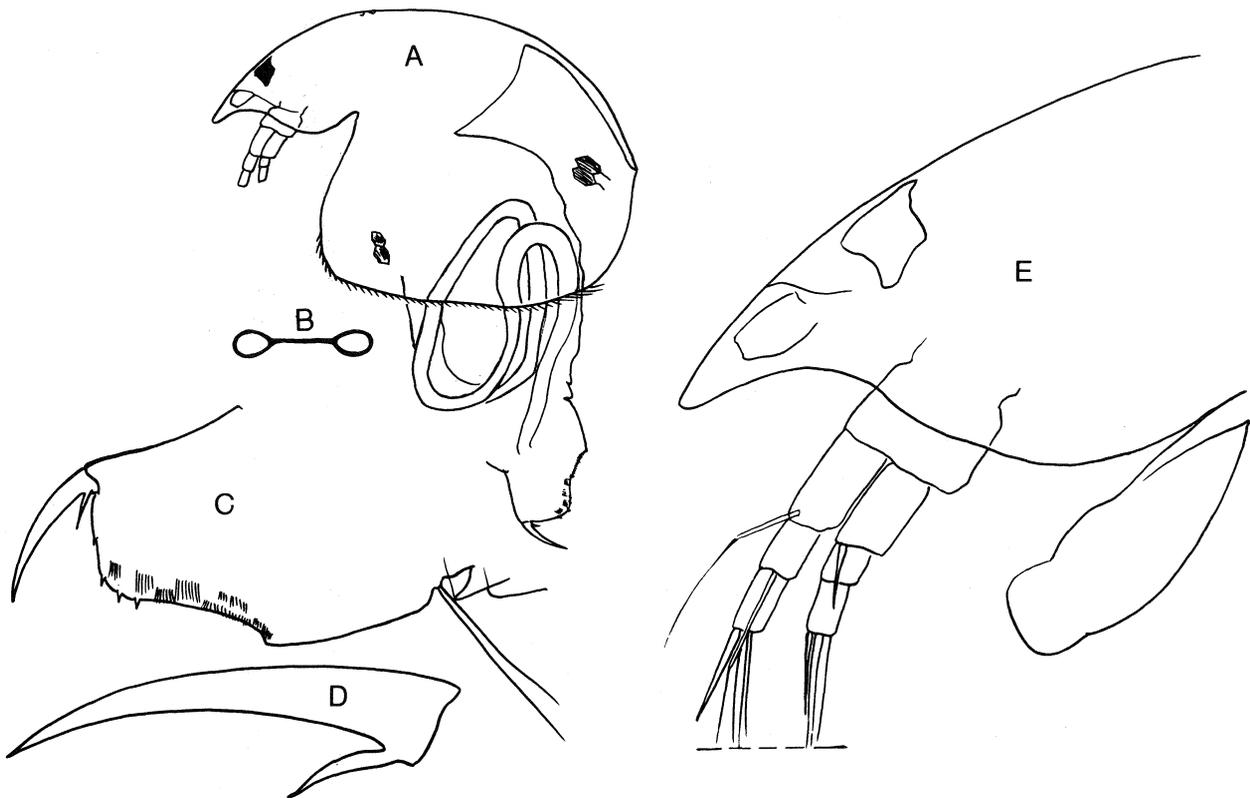


Fig. 77. *Monospilus diporus* ♀, Murray R. at Mannum, S.A., 9.viii.76. A, lateral view of whole animal, length 0.49 mm; B, head pores; C, postabdomen; D, claw; E, head. (A from slide 1898, remainder from slide 346.)

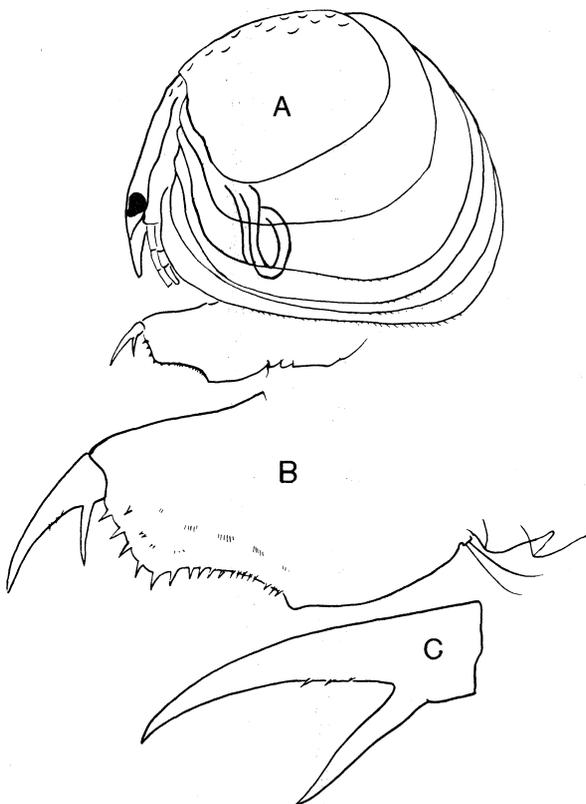


Fig. 78. *Monospilus dispar* ♀, Rybinsk Reservoir, Borok, USSR. A, lateral view of whole animal, length 0.4 mm; B, postabdomen; C, claw.

Type locality. Murray R. at Mannum, S.A.

Distribution. Lower Murray-Darling system (see R. Shiel, in prep.).

Differential diagnosis. For comparative purposes the type species *M. dispar*, is illustrated in Fig. 78. It possesses one head pore whereas *M. diporus* has two interconnected major head pores. The ratio length: height in *M. diporus* is 1.4 and in *M. dispar* 1.2. *Monospilus diporus* has a seta on the basal segment of one antennal ramus, but it is lacking in *M. dispar*. The general outline of the postabdomen is similar in the two, but in *M. diporus* there are a few anal teeth compared to numerous teeth in *M. dispar*. The basal spine of the claw is comparatively short in *M. diporus*.

***Monospilus elongatus* n. sp.**

Fig. 79

Material. S.A.: 394.

Holotype. AM ♀ P31300.

Paratypes. MGU ♀ 3111, 3113, 3114, ZIN ♀ 3112.

Female. Body oblong oval in lateral view. ratio length: height 1.96 (holotype P31300). No denticles on ventro-posterior corner of valve. Surface of shell without sculpturing. Ventral border of valve with setae, scarce and rather long in its posterior part. Anterior end

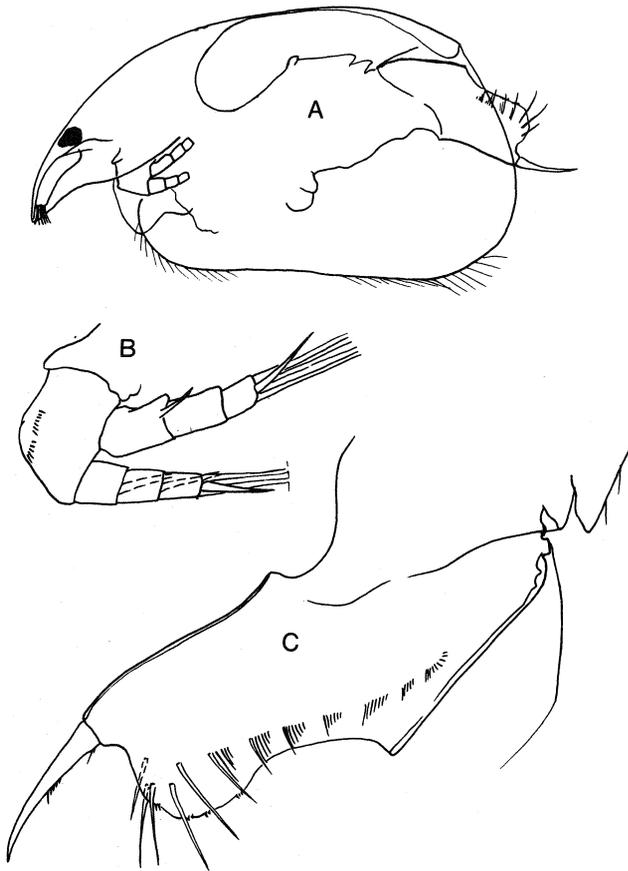


Fig. 79. *Monospilus elongatus* ♀, Murray R. at Mannum, S.A., 13.vii.78 A, lateral view of whole animal, length 0.48 mm; B, antenna; C, postabdomen. (All from slide AM ♀ P31300.)

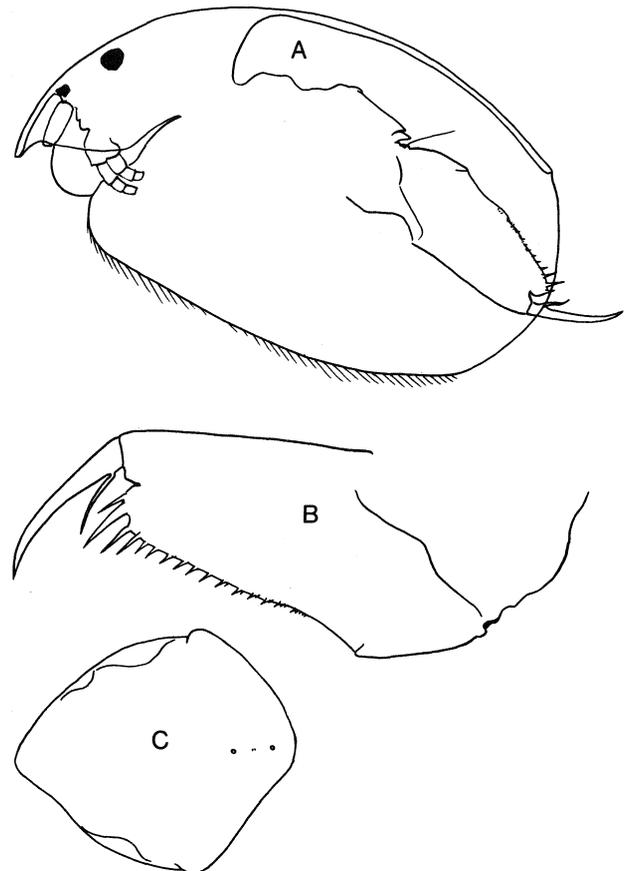


Fig. 80. *Oxyurella tenuicaudis* ♀, Sheepwash Lag., via Nelson, Vic., 11.viii.72. A, lateral view of whole animal, length 0.37 mm, slide 2195; B, postabdomen, slide 2205; C, head shield, slide 2205.

of head shield blunt. Antennule not reaching tip of rostrum. Antennal setae 0-0-3/1-1-3, large spines 1-0-1/0-0-1. Head pores could not be definitely discerned in lateral view of the holotype.

Postabdomen elongated. Preanal angle well expressed, so anal margin concave. Upper distal end of postabdomen widely rounded and with a few solitary large lateral setae reaching well beyond its margin. More proximally, these setae shorter and accompanied by other setae. These groups extending onto lateral side of postabdomen far more proximally than preanal angle. A few extremely small anal teeth. Claw with setae on its concave side in middle and basal parts.

Labral plate wide, not ciliated. Intestine convoluted.

Length. 0.48 mm.

Male. Unknown.

Type locality. The Murray River at Mannum, S.A.

Distribution. Lower Murray, though it is associated with intrusion of Darling R. water, so it could be from that system (R. Shiel, personal communication).

Differential diagnosis. Body elongated. Ratio length: height 1.96. Postabdomen elongated and possessing long lateral setae. Basal spine of claw, if any, very small.

Genus *Oxyurella* Dybowski & Grochowski, 1894

Oxyurella Dybowski & Grochowski, 1894: 381.—Smirnov, 1971b: 491-493.

General body form very similar to that of *Alona*, however head pores separate in *Oxyurella*. Postabdomen elongated.

The type species is *Oxyurella tenuicaudis* (Sars, 1862).

Key to Australian Species of *Oxyurella*

1. Claw with one basal spine; a few distal anal teeth much longer than proximal teeth *O. tenuicaudis* (Sars, 1862)
- Claw with one big basal spine and a few small spines proximally; anal teeth gradually increase in size *O. singalensis* (Daday, 1898)

***Oxyurella tenuicaudis* (Sars, 1862)**

Fig. 80

Alona tenuicaudis Sars, 1862b: 285-286.

Alona wallaciana Henry, 1919: 472-474, pl. XLI, figs 7, 8, n. syn.

Material. N.S.W.: 81, 118, a slide in the Australian Museum "P:4330 *Alona wallaciana* Henry. Holotype. Kendall." Vic.: 203, 259, 260, 261.

Slides. AM ♀ P27720, MGU ♀ 2205, 2195, ZIN ♀ 2180.

Female. The valves of the females studied, including that on Henry's slide P:4330, are covered with fine granules; there are no longitudinal lines.

Length. 0.37 mm (slide 2195).

Ecology. In coastal dune lakes, both acid and alkaline.

Distribution. Coastal areas of N.S.W. and Vic.

Differential diagnosis. There is one basal spine on the claw. A few distal anal teeth are much longer than the proximal teeth.

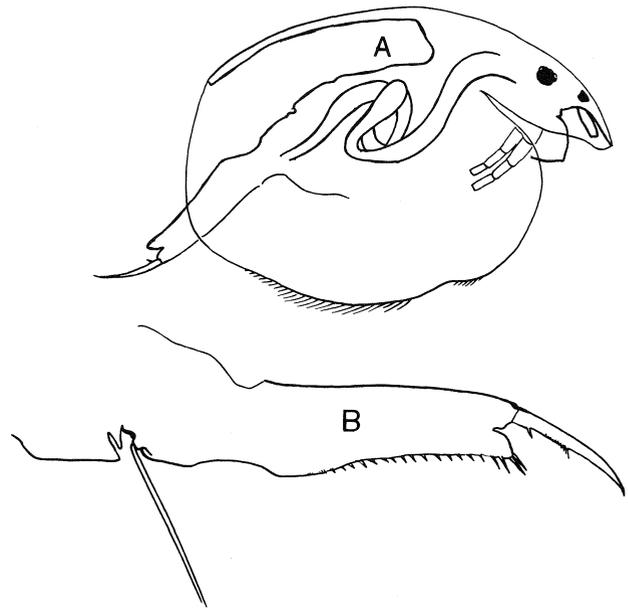


Fig. 81. *Euryalona orientalis* ♀, Gladys Lag., via Clare, Qld, 18.vi.74. A, lateral view of whole animal, length 0.62 mm; B, postabdomen. (Both on slide 666.)

Oxyurella singalensis (Daday, 1898)

Alonopsis singalensis Daday, 1898: 43–45, fig. 20.

Material. Qld: 16, also skeletal fragments in mud of L. Euramoo and L. Barrine.

Length. Up to 0.9 m.

Distribution. Australia: northern Qld. World: Ethiopic and Indo-Malayan regions.

Differential diagnosis. The claw has one big basal spine and a few small spines proximally. The size of the anal teeth increases gradually.

Genus *Euryalona* Sars, 1901

Euryalona Sars, 1901: 80–81.—Smirnov, 1971b: 497–498.

The type species is *Euryalona orientalis* (Daday, 1898), which is the only species known in Australia.

Euryalona orientalis (Daday, 1898)

Fig. 81

Alonopsis orientalis Daday, 1898: 45–48, figs 21, 22.

Euryalona occidentalis Sars, 1901: 81–84, pl. XII, Figs 1, 1 a-h.

Material. Qld: 12, 13, 25.

Slide. MGU ♀ 666.

Length. Up to 1 mm.

Distribution. Australia: northern Qld. World: circumtropical.

Family MACROTHRICIDAE Norman & Brady, 1867

Macrothricidae Norman & Brady, 1867: 9.—Smirnov, 1976: 1–173.

Lyncodaphnidae Sars, 1862: 299.

The type genus is *Macrothrix* Baird, 1843.

Key to All Genera of Macrothricidae

(Note: For a shortened key to Australasian genera see p.69)

1. Antennule two-segmented. Postabdomen wide, its dorsal side convex, having the appearance of a wide arc with denticles *Ilyocryptus* Sars, 1862
- Antennule one-segmented. Dorsal side of postabdomen straight or convex 2
- 2(1). Anal opening in middle part of postabdomen 3
- Anal opening in distal part of postabdomen 4
- 3(2). Antennal setae 0-0-0-3/1-1-3, spines 1-1-0-1/0-0-1 (Holarctic) *Ophryoxus* Sars, 1862
- Antennal setae 0-0-0-3/0-0-3, spines 0-1-0-1/0-0-1 (Nearctic) *Parophryoxus* Doolittle, 1909

- 4(2). Six pairs of thoracic limbs. Limbs III-V with large exopodites (Holarctic) *Acantholeberis* Lilljeborg, 1853
 — Five pairs of thoracic limbs. All limbs with small exopodites 5
- 5(4). Valve with numerous papilla-like outgrowths bearing bristles on apices (Neotropical) *Cactus* Smirnov, 1976
 — Valve without numerous papilla-like outgrowths 6
- 6(5). Shell with long rough bristles. No claw on postabdomen. Antennae with numerous spines *Neothrix* Gurney, 1927
 — Shell not covered with long rough bristles. Postabdomen with claws and antenna commonly with only a few spines 7
- 7(6). Intestine not convoluted 8
 — Intestine convoluted 15
- 8(7). Setae of ventral margin of valve lanceolate (Holarctic) *Lathonura* Lilljeborg, 1853
 — Setae of ventral margin of valve not lanceolate 9
- 9(8). Postabdomen with no cuts in dorsal side and usually not widely oval (if widely oval then no such cuts) 10
 — Postabdomen widely oval, with cuts on its dorsal side 16
- 10(9). Postabdomen tapers towards base of claw. No anal teeth. Claw with a basal spine *Pseudomoina* Sars, 1911
 — Postabdomen does not taper towards base of claw. Claw without a basal spine 11
- 11(10). Head shield with a globular bulge (Neotropical) *Onchobunops* Fryer & Paggi, 1972
 — Head shield with no globular bulge 12
- 12(11). Valve with a dorsal keel advancing onto posterior side of valve (Holarctic) *Bunops* Birge, 1893
 — Valve with no dorsal keel advancing onto posterior side of valve 13
- 13(12). Antennule dilates distally *Macrothrix* Baird, 1843
 — Antennule does not dilate distally 14
- 14(13). Exopodite of limb IV with 2-3 setae *Echinisca* Liévin, 1848
 — Exopodite of limb IV with 5 setae (Holarctic) *Wlassicsia* Daday, 1904
- 15(7). Shell without a dorsal tooth. Four-segmented branch of antenna with 4 setae *Streblocerus* Sars, 1862
 — Shell with a dorsal tooth (in region of dorsal fusion of valves). Four-segmented branch of antenna with 3 setae (Holarctic) *Drepanothrix* Sars, 1862
- 16(9). Groups of anal teeth on postabdomen, one large solitary tooth situated at proximal side of anal opening (pantropical, recently found near Darwin by BVT) *Grimaldina* Richard, 1892
 — No anal teeth. Antennule short and thick (Ethiopian region, Ceylon, Malacca, New Guinea) *Guernella* Richard, 1892

Shortened Key to Genera of Macrothricidae Found to Date in Australia

1. Antennule one-segmented; dorsal side of postabdomen straight or convex 2
 - Antennule two segmented; dorsal side of postabdomen convex, having appearance of a wide arc *Ilyocryptus* Sars, 1862
- 2(1). No claw on postabdomen; valve with long bristles *Neothrix* Gurney, 1927
 - Postabdomen clawed; valve with small setules or glabrous 3
- 3(2). Intestine convoluted *Streblocerus* Sars, 1862
 - Intestine not convoluted 4
- 4(3). Postabdomen tapers towards base of claw; claw with a basal spine; no anal teeth *Pseudomoina* Sars, 1911
 - Postabdomen not tapering towards base of claw; claw lacks a basal spine
- 5(4). Antennule dilated distally *Macrothrix* Baird, 1843
 - Antennule not dilated distally *Echinisca* Liévin, 1848

Genus *Ilyocryptus* Sars, 1862

Acanthocercus, partim, Liévin, 1848: 32.

Ilyocryptus Sars, 1862a: 154; 1862b: 281-282.—Smirnov, 1976: 42.

Head small and triangular. Valve wide and straight on dorsal side; its ventral and posterior margins widely arched. Moulded shells commonly not discarded and many valves seen one over the other. Postabdomen wide, its dorsal side convex and bearing lateral setae while ventral side straight. Claw long.

All species of *Ilyocryptus* are slowing-moving mud dwellers.

The type species is *Ilyocryptus sordidus* (Liévin, 1848).

Key to Australian Species of *Ilyocryptus*

1. Antennule rather short, its length less than 8 times its width 2
 - Antennule very thin, its length 8-10 times its width *I. spinifer* Herrick, 1882
2. Lateral setae of postabdomen long
 - *I. sordidus* (Liévin, 1848)
 - Lateral setae of postabdomen short
 - *I. brevidentatus* Ekman, 1905

Ilyocryptus sordidus (Liévin, 1848)

Acanthocercus sordidus Liévin, 1848: 34-37, Tab. VIII, figs 7-12.

Ilyocryptus sordidus.—Sars, 1896: 28-30, pl. 5, figs 1-3; Henry, 1922: 38; Smirnov, 1976: 45-49, figs 12-15.

Material. Qld.: 59. N.S.W.: 232. W.A.: 422.

Slides. AM ♀ P27745, MGU ♀ 3028.

Comment. Several subspecies of *I. sordidus* have been described (Smirnov, 1976), mainly by minor differences in postabdominal structure. None has been indicated for Australia.

Distribution. Occurs sparsely in Qld, N.S.W., W.A., and probably other states as well.

Differential diagnosis. The anal aperture opens in the middle part of the dorsal side of the postabdomen. The antennule is short, its length exceeding its width by about 4 times. The shell lacks warts and outgrowths. Lateral setae of postabdomen are long.

Ilyocryptus spinifer Herrick, 1882

Fig. 82

Ilyocryptus spinifer Herrick, 1882: 39-41, 246, pl. VIII, fig. 16, pl. IX, figs 1-3.—Henry, 1922: 37-38, pl. VI, figs 1, 1A; Smirnov, 1976: 53-56, figs 13, 22, 23.

Ilyocryptus halyi Brady, 1886: 294-295, pl. 37, figs 6-9. *Ilyocryptus longiremis* Sars, 1888: 33-41, pl. 4.—Henry, 1919: 468.

Material. Qld.: 12, 21, 25, 49, 64. N.S.W.: 80, 87, 88, 93, 100, 120, 128, 132, 185. Vic.: 233.

Slides. AM ♀ P27746, MGU ♀ 2341, 2573, ZIN ♀ 2574.

Ecology. We recorded *I. spinifer* over a very wide pH range (3.5-8.5) and observed live specimens moving bottom materials, including filamentous algae, with their antennae.

Distribution. Eastern Australia.

Differential diagnosis. The anal aperture opens in the middle part of the postabdomen. Antennule length exceeds its width by more than 8 times. There are no spines on the antennules and the shell lacks warts and outgrowths. Lateral setae of postabdomen are long and not more than 8 in number.

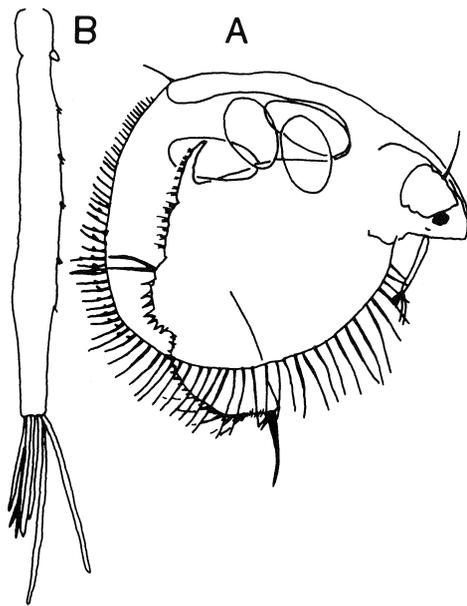


Fig. 82. *Ilyocryptus spinifer* ♀, after Rey & Saint-Jean. A, lateral view of whole animal; B, antennule.

Ilyocryptus brevidentatus Ekman, 1905

Ilyocryptus brevidentatus Ekman, 1905: 5-7, tab. 1, fig. 1.

Material. Vic.: 225.

Slide. MGU ♀ 3074.

Distribution. Australia: apparently isolated in north-eastern Victoria. World: South America.

Differential diagnosis. The anal aperture opens in the middle part of the dorsal side of the postabdomen. The antennule is comparatively short and bears no spines. The shell lacks warts and outgrowths. The lateral setae of the postabdomen are short.

Ilyocryptus agilis Kurz, 1878 has also been indicated for Australia (Williams, 1978, fig. 4, p 673) but this is a misprint (J. Williams, personal communication).

Genus *Macrothrix* Baird, 1843

Macrothrix Baird, 1843: 87 (subgenus); 1850: 103.—Lilljeborg, 1853: 47; Smirnov, 1976: 69-70.

Until recently the taxonomy of the genus *Macrothrix* was utterly confused (see comments by Löffler, 1968, p 148), but Smirnov's (1976) review of the morphology and taxonomy of the family and genus is now available. We follow his treatment here and limit the genus *Macrothrix* to forms having the antennule dilated distally.

The type species is *Macrothrix laticornis* (Jurine, 1820).

Key to Australian Species of *Macrothrix*

1. Dorsal edge of head and valves finely serrated in places *M. spinosa* King, 1853

- Dorsal edge of head and valves not serrated 2
- 2(1). Head and valves with short, closely spaced hairs *M. hystrix* Gurney, 1927
- Head and valve glabrous 3
- 3(2). Distal joint of setae natatoriae short, its length being several times less than that of proximal joint *M. breviseta* Smirnov, 1976
- Distal joint of setae natatoriae long 4
- 4(3). Length of distal joint of setae natatoriae a little less than 1.5 times length of proximal joint *M. hirsuticornis* Norman & Brady, 1867
- Length of distal joint of setae natatoriae much greater than 1.5 times that of proximal joint . . . *M. longiseta* Smirnov, 1976

Macrothrix spinosa King, 1853

Fig. 83

Macrothrix spinosa King, 1853b: 256, pl. VIF.—Sars, 1888: 25-32, pl. 3; Playfair, 1915: 140-141, pl. VII, figs 1, 2 (*M. spinosa* and *M. spinosa dentata*); Henry, 1922: 36; Smirnov, 1976: 73-76, figs 41-44.

Material. Qld: 19, 38, 60. N.S.W.: 86, 93, 161, 172. Vic.: 237. N.T.: 453.

Slides. AM ♀ P27750, P27751, MGU ♀ 2563, 2566, ZIN ♀ 2367.

Length. 0.54 mm.

Ecology. Markedly seasonal in occurrence—in the University Pond, Brisbane and in Borumba Dam (Qld) *Macrothrix spinosa* is common in summer and apparently absent in winter and spring (Timms, 1967; Timms and Midgley, 1969).

Type locality. A roadside pond at South Creek between Sydney and Liverpool—long since destroyed by urbanization.

Distribution. Qld, N.S.W., Vic., S.A. (Petkovski, 1973b), N.T.

Differential diagnosis. The dorsal edge of the head and valves is serrulated, at least in places. As noted by King (1853b) and Sars (1888), there is a denticle on the border between the distal and proximal joints. The distal joint of the setae natatoriae is short.

Macrothrix hirsuticornis Norman & Brady, 1867

Macrothrix hirsuticornis Norman & Brady, 1867: 10-11, pl. XXIII, Figs 6, 7.—Smirnov, 1976: 79-87.

Macrothrix hirsuticornis comprises two subspecies (Smirnov, 1976) though Flössner (1972: p 253) notes that these are not true subspecies. We consider that only the typical subspecies is known in Australia.

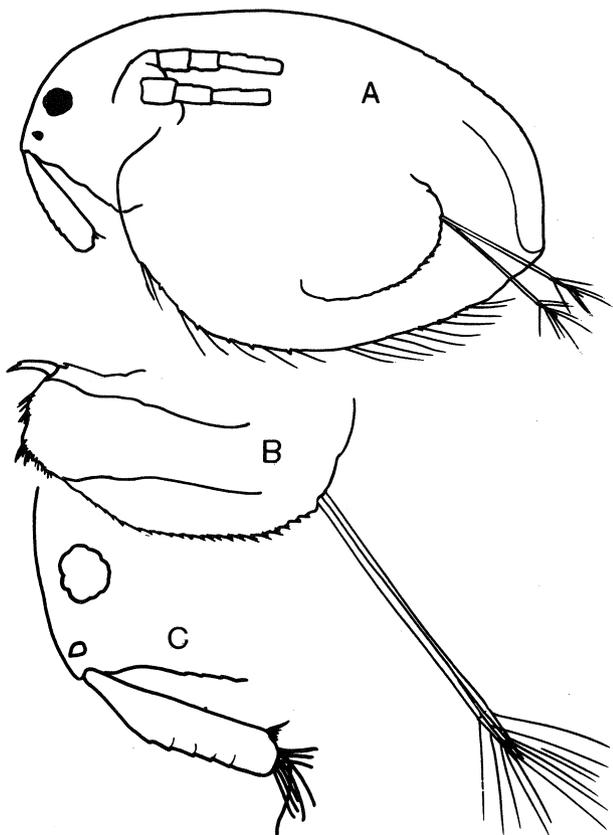


Fig. 83. *Macrothrix spinosa* ♀, Gilberts Gulch, via Orbost, Vic., 28.i.71. A, lateral view of whole animal, length 0.54 mm, slide 2563; B, postabdomen, slide 2566; C, antennule, slide 2566.

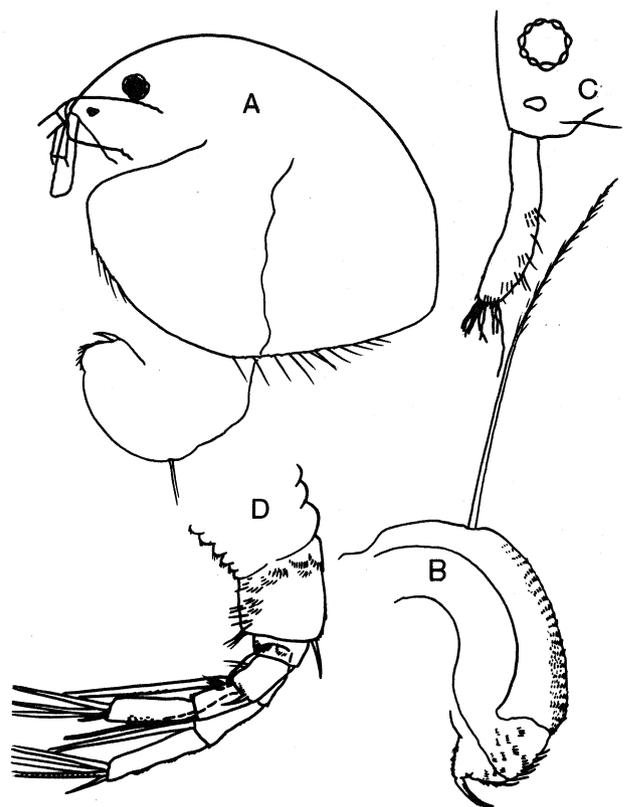


Fig. 84. *Macrothrix hirsuticornis hirsuticornis* ♀, pool near L. Omeo, Vic., 10.viii.69. A, lateral view of whole animal, length 1.14 mm; B, postabdomen; C, antennule; D, antenna. (A and B from slide 915, C and D from slide 991.)

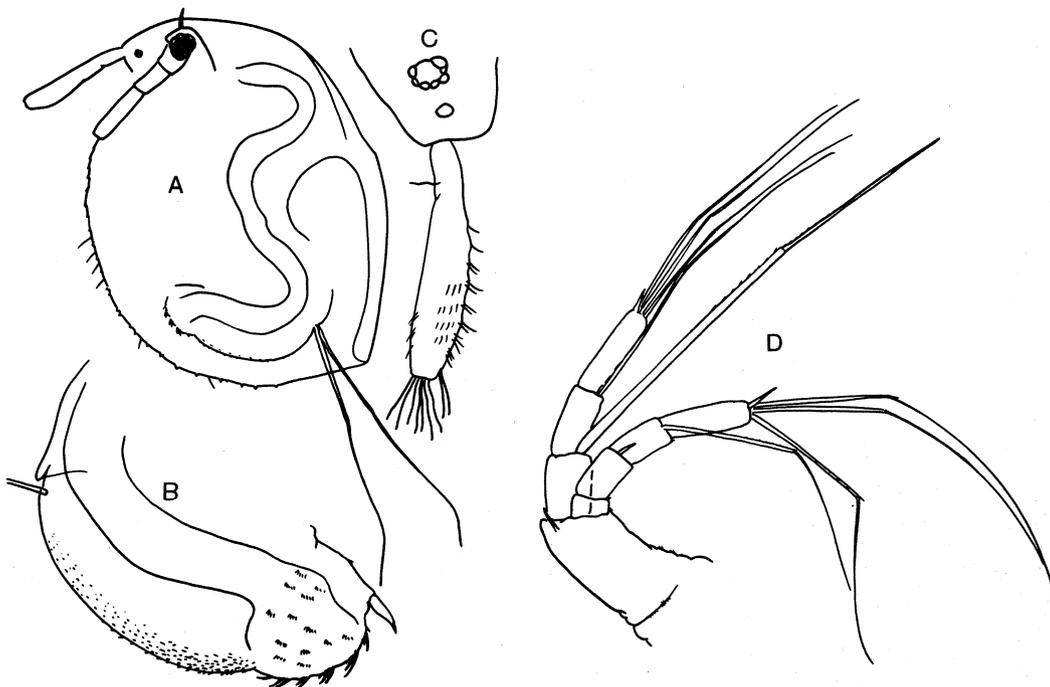


Fig. 85. *Macrothrix longiseta* ♀, L. Purrumbete, Vic., 19.viii.70. A, lateral view of whole animal, length 0.73 mm, slide 2644; B, postabdomen; C, antennule; D, antenna. (B, C and D from slide 2648.)

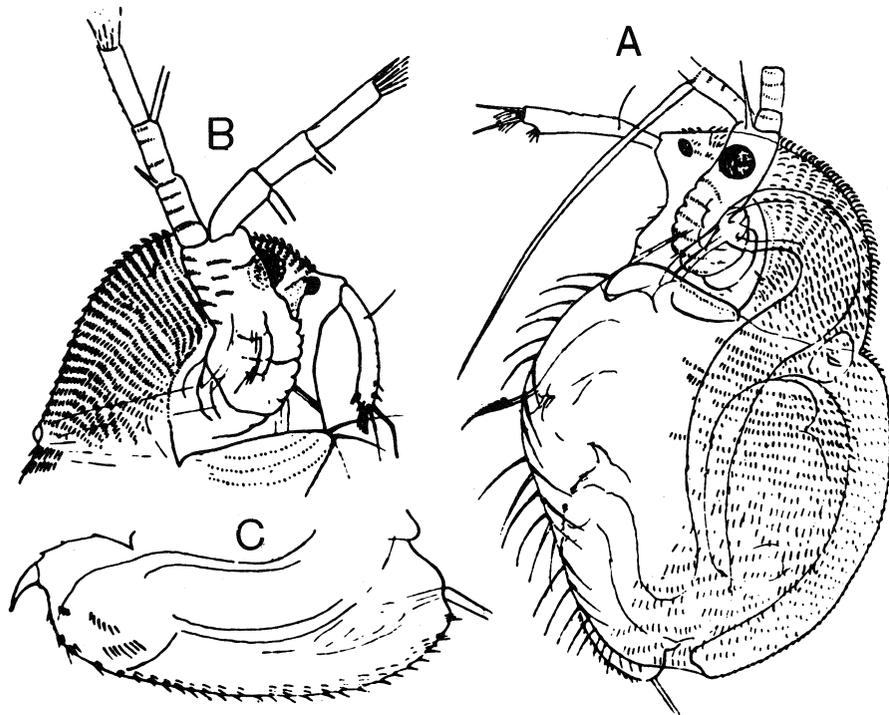


Fig. 86. *Macrothrix hystrix* ♀, after Gurney, 1927. A, lateral view of whole animal, length 0.72 mm; B, head of female; C, postabdomen.

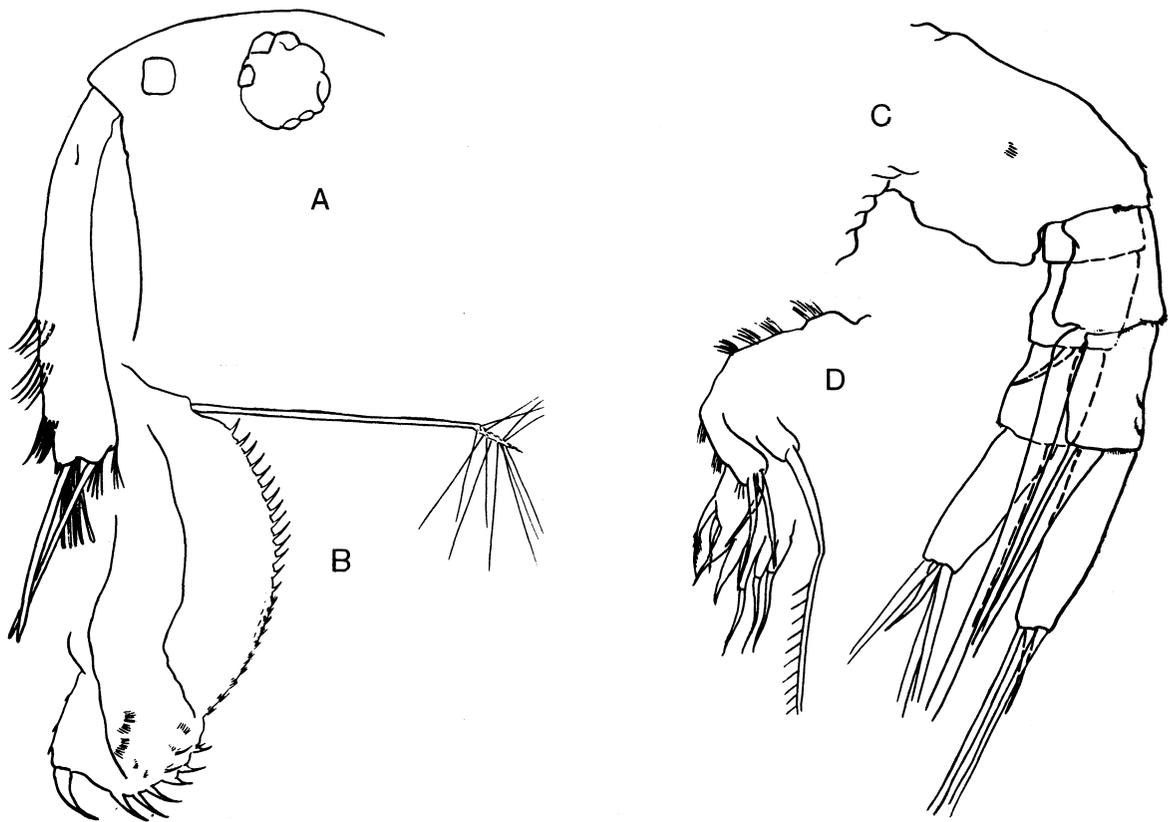


Fig. 87. *Macrothrix breviseta* ♀ L. Buchanan, via Charters Towers, Qld, 16.vii.74. A, head and antennule; B, postabdomen; C, antenna. (A-C from slide 2796.) D, thoracic limb I, slide 2802.

Macrothrix hirsuticornis hirsuticornis

Norman & Brady, 1867

Fig. 84

Macrothrix hirsuticornis hirsuticornis.—Smirnov, 1976: 80–85, fig. 52.**Material.** Vic.: 207, 219. W.A.: 412.**Slides.** AM ♀ P27748, MGU ♀ 991, 915. ZIN ♀ 1027.**Length.** 1.14 mm.**Distribution.** Vic, W.A., and probably at least other southern states.**Differential diagnosis.** The dorsal edge of the shell is not serrated. The head may be separated by a cleft in the dorsal side of the body, but the fold separating the head is simple (not double or triple). The distal joint of the setae natatoriae is long, its length being less than 1.5 times the length of the proximal joint. The head and valves are glabrous.*Macrothrix longiseta* Smirnov, 1976

Fig. 85

Macrothrix longiseta Smirnov, 1976: 91, fig. 61.**Material.** Vic.: 298. Tas.: 337.**Holotype.** MGU ♀ 2644.**Paratypes.** AM ♀ P27749, ZIN ♀ 2489, BM ♀ 2646.**Slides.** AM ♀ P31314, ♂ P31315, MGU ♀ 2648.**Female.** Dorsal edge of head smooth, not separated from valves. antenna club-like, clearly widening in its distal part, and with groups of setules. Antennal setae 0-0-1-3/1-1-3, and spines 0-1-0-1/0-0-1. Postabdomen with groups of spines on anal margin and setules in clusters on its lateral surface. Preanal margin with setules diminishing in size and finally disappearing at base of setae natatoriae. Distal joint of setae natatoriae without setules (i.e. not feathered). Ratio of length of distal joint of setae natatoriae to length of proximal joint 5:3. Ocellus situated closer to base of antennule than to complex eye. Intestine not convoluted.**Length.** 0.73 mm (holotype 2644).**Type locality.** Lake Purrumbete (Vic.).**Distribution.** Vic., Tas., and possibly other southern states.**Differential diagnosis.** The dorsal edge of the shell is not serrated. The antennule has groups of setules. The head and valves are glabrous. The length of the distal joint of the setae natatoriae is more than 1.5 times the length of the proximal joint. The anal edge of the postabdomen has groups of spines and the preanal edge has small setules diminishing to the base of the setae natatoriae.*Macrothrix hystrix* Gurney, 1927

Fig. 86

Macrothrix hystrix Gurney, 1927: 68–69, fig. 6.—Smirnov, 1976: 94–95, fig. 65.**Material.** Literature.**Length.** 0.72 mm.**Type locality.** Waters near Longreach (Qld).**Distribution.** Known only from type locality in Qld.**Differential diagnosis.** The dorsal side of the shell is not serrated, but there are rows of setules on the dorsal side of the head and shell. The head is separated from the valves on the dorsal side. The dorsal side of the postabdomen is convex.*Macrothrix breviseta* Smirnov, 1976

Fig. 87

Macrothrix breviseta Smirnov, 1976: 95–97, fig. 67.**Material.** Qld: 30, 32. Vic.: 213. W.A.: 403. N.T.: 451.**Holotype.** MGU ♀ 2798.**Paratypes.** AM ♀ P27747, ZIN ♀ 2799.**Slides.** MGU ♀ 2796, 2802.**Female.** Dorsal side of head and shell not serrated. Ventral edge of valve with a few serrations on its anterior part and many posteriorly. Dorso-posterior corner of the valve visible. Dorsal (but not cephalic) keel present. Antennule with transverse rows of setules on its anterior distal side; this side wavy in outline. Sensory papillae of different length on distal end of antennule. Antennal setae 0-0-1-3/1-1-3, spines 0-1-0-1/0-0-1.

Postabdomen with a depression on dorsal side, at proximal end of anal opening. Anal edge with spines and groups of small setae on its lateral edge. Preanal edge with small setae, increasing in size to form a row of denticles towards bases of setae natatoriae. Distal joint of setae natatoriae short (approximately 5 times shorter than proximal joint), and bearing long hair-like setules. Ocellus situated closer to base of antennule than to eye. Intestine not convoluted. Leg I with three setae on external branch of its endite, one being short. The long seta of exopodite of leg I with rare setules on one side of its distal part.

Length. 0.56 mm (holotype 2798).**Male.** Unknown.**Ecology.** Planktonic. It can live in slightly saline water—L. Buchanan, the type locality was 4 ‰ at the time of collection.**Type locality.** L. Buchanan, via Charters Towers, Qld (Loc. No. 30).**Distribution.** Mainly a northern Australian species, though there is one record from southern Victoria.**Differential diagnosis.** The distal joints of the setae natatoriae are short. The preanal edge of the postabdomen has short setae increasing in size to form a row of denticles towards the base of the setae natatoriae. It differs from *Macrothrix hirsuticornis* by the anterior distal side of the antennule being wavy and bearing three transverse groups of setae. It is very similar to *Echinisca carinata* found in the littoral of the type locality, L. Buchanan, but differs by the antennule dilating distally and by having rather long, sparse setules on the long exopodite seta of thoracic limb I.

Genus *Echinisca* Liévin, 1848

Echinisca Liévin, 1848: 31–32.—Sars, 1916: 323, 325; Smirnov, 1976: 103.

The genus *Echinisca* is understood as comprising *Macrothrix*-like forms having the antennule not dilated distally. Other characters suggested by Petkovski (1973b) are difficult to apply until they are known for more taxa. Some authors (e.g. Fryer, 1974: 142) still regard *Echinisca* as inseparable from *Macrothrix*. Admittedly they comprise an assortment of incompletely studied species, but at present it is convenient to make two main groupings of them as *Macrothrix* and *Echinisca*.

The type species is *Echinisca rosea* Liévin, 1848.

Key to Australian species of *Echinisca*

1. Segments (second and third) of four-segmented branch of antenna with groups of large spines *E. pectinata* Smirnov, 1976
- Segments of four-segmented branch of antenna with no groups of large spines 2
- 2(1). Teeth of preanal edge of postabdomen arranged in groups of 2–3; these groups situated in proximal part of preanal edge of postabdomen with their size increasing proximally *E. timmsi* Smirnov, 1976
- Teeth on preanal edge of postabdomen, if present, ungrouped 3
- 3(2). Head shield stepped in its posterior part (lateral view) so that height suddenly decreases in posterior part of the head shield *E. hardingi* (Petkovski, 1973)
- Dorsal side of head shield smoothly convex 4
- 4(3). Blunt unserrated prominence on ventral side of head *E. capensis* Sars, 1916
- No big prominence on ventral side of head 5
- 5(4). Carapace markedly keeled *E. carinata* Smirnov, 1976
- Carapace not, or only slightly, keeled 6
- 6(5). Distal segment of setae natatoriae very short 7
- Distal segment of setae natatoriae long 8
- 7(6). Long spines on largest seta of antenna *E. williamsi* n.sp.
- Largest setae of antenna with short spines *E. triserialis* (Brady, 1886)
- 8(6). Largest setae of antenna with spines *E. rosea* Liévin, 1848
- Largest setae of antenna with setules 9
- 9(8). Distal segment of setae natatoriae shorter than proximal one *E. schauinslandi* (Sars, 1904)
- Distal segment of setae natatoriae longer than proximal one *E. flagellata* n.sp.

Echinisca rosea Liévin, 1848

Echinisca rosea Liévin, 1848: 31 tab. 7, figs 3–7.—Smirnov, 1976: 104–109, figs 76–80.

Material. Qld: 12, 15, 16, 17, 21, 27.

Length. 0.7 mm.

Ecology. Littoral.

Distribution. North Qld, but it could live further south as it occurs in northern Europe among other areas in the Holarctic (Smirnov, 1976).

Differential diagnosis. The carapace is not keeled and its dorsal outline is evenly arched. The setae natatoriae have a long distal segment. The ventral edge of the head lacks a prominence. The antennule has rows of setae, but no spines. The antennal segments have no groups of large spines. The postabdomen has small ungrouped teeth along its preanal and anal margins.



Fig. 88. *Echinisca triserialis* ♀, a billabong W of Anakie, Qld, 18.vii.74. A, lateral view of whole animal, length 0.57 mm, slide 2994; B, antennule, slide 2994; C, antenna, slide 3004; D, postabdomen, slide 3005; E, thoracic limb I, slide 3004; F, inner spines of endite of limb I (names according to Fryer, 1974—compare his figs 61, 62), slide 3004.

Echinisca triserialis (Brady, 1886)

Fig. 88

Macrothrix triserialis Brady, 1886: 295.—Henry, 1922: 36–37 (no figures; it is doubtful whether Henry's description pertains to this taxon); Fryer, 1974: 199–203, figs 69–77.
Macrothrix chevreuxi Guerne & Richard, 1892: 530–533.
Echinisca triserialis.—Smirnov, 1976: 109–111, figs 82–84.

Material. Qld: 9, 11, 24, 37, 42. N.S.W.: 80, 85, 143, 145. Vic.: 241. S.A.: 374, 378.

Slides. AM ♀ P27743, MGU ♀ 2994, 3004, 3005, ZIN ♀ 2993.

Female. Dorso-posterior corner of carapace pointed; its dorsal margin with fine setulations on its posterior part. Antennule with small indentations along its anterior side, but no transverse groups of long setae. Antennal setae 0-0-1/1-1/3, spines 0-0-0-1/0-1-1. Largest antennal seta (that of basal segment of 3-segmented branch) with two larger spines in the area of the joint between its proximal and distal segments and distally followed by many small spines. Labrum with few serrations.

Thoracic limb I with three setae on external branch of exopodite. The small inner spine of internal branch of endite specialized and similar to that of *Macrothrix laticornis* as depicted by Fryer (1974: figs 61, 62). Setae natatoriae with a very short distal segment. Postabdomen with teeth, which diminish distally, on its preanal margin, and groups of setae on its anal margin.

Ocellus small and situated much closer to base of antennule than to eye.

Ecology. Littoral.

Distribution. Mainly Qld and N.S.W., also Vic., and S.A, and possibly elsewhere as well.

Differential diagnosis. The carapace is slightly keeled. The setae natatoriae have a very short distal segment (it is long in *E. carinata* in which the carapace is keeled). The dorsal outline of the head and carapace is evenly arched. The ventral edge of the head has no prominence. The antennule has no spines, and the antennal segments have no groups of large spines. The largest seta of the antenna has short spines. The postabdomen has ungrouped small teeth along its preanal and anal margins.

Echinisca schauinslandi (Sars, 1904)

Macrothrix schauinslandi Sars, 1904: 632-633, tab. 34, figs 4, 4a-b.

Macrothrix burstalis Smith, 1909: 83-84, pl. 16, fig. 3, n. syn.

Material. *Tas.*: 333.

Female. Body oval in outline. Antennule slightly incurved; several setae on distal part of its anterior surface and one seta on proximal part. Antennal setae 0-0-1-3/1-1-3. Preanal edge of postabdomen convex with numerous denticles. Teeth on anal edge of postabdomen. Distal segment of setae natatoriae much shorter than proximal segments. Ocellus small and located much closer to base of antennule than to eye.

Length. 1.1 mm.

Male. Unknown.

Type locality. Lake Wakatipu, South Island of New Zealand.

Distribution. Tasmania, New Zealand.

Differential diagnosis. The distal segment of the setae natatoriae is long, but still much shorter than the basal segment. The largest antennal seta bears short setules distally. The postabdomen has small, numerous preanal teeth, and irregular anal teeth. The ventral margin of the head is even.

Echinisca capensis Sars, 1916

Echinisca capensis Sars, 1916: 323-324, pl. XXVI, fig 1, 1a-d.—Smirnov, 1976: 122-124.

Of the two subspecies only the typical form is found in Australia.

Echinisca capensis capensis Sars, 1916

Fig. 89

Echinisca capensis capensis.—Smirnov, 1976: 122, figs 100-102.

Material. *N.S.W.*: 153. *Vic.*: 224, 254. *Tas.*: 320, 321, 322. *S.A.*: 377, 379. *W.A.*: 404.

Slides. AM ♀ P27738, MGU ♀ 1794, 2575, 2679, 2680, 2681, 2683, 2683, ZIN ♀ 1622.

Length. Up to 1.2 mm.

Ecology. Littoral.

Distribution. Southern areas of Australia.

Differential diagnosis. There is a large, blunt, unsertated prominence on the ventral side of the head. There are no groups of large spines on the segments of the four-segmented branch of the antenna, and no grouped teeth on the preanal margin of the postabdomen. The distal end of the postabdomen is obliquely cut. The anal margin has irregular small spines and lateral groups of

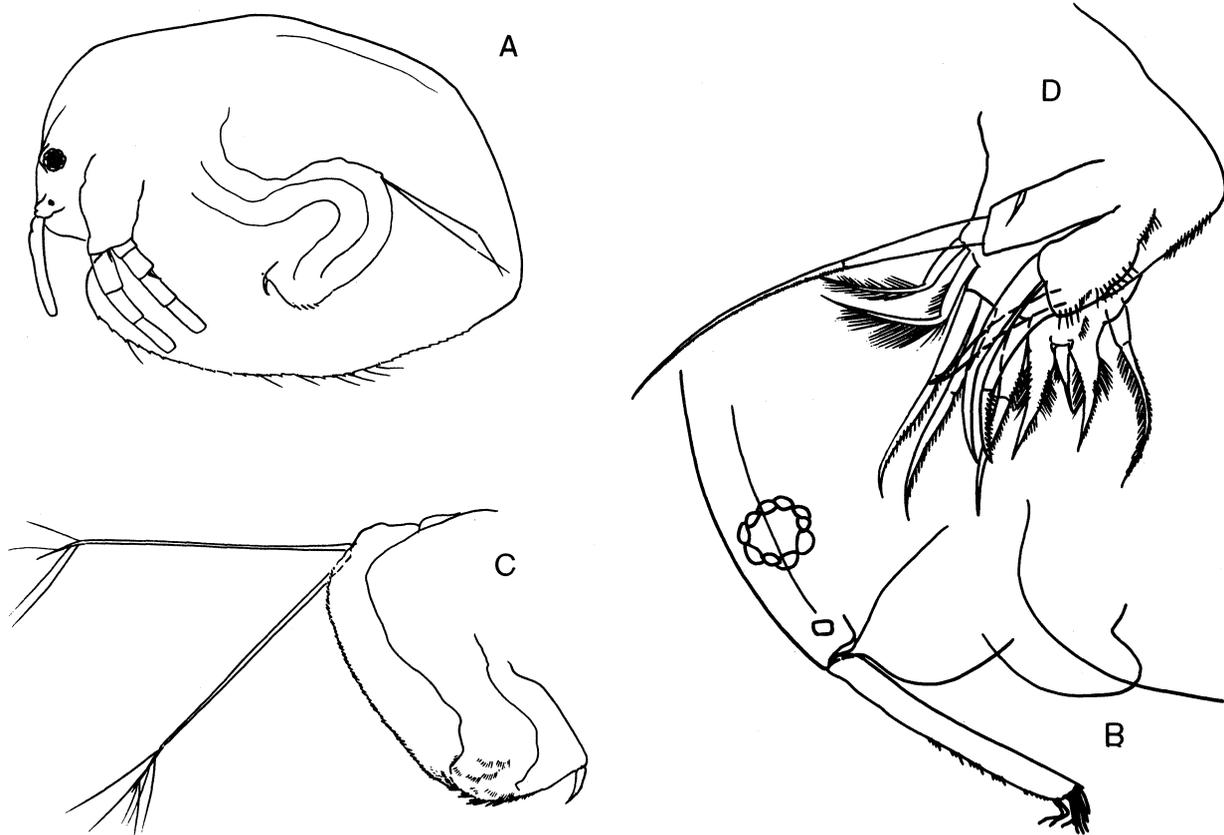


Fig. 89. *Echinisca capensis capensis* ♀, Tower Hill L., Vic., ii.68. A, lateral view of whole animal, length 1.1 mm, slide 1622; B, antennule, slide 1622; C, postabdomen, slide 1794; D, thoracic limb I, slide 1794.

setules. The females from Tower Hill Lake (Loc. No. 244) have dense setules on the preanal margin of the postabdomen, while females from a pond near Lake Goldsmith (Loc. No. 254) have denticles.

Echinisca hardingi (Petkovski, 1973)

Macrothrix (*Macrothrix*) *hardingi* Petkovski, 1973b: 170-1709, 189, figs 17-34, 60.

Echinisca hardingi.—Smirnov, 1976: 125-130, figs 106-108.

Material. Literature.

Comment. Petkovski (1973b) notes the antennule of his *Macrothrix hardingi* has a structure characteristic of the genus *Echinisca*.

Length. Up to 1.57 mm.

Type locality. A large pond at East Yellowdine and Granite Pool at East Merridin (W.A.).

Distribution. South-west Western Australia.

Differential diagnosis. The head shield is depressed step-wise in its posterior part (in lateral view). There are no groups of large spines on the segments of the four-segmented branch of the antenna and no grouped teeth on the preanal edge of the postabdomen. The setae natatoriae are $1\frac{1}{2}$ times as long as the postabdomen, the distal $\frac{2}{3}$ being feathered.

Echinisca timmsi Smirnov, 1976

Fig. 90

Echinisca timmsi Smirnov, 1976: 135, figs 116-117.

Material. N.S.W.: 83, 96.

Holotype. MGU ♀ 2567.

Paratypes. AM ♀ P27742, ZIN ♀ 2568.

Slides. MGU ♀ 2569.

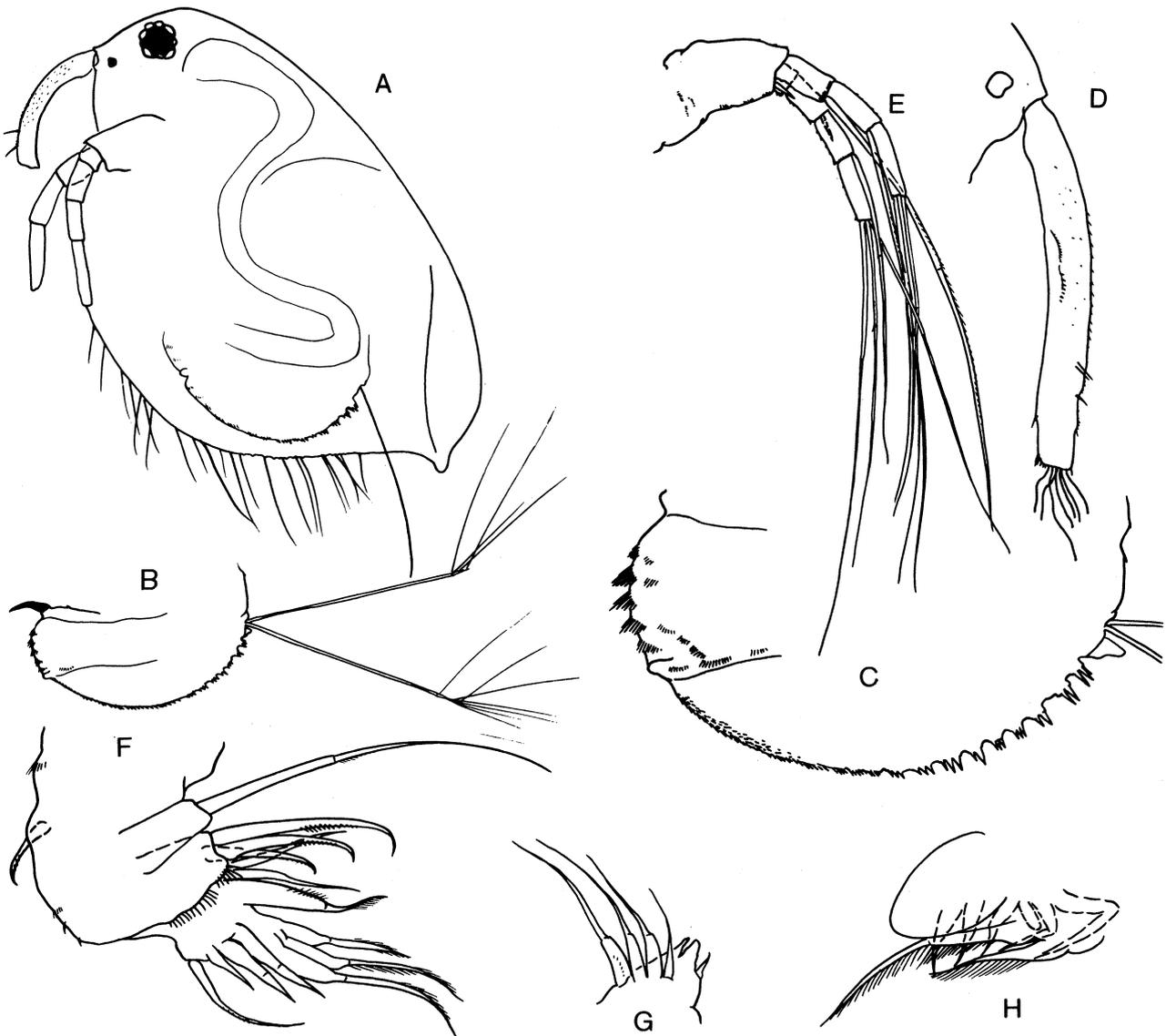


Fig. 90. *Echinisca timmsi* ♀, a swamp near Sugar Point, The Broadwater, Myall Lakes area, N.S.W., 13.iv.75. A, lateral view of whole animal, length 0.68 mm, slide 2567; B and C, postabdomen; D, antennule; E, antenna; F, thoracic limb I; G, limb II; H, limb IV. (B-H slide 2596.)

Female. Shell oval in lateral view with no depression between head and valves; dorsal side less convex than ventral side. Latter with long setae and irregular denticles, more expressed posteriorly. Dorsal side of shell smooth, not serrated. Dorso-posterior corner of shell produced into a short blunt outgrowth. Shell with slightly expressed polygons and small dots.

Antennule cylindrical, long and its base narrow. Its distal part with a few short setules and anterior edge with short setules. Sensory papillae, of various lengths, situated on distal end of antennule. Antennal setae 0-0-1-3/1-1-3, and spines 0-1-0-0/0-0-0. Basal joint of antennule with a spine.

Dorsal (preanal) side of postabdomen convex, with groups of denticles gradually transformed, from approximately middle of preanal side, into setules. Anal side with groups of setae. Claw small, chitinized, and without basal spines. Setae natatoriae with a long basal joint and a short distal joint bearing long setules. Short outgrowth on postabdomen, near base of setae natatoriae.

Thoracic limb I with external branch of its endite with 3 chitinized setae of different length. Inner branch of endite subdivided into an anterior lobe with 4 setae and a posterior lobe with large setae. Posterior side of the endite with setae, the anteriormost being the largest.

Intestine without a loop or outgrowths. Ocellus situated closer to base of antennule than to complex eye.

Length. 0.68 mm.

Male. Unknown.

Ecology. Littoral, in acid humic waters.

Type locality. Eurunderee Lagoon, Myall Lakes National Park, N.S.W. (Loc. No. 96).

Distribution. Coastal northern N.S.W.

Differential diagnosis. The posterior end of the carapace has a short blunt outgrowth. The postabdomen has groups of denticles along the anterior part of the dorsal side (morphologically dorsal side). The basal joint of the antennule has a spine. The distal joint of the setae natatoriae is short.

Echinisca pectinata Smirnov, 1976

Fig. 91

Echinisca pectinata Smirnov, 1976: 135-137, fig. 118.

Material. Qld: 34. N.S.W.: 133, 138, 145. Vic.: 256.

Holotype. MGU ♀ 878.

Paratypes. AM ♀ P27741, MGU ♀ 976, ZIN ♀ 1217, BM ♀ 2684.

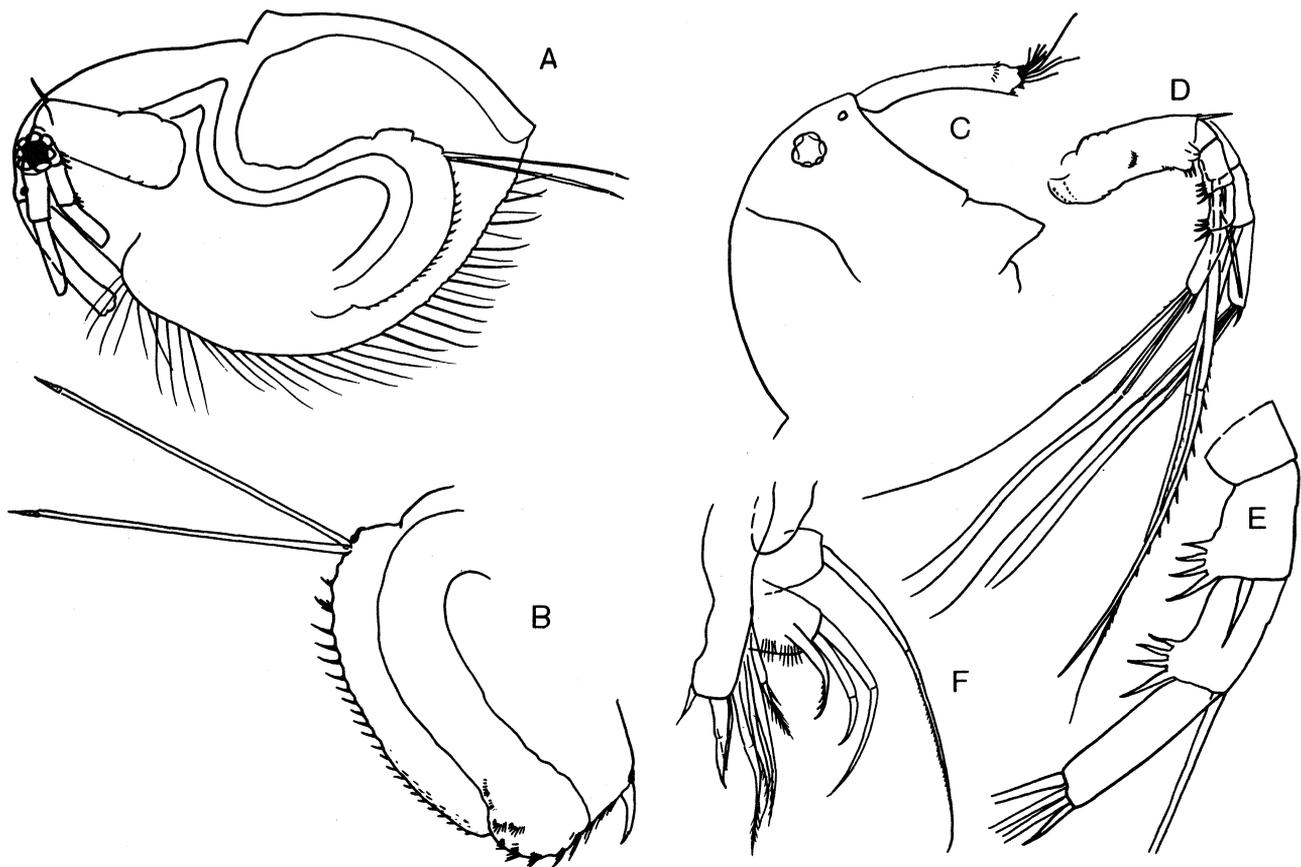


Fig. 91. *Echinisca pectinata* ♀, Main Bridgewater L., via Portland, Vic., 18.viii.72. A, lateral view of whole animal, length 0.67 mm, slide 878; B, postabdomen, slide 1217; C, head, slide 1217; D and E, antenna (right), slide 1217; F, thoracic limb I, slide 1449.

Female. Shell oval in lateral view. Dorsal side beyond head stepped so that anterior part of brood chamber is higher than posterior part of head. Dorsal side of shell smooth, not serrated, and its dorso-posterior corner acute. Ventral edge of valve with large setae of different thicknesses and broad denticles, occurring mainly posteriorly. Ventral margin of head straight.

Antennule dilated distally. Basal joint of antenna with a group of spines on distal inner angle and a separate spine. Antennal setae 0-0-1-3/1-1-3, and spines

0-5-4-1/0-0-1. Four-segmented branch with four spines forming a pecten on distal inner corner of second and third segments. (Analogous groups of spines on antennal segments are known also for species of *Leydigia* (Chydoridae). This case may serve as an example of the parallel formative processes within different unrelated genera (Smirnov, 1971b).)

Preanal edge of postabdomen convex and with denticles that increase in size proximally. Anal aperture edged with groups of setae. Claw with no basal spines. Setae natatoriae with a long basal joint and a short distal joint.

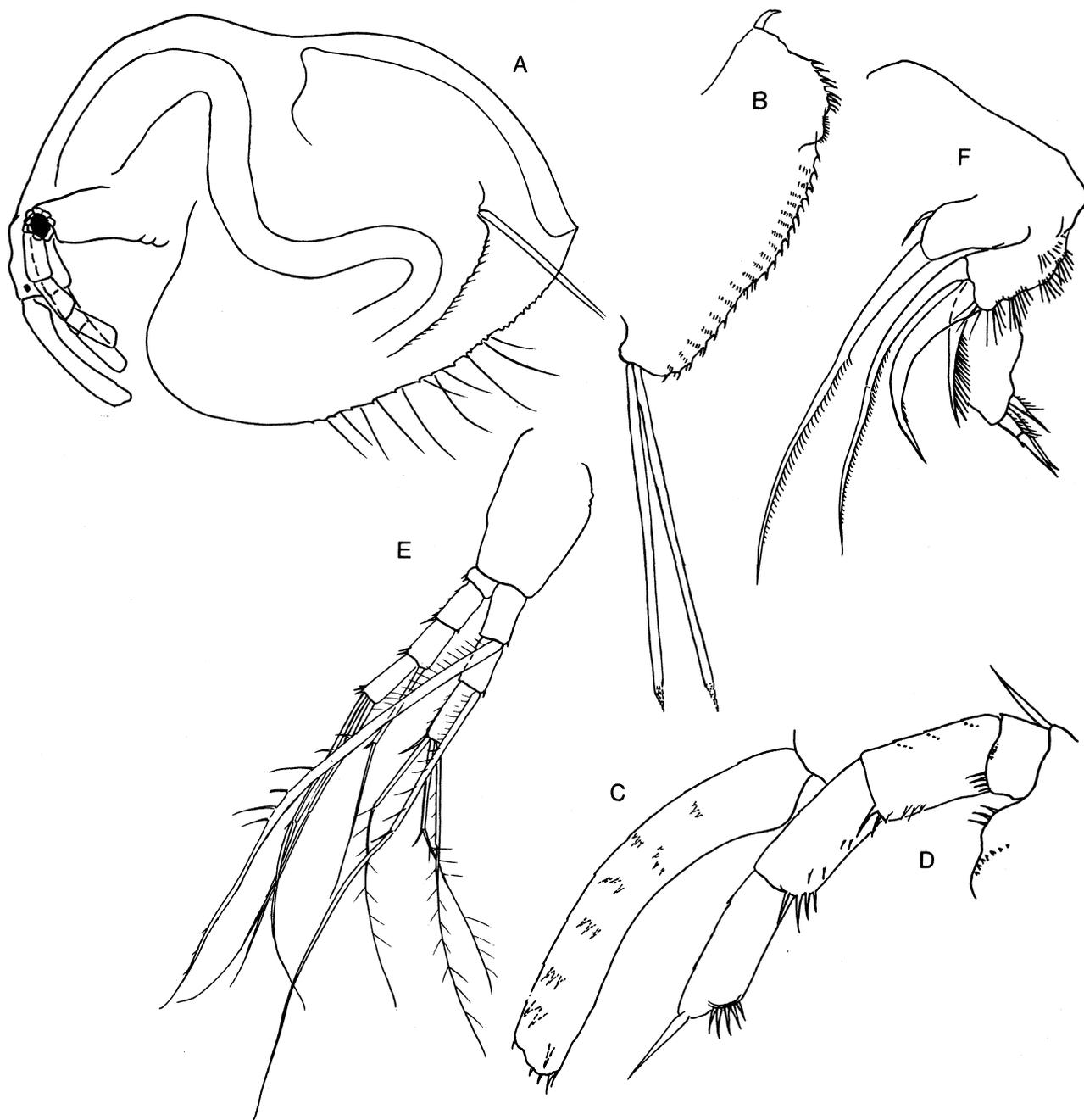


Fig. 92. *Echinisca williamsi* ♀, L. Powlathanga, via Charters Towers, Qld, 26.vi.74. A, lateral view of whole animal, length 0.58 mm; B, postabdomen; C, antennule; D, four-segmented branch of antenna (left); E, antenna (left); F, thoracic limb I. (A, B from slide 2876, C, D, F from slide 2886; E from slide 2877.)

External branch of endite of thoracic limb I with 3 setae of different length. Exopodite with one long seta with small setules along one side of its distal joint. Thoracic limb IV with 2 setae on the exopodite and a series of 5 soft setae on its endite.

Ocellus situated closer to base of antennule than to complex eye.

Length. 0.67 mm.

Male. Unknown.

Ecology. Littoral.

Type locality. Main Bridgewater L. (Vic.) (Loc. No. 256).

Distribution. Eastern Australia.

Differential diagnosis. The anterior part of the brood chamber is stepped, so that it is higher than the posterior end of the head. The carapace is not keeled. There are groups of spines forming a pecten on the second and third joints of the four-segmented branch of the antenna. The distal joint of the setae natatoriae is short and bears long setules.

Echinisca williamsi n. sp.

Fig. 92

Material. Qld: 12.

Holotype. AM ♀ P27744.

Paratypes. MGU ♀ 2876, 2886, ZIN ♀ 2877.

Female. Dorsal edge of carapace smooth (i.e. not serrated); ventral edge with irregular denticles and long setae. Small dorso-posterior angle to carapace.

Antennule with groups of denticles. Antennal setae 0-0-1-3-/1-1-3. Both its distal joints and the basipodite with long spines; in addition, segments of four-segmented branch with groups of small spines. (Similar spines are present in *Echinisca rosea*, however, these groups of small spines are not depicted or mentioned by Lilljeborg (1900), Behning (1941) or Flössner (1972).) Largest seta of antenna, i.e. seta of proximal segment of three-segmented branch, with long spines, at least in its middle.

Postabdomen with spines and small setae on anal edge, and spines of comparatively small size along preanal margin, as well as setules on sides of preanal part. Distal joint of setae natatoriae very short. By comparison it is very long in *E. rosea* according to Lilljeborg (1900), Behning (1941), and Srámek-Hušek *et al.* (1962).

Thoracic limb I with three setae of different length on external branch of its exopodite. Setules of the shortest of these setae long and unilateral.

Ocellus situated close to base of antennule, much closer than to base of eye. Intestine not convoluted.

Length. 0.58 mm (holotype P27744).

Male. Unknown.

Ecology. Littoral.

Type locality. Lake Powlathanga, via Charters Towers, Qld (Loc. No. 12).

Etymology. The species is named after Professor W.D. Williams, Adelaide University.

Distribution. Known only from type locality in northern Qld.

Differential diagnosis. The carapace is not keeled. The distal joint of the setae natatoriae is very short. The teeth of the postabdomen are of moderate size and rather uniform in length. The antennule bears groups of denticles.

E. williamsi is similar to *E. rosea*, but differs in having short distal joints of the setae natatoriae and long spines on the largest seta of the antenna.

Echinisca flagellata n.sp.

Fig. 93

Material. Tas.: 311.

Holotype. AM ♀ P27740.

Paratypes. MGU ♀ 2979, ZIN ♀ 2980.

Slides. MGU ♀ 2983.

Female. Body broadly oval in outline; its dorsal margin evenly convex and smooth in lateral view. Antennule thin with many transverse rows of setae. Antennal setae 0-0-1-3-/1-1-3, spines 0-1-0-1-/0-0-1; largest seta setulated but lacks spines.

Dorsal side of postabdomen broadly convex. Preanal margin covered with very small setules and anal margin with several teeth. Distal segment of setae natatoriae longer than proximal one.

Exopodite of thoracic limb I with a short and long seta, the latter with unilateral setulation. External branch of its endite with three setae of different length. Internal branch with groups of setae which include the peculiar small inner setae. Limb II with a very big endite with powerful stiff setae, getting smaller towards gnathobase and ending with a feathered seta. Four setae in gnathobasic fan. Limb III and IV with two rows of setae on their endite and comparatively large exopodites.

Intestine not convoluted. Ocellus small and situated closer to base of antennule than to eye.

Length. 1.39 mm (holotype P27740).

Male. Unknown.

Type locality. A pool 8 km east of Steppes, central Tasmania (Loc. No. 311).

Distribution. Known only from type locality in Tasmania.

Differential diagnosis. The body in outline is broadly oval with the dorsal margin evenly convex and smooth. The antennule has many transverse rows of setae. The largest seta of the antenna has small setules but no spines. The distal segment of the setae natatoriae is longer than the proximal one.

Echinisca flagellata n. sp. is similar to *Macrothrix propinqua* Sars, 1909, but it differs in that the antennule does not dilate distally. It is also similar to *Echinisca hardingi* (Petkovski) in the form of the antennule, antenna, setae natatoriae, and in size. However, *E.*

flagellata differs in that the dorsal outline is evenly arched and there are teeth on the anal margin.

Echinisca carinata Smirnov, 1976

Fig. 94

Echinisca carinata Smirnov, 1976: 124, fig. 104.

Material. Qld: 30. N.S.W.: 136, 137, 139, 158, 163, 165, 167. Tas.: 320, 335. W.A.: 413.

Holotype. MGU ♀ 2815.

Paratypes. AM ♀ P27739, ZIN ♀ 2816.

Slides. MGU ♀ 2818, 2819.

Female. Dorsal edge of valve essentially smooth (i.e. not serrated), however in some specimens very small

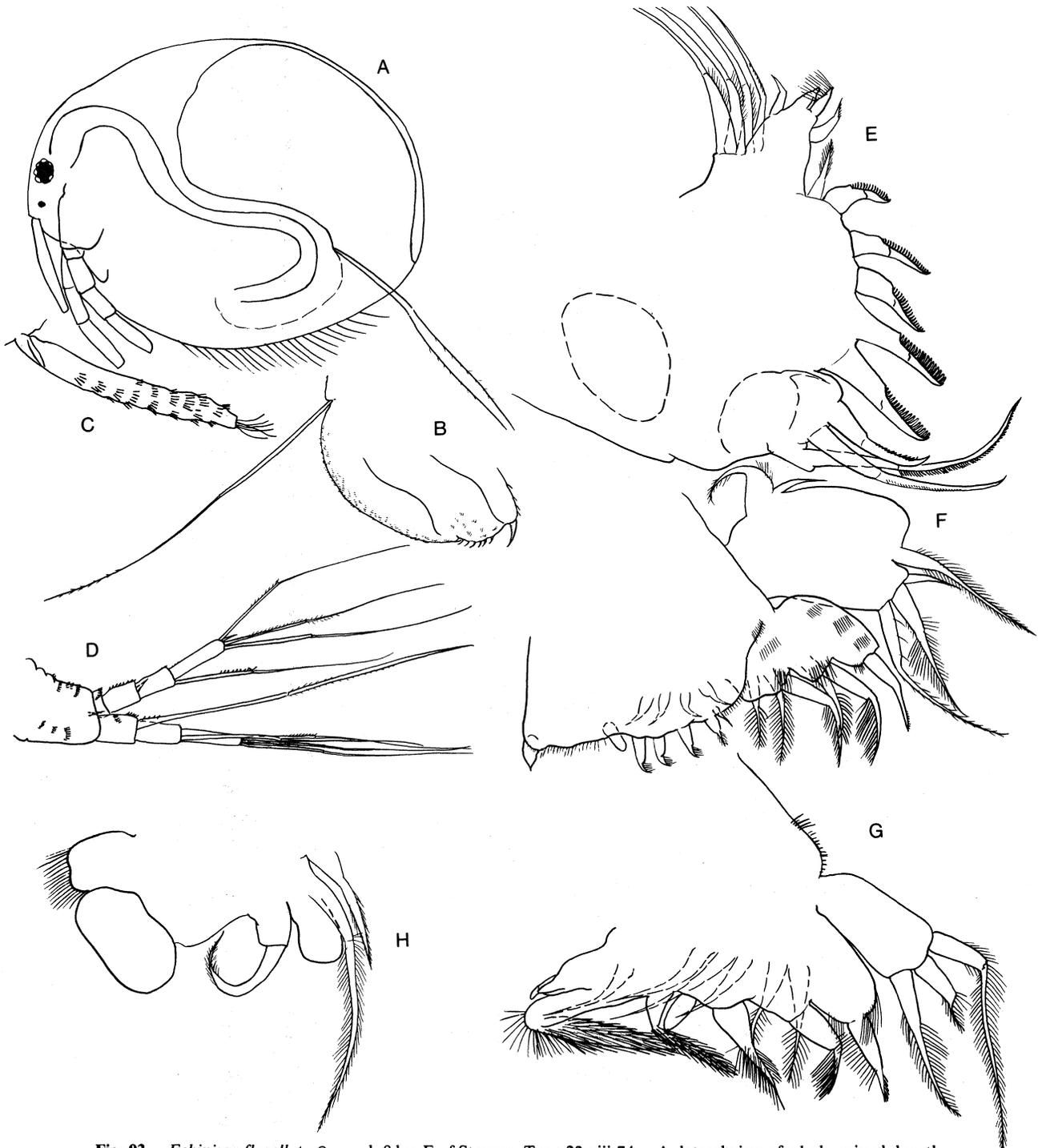


Fig. 93. *Echinisca flagellata* ♀, pool, 8 km E of Steppes, Tas., 22.viii.74. A, lateral view of whole animal, length 1.39 mm; B, postabdomen; C, antennule; D, antenna; E, limb II; F, limb III; G, limb IV; H, limb V. (G-D from slide 2979; E-H from slide 2983.)

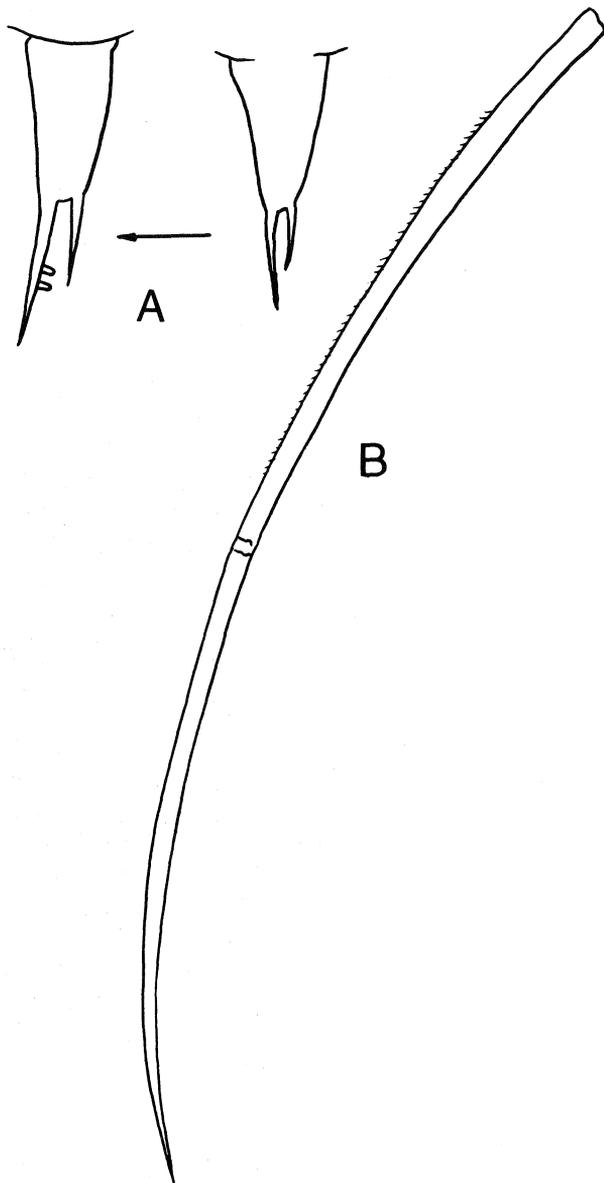


Fig. 94. *Echinisca carinata* ♀, L. Buchanan, via Charters Towers, Qld, 16.vii.74. A, inner spines of thoracic limb I (arrow points to the anterior end of the animal); B, largest seta of antenna (belonging to the first segment of the three-segmented ramus). (Both from slide 2819.)

occasional serrations in posterior part of dorsal edge (slide 2816). Marked dorsal (but not cephalic) keel on the carapace. Ventral edge of valves with rough irregular serrations and stout setae with very short setules. Small dorso-posterior angle to carapace.

Antennule not dilated distally, and with groups of setae on anterior surface of its distal half. Sensory papillae of antennule of different lengths. Antennule seta 0-0-1-3/1-1-3, and spines 0-1-0-1/0-0-1; largest seta has setules but no spines.

Postabdomen with spines and groups of seta on anal edge and spines increasing proximally on preanal edge. Distal joint of setae natatoriae very short, but with long setules.

Thoracic limb I with 3 setae on external branch of its endite, one much longer than other two. Small inner spines of internal branch of endite of limb I similar to those of *Macrothrix laticornis* is depicted by Fryer (1974, fig. 61). The long setae of exopodite of limb I with short densely spaced setules.

Intestine not convoluted.

Length. 0.65 mm (holotype 2815).

Male. Unknown.

Ecology. Littoral. May live in slightly saline (c. 4‰) and ephemeral pools.

Type locality. L. Buchanan, via Charters Towers, Qld (Loc. No. 30).

Distribution. Qld, N.S.W., Tas., W.A., and possibly other states as well.

Differential diagnosis. The dorsal edge of the carapace is markedly keeled. The setae natatoriae have very short distal joints. The preanal angle of the postabdomen has spinules increasing towards the base of the setae natatoriae.

Echinisca carinata is similar to *Macrothrix breviseta* found in the limnetic zone of the type locality (L. Buchanan), but differs in having the antennule not dilating distally, and in the short, densely spaced setules of the long exopodite seta of thoracic limb I.

Incertae sedis

Macrothrix spinosa Gurney, 1927: 67-68, fig. 5.

Genus *Pseudomoina* Sars, 1912

Pseudomoina Sars, 1912: 1-5.—Smirnov, 1976: 151.

Head defined from remainder of carapace by a dorsal depression. Carapace oval, its ventral edges densely setiferous. A tuft of long setae present at ventro-posterior corner of valve. Antennal setae 0-1-1-3/1-1-3, and spines 0-1-0-1/0-0-0. Postabdomen tapers distally; no distinct anal teeth present. Five pairs of thoracic limbs. External branch of endite of limb I with 4 setae. Intestine without caeca and convolutions. Both ocellus and eye present.

Pseudomoina is a monotypic genus. The type species is *Pseudomoina lemnae* (King, 1853).

Pseudomoina lemnae (King, 1853)

Fig. 95

Moina lemnae King, 1853a: 250-251, pl. IV.—Sars, 1888: 68. *Lathonura lemnae*.—Schoedler, 1877: 14.

Pseudomoina lemnae.—Sars, 1912: 5-13, pl. X; Henry, 1922: 37; Brehm, 1932: 81; 1938: 103, 120, Abb. 7; Petkovski, 1973b: 182-188, figs 44-59, 62; Fryer, 1974: 229-230, figs 113-115; Smirnov, 1976: 151-153, figs 134-136.

Material. N.S.W.: 88, 96, 99, 149. Vic.: 210, 214, 216, 232, 233. Tas.: 292, 299.

Slides. AM ♀ P27754, MGU ♀ 2584, ZIN ♀ 2585.

Length. Female 1.2 mm, male 0.8 mm.

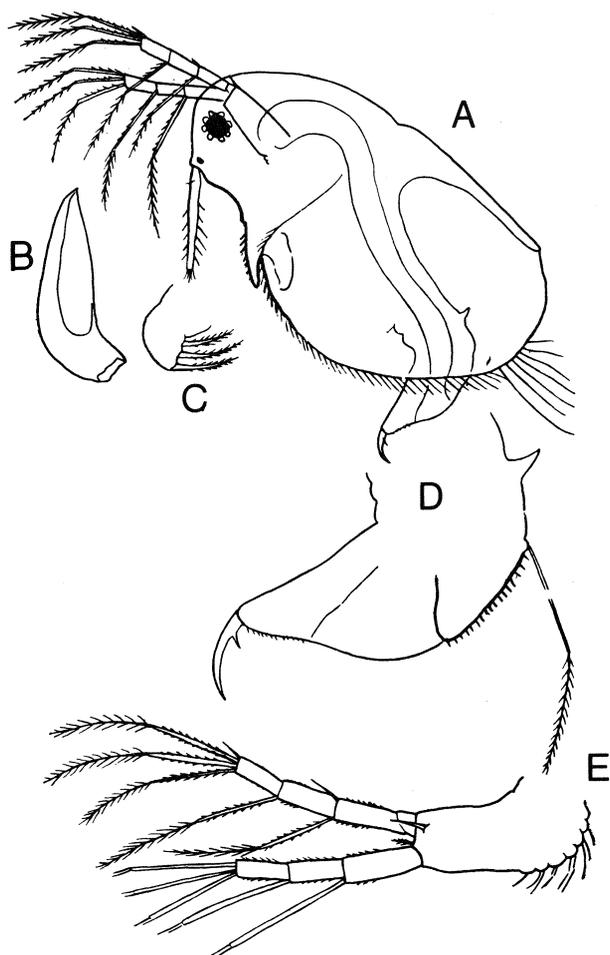


Fig. 95. *Pseudomoina lemnae* ♀, after Smirnov, 1971b. A, whole animal, length 1.2 mm; B, mandible; C, maxilla; D, postabdomen; E, antenna.

Ecology. Littoral.

Type locality. A pond near Cook's River close to Sydney.

Distribution. South-eastern Australia.

Genus *Streblocerus* Sars, 1862

Streblocerus Sars, 1862b: 284.

Body high, postabdomen short. Preanal edge of postabdomen serrated. Distal joint of setae natatoriae long. Intestine convoluted and an ocellus and an eye present. The genus is easily recognized by the bent antennules with several short and rather thick bristles.

Of the two known species of *Streblocerus* only the type species *Streblocerus serricaudatus* (Fischer, 1849) occurs in Australia.

Streblocerus serricaudatus (Fischer, 1849)

Fig. 96

Daphnia laticornis Fischer, 1849: 45–50, Taf. IV, figs 11–VIII.
Streblocerus serricaudatus Lilljeborg, 1900: 362, tab. 56, figs 15–27, tab. 57, fig. 1.—Smirnov, 1976: 166–171, fig. 155.

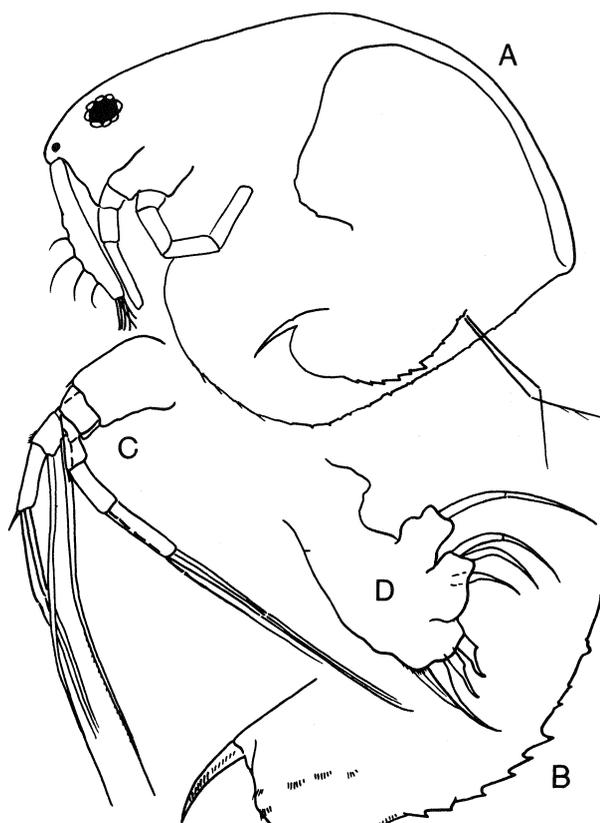


Fig. 96. *Streblocerus serricaudatus* ♀, "Pine Forest Lag." via Nelson, Vic., 11.viii.72. A, lateral view of whole animal, length 0.6 mm; B, postabdomen; C, antenna; D, limb I. (A, B, D from slide 1448; C from slide 1649.)

Material. Qld: 49. N.S.W.: 79, 81, 83, 96, 98, 100. Vic.: 226, 258. Tas.: 303.

Slides. AM ♀ P27755, MGU ♀ 2379, 1448, 1649, ZIN ♀ 2545.

Length. Up to 0.6 mm.

Ecology. Littoral. It 'swims' using strokes of the antennae, in the bottom material which may include filamentous algae. *S. serricaudatus* is usually found in soft acid waters but in Loc. No. 258 the pH was 7.8 and Ca content 60 mg/l at the time of collection. In Europe this species lives in similar habitats—soft acid waters (in sphagnum bogs) but occasionally hard waters (55 mg/l CaO) (Flössner, 1962).

Distribution. Eastern Australia.

Genus *Neothrix* Gurney, 1927

Neothrix Gurney, 1927: 69.—Smirnov, 1976: 171.

General body form ovoid. Carapace and head covered with bristles. Postabdomen with no claw, a unique feature for all known females of Cladocera. External branch of endite of leg I with 4 setae. Intestine not convoluted.

Neothrix is a monotypic genus endemic to Australasia.

The type species is *Neothrix armata* Gurney, 1927.

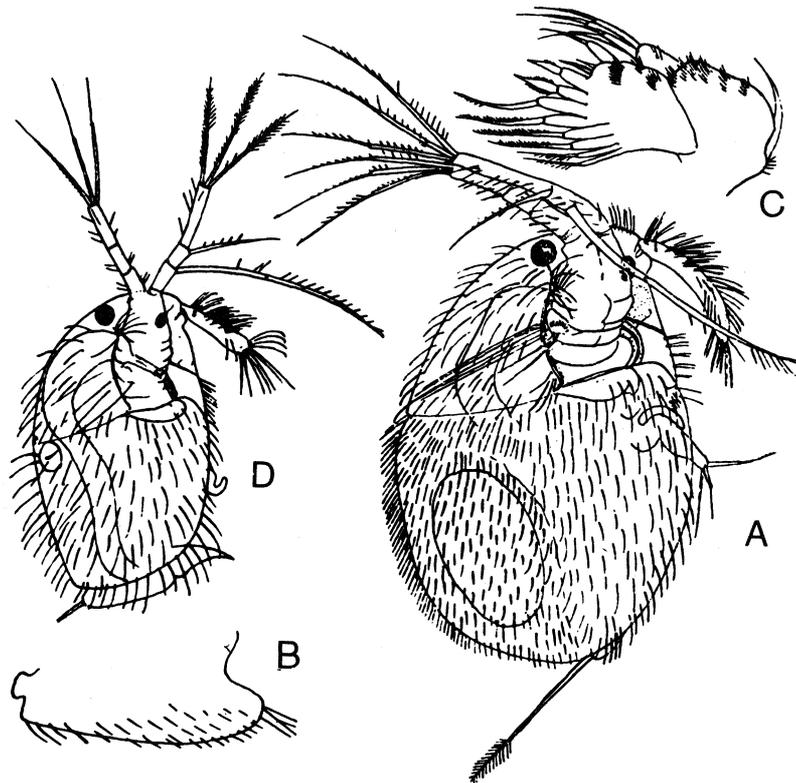


Fig. 97. *Neothrix armata* ♀, after Gurney, 1927. A, lateral view of whole animal; B, postabdomen of ♀; C, thoracic limb I of ♀; D, lateral view of ♂.

Neothrix armata Gurney, 1927

Fig. 97

Neothrix armata Gurney, 1927: 69–71, fig. 7.—Fryer, 1974: 231–236, figs 116–127 (L. Rotoiti, New Zealand); Smirnov, 1976: 171–173, fig. 160.

Material. Qld.: 31. Vic.: 204, 257. W.A.: 403, 406, 422, 425, 426.

Slides. Female: AM P27752, MGU 3030. Ephippium: AM P27753, MGU 3034, ZIN 3031.

Female. The ephippium contains one, rarely two eggs. Its surface bears sparsely spaced bristles and small circles.

Ecology. *Neothrix armata* has not been studied alive before, so we observed some females collected near the shore of Swan Lake, Vic. (Loc. No. 257). It swims by rapid simultaneous jerks of its antennae, typically ventral side up, above, on the surface of, or among clumps of particulate material. If disturbed it swims in free water. If swimming slowly its head points upwards, but at each stroke of the antennae the head moves forwards and the body is horizontally orientated. Sometimes it rests on the bottom with its head downwards. If arrested by some obstacle (e.g. a filament) it attempts to release itself by numerous jerks of the antennae. If disturbed, *Neothrix armata* remains still for 1–2 seconds, feigning death.

It feeds by handling clumps of organic matter about ¼ of its length with thoracic limbs I and II. A food

particle is rotated between the legs and the food is scraped—no filtratory currents or permanent undulations of thoracic limbs were observed. These observations concur with those reported by Fryer's (1974) morpho-functional study on preserved material, namely that it is a benthic animal, feeding by mechanical handling of food particles and using no filtration.

It is clean; the bristles on the carapace seem to keep organic particles off its body.

Type locality. Waters near Longreach, Qld.

Distribution. Qld, Vic., and particularly W.A.; possibly other states as well.

Family MOINIDAE Goulden, 1968

Moinidae Goulden, 1968: 1–101.—Smirnov, 1976: 174–229.

The type genus is *Moina* Baird, 1850.

Key to the Genera of Moinidae

1. Distal segment of four-segmented branch of antennae with four setae; ocellus present *Moinodaphnia* Herrick, 1887
- Distal segment of four-segmented branch of antenna with three setae; ocellus absent (except in *Moina reticulata* (Daday, 1903), but this species not known for Australia) *Moina* Baird, 1850.

Genus *Moinodaphnia* Herrick, 1887

Moinodaphnia Herrick, 1887: 35.—Sars, 1901: 15–16; Goulden, 1968: 83–84; Smirnov, 1976: 187.
Paramoina Sars, 1888: 68.

The shell is wide, the head small. The distal segment of the four-segmented branch of the antenna has four setae.

This is a monotypic genus with the type species *Moinodaphnia macleayi* (King, 1853) originally described from Australia.

***Moinodaphnia macleayi* (King, 1853)**

Fig. 98

Moina macleayi King, 1853a: 251252, pl. 5.

Moinodaphnia macleayi.—Sars, 1888: 68; 1896: 28; 1901: 16–19, pl. 3, figs 1–10; Henry, 1922: 34, pl. 4, fig. 6; Brehm, 1933: 669–670, fig. 10; 1953: 324–325, fig. 92; Goulden, 1968: 84–87, figs 45–46; Smirnov, 1976: 187–189, figs 165–166.

Moina submucronata Brady, 1886: 294, pl. 37, figs 4, 5.

Moina Juanae Brehm, 1948: 99–100, figs 2A–C.

Material. Qld: 24, 48. N.S.W.: 79, 82, 83, 84, 91, 97, 100, 101.

Length. Female up to 1.1 mm, male up to 0.6 mm.

Ecology. This species often occurs in the littoral of coastal lagoons and swamps which are markedly acid (pH 3.5–6.0). It is a filter feeder.

Type locality. A pond at Elizabeth Bay (Sydney).

Distribution. Coastal Qld and N.S.W.

Genus *Moina* Baird, 1850

Moina Baird, 1850: 100.—Goulden 1968: 11; Smirnov, 1976: 189–190.

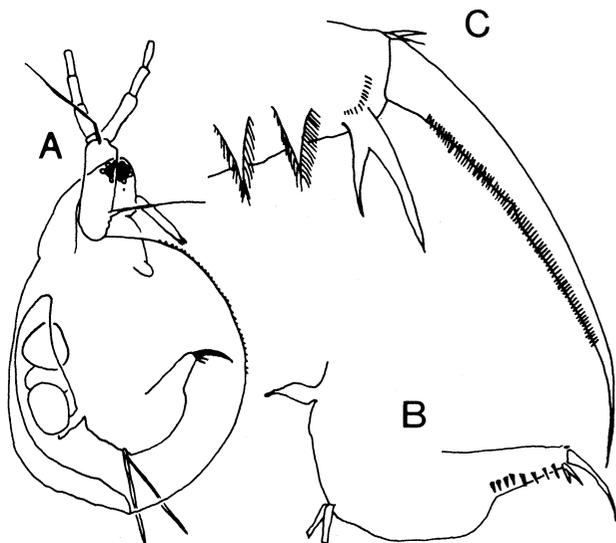


Fig. 98. *Moinodaphnia macleayi* ♀, after Rey & Saint-Jean. A, lateral view of whole animal; B, postabdomen; C, claw of postabdomen.

Body globular with a relatively large head. Distal segment of four-segmented branch of antenna with three setae.

The type species is *Moina brachiata* (Jurine, 1820).

Key to Australian Species of *Moina*

1. Antennule very thin, about 11–12 times as long as wide; ephippium with two eggs *M. tenuicornis* Sars, 1896
— Antennule not very thin; ephippium with one or two eggs 2
- 2(1). No seta on anterior side of the penultimate segment of thoracic limb I
..... *M. mongolica* Daday, 1901
— A seta on anterior side of penultimate segment of thoracic limb I 3
- 3(2). Ventral edge of valve straight or slightly concave in its posterior half; ephippium with one egg *M. flexuosa* Sars, 1897
— Ventral edge of valve evenly arched; ephippium with one or two eggs 4
- 4(3). Ephippium with one egg
..... *M. micrura* Kurz, 1874
— Ephippium with two eggs
..... *M. australiensis* Sars, 1896

***Moina micrura* Kurz, 1874**

Moina micrura Kurz, 1874: 13–15, pl. I, fig. 1.—Goulden, 1968: 28–37, figs 8–12; Smirnov, 1976: 194–200.

Monoculus rectirostris Jurine, 1820: 134–135, pl. 13, figs 3, 4.

Of the three subspecies now recognized only the typical form is known in Australia. However a subspecies key is given to allow the possibility of differentiating the other subspecies.

Differential diagnosis. The antennule is not very long and thin. The ventral edge of the valve is evenly arched. There is a seta on the anterior side of the penultimate segment of thoracic limb I. The ephippium contains one egg.

Key to Subspecies of *Moina micrura*

1. Concave side of claw with a uniform row of setules
..... *M. micrura micrura* Kurz, 1874
— Concave side of claw with proximal setules larger, forming a separate pecten 2
- 2(1). Dorsal side of postabdomen with comparatively large setae; basal setae of antenna short
..... *M. micrura ciliata* Daday, 1905

— Dorsal side of postabdomen with comparatively short setae; basal setae of antenna long
 ... *M. micrura dubia* Guerne & Richard, 1892

Moina micrura micrura Kurz, 1874
 Figs 99, 100

Moina micrura micrura Kurz, 1874: 13–15, pl. I, fig. 1.—
 Smirnov, 1976: 196–200, figs 171–176.

Moina propinqua Sars, 1885: 29–35, tab. 5, figs 5, 6, tab. 6.

Material. Qld: 7. S.A.: 356, 365, 393. N.T.: 451, 453, 454.

Slide. MGU ♀ ephippial ♀, ♂ 2871, ♀ 2874.

Length. Female 0.97 mm, male 0.64 mm.

Ecology. This form is limnetic, as is *Moina micrura sensu lato* (Goulden, 1968; Timms, 1970a).

Distribution. Qld, S.A., N.T., but probably more widespread. *M. micrura sensu lato* has been reported from N.S.W., and Vic., (Goulden, 1968; Timms, 1970a).

Moina australiensis Sars, 1896

Fig. 99

Moina australiensis Sars, 1896: 18–24, pl. 3, figs 1–11.—
 Henry, 1922: 34–35; Brehm, 1953a: 6–9, fig. 2; Goulden,
 1968: 48–51, fig. 21; Vidal, 1970: 203–208, figs 1, 2 (*Moina*
 sp., New Zealand); Smirnov, 1976: 203–204, figs 183–184.

Material. N.S.W.: 154, 162. Vic.: 247. W.A.: 404.

Slides. MGU ♀ 2624, ZIN ♀ 2625.

Length. Up to 1.9 mm.

Ecology. This species is euryhaline, for Brehm (1953b) records it from a saline lake and our Victorian record (Loc. No. 247, L. Coragulac) was slightly saline (5 ‰) at the time of sampling, but the two N.S.W. records are from freshwater.

Type locality. Sydney.

Distribution. N.S.W., Vic., W.A., but probably more widespread. Goulden's distribution map showing a record for near Rockhampton, Qld, is erroneous; it probably refers to *M. micrura* (syn. *M. propinqua* Sars, 1885) but it is omitted from the appropriate map.

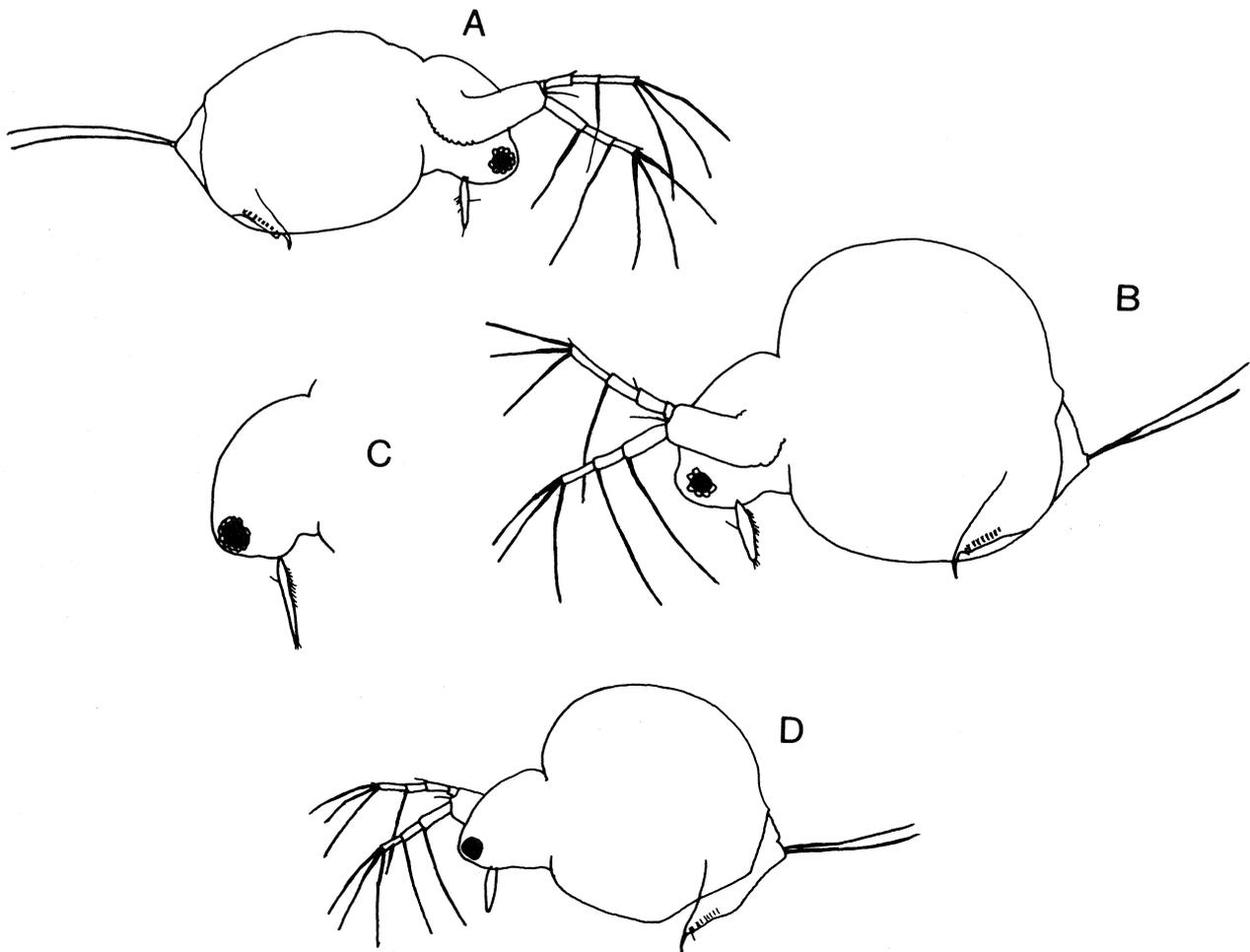


Fig. 99. Various Moinidae. A, *Moina micrura* ♀; B, *Moina australiensis* ♀; C, head of *Moina tenuicornis* ♀; D, *Moina flexuosa* ♀.

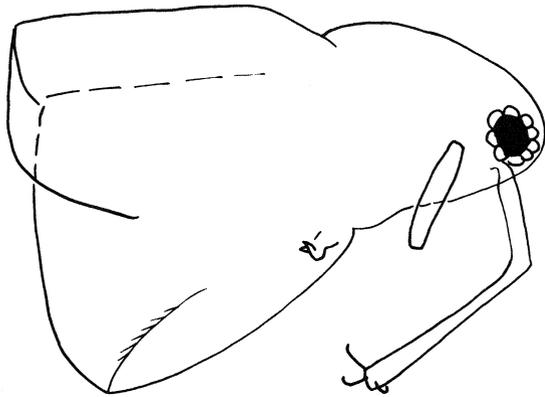


Fig. 100. *Moina micrura micrura*. Gynandromorphous individual, Anthony Lagoon, N.T., vii.75, slide 2874.

Differential diagnosis. The ventral edge of the valve is uniformly convex. Thoracic limb I has a seta on the anterior side of the penultimate segment. This seta is not pectinate. The seta of the posterior side of the valve are grouped. The ephippium contains two eggs.

Moina tenuicornis Sars, 1896

Fig. 99

Moina tenuicornis Sars, 1896: 24–27, pl. 4, figs 1–8.—Haase, 1903: 150, fig.5; Henry, 1919: 468; 1922: 35; Smirnov, 1976: 213, fig. 195.

Material. N.S.W.: Parramatta (vial in Australian Museum P:6212), a slide in the Australian Museum “P:5894 *Moina tenuicornis* Sars, Loc. Corowa”. Vic.: 212, 213, 216, 217, 241. W.A.: 427.

Slides. MGU ♀ 1239, ZIN ♀ 1427.

Length. Up to 1.2 mm.

Type locality. A pond in Sydney.

Distribution. N.S.W., Vic., W.A., but probably more widespread.

Differential diagnosis. The antennule is very thin, its length being 11–12 times its width. The ventral edge of the valve is uniformly convex. Thoracic limb I has a seta on the anterior side of the penultimate segment; this seta is not pectinate. The ephippium contains two eggs.

Moina flexuosa Sars, 1897

Fig. 99

Moina flexuosa Sars, 1897: 18–23, pl. 3, figs 1–7.—Goulden, 1968: 55–58, figs 24, 25; Smirnov, 1976: 225, fig. 208.

Material. Literature.

Length. 0.9 mm.

Type locality. A depression 60 km east of Roebuck Bay, W.A.

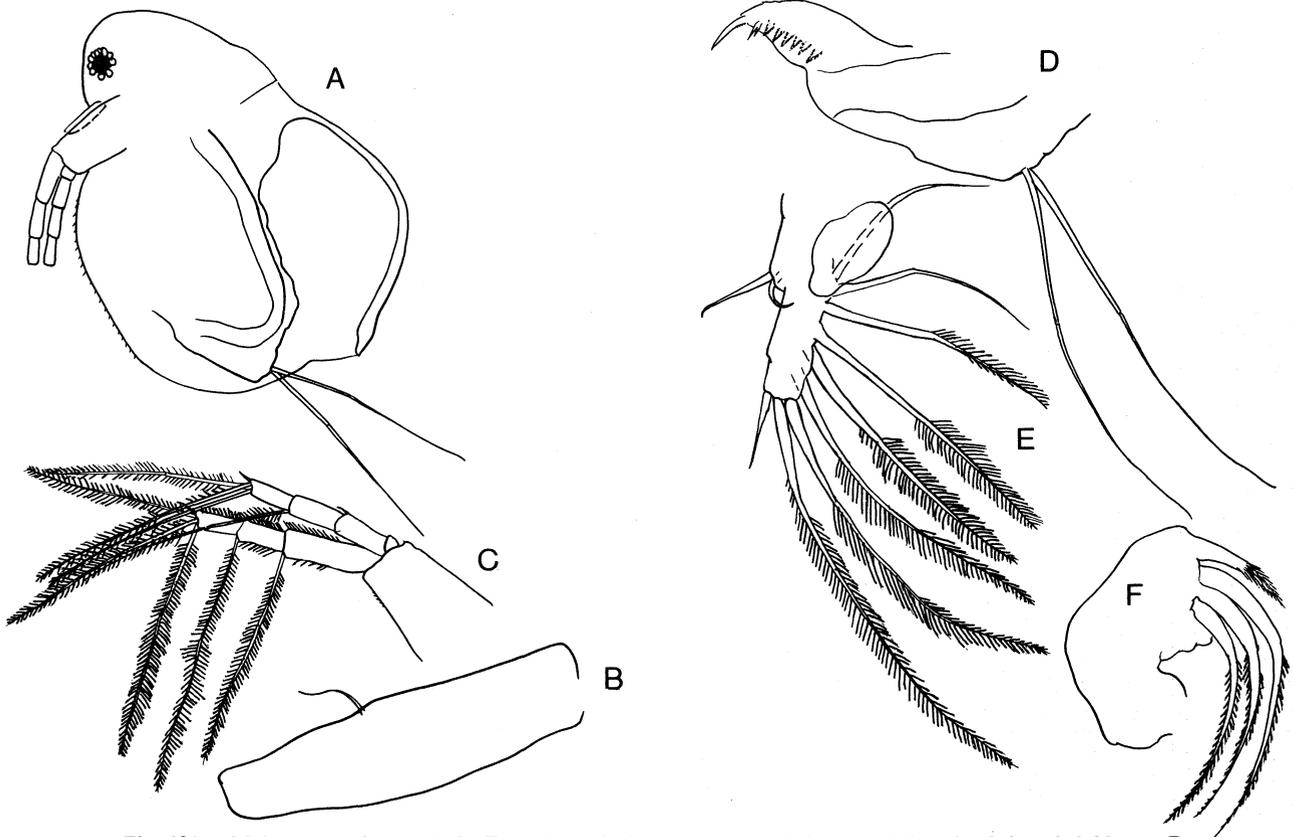


Fig. 101. *Moina mongolica* ♀, Lake Eyre, S.A., 27.ix.74. A, lateral view of whole animal, length 0.95 mm; B, antennule of an ephippial ♀; C, antenna (left); D, postabdomen; E, thoracic limb I; F, maxillule. (A–C from slide 2951; D–F from slide 2955.)

Distribution. Known only from its type locality in north-west W.A.

Differential diagnosis. The ventral edge of the valve is straight posteriorly. Thoracic limb I has a seta on the anterior side of the penultimate segment. The ephippium contains one egg; its surface is knobby.

Moina mongolica Daday, 1901

Figs 101, 102

Moina mongolica Daday, 1901: 444-445, pl. 21, figs 11-15, pl. 22, figs 1-3.—Goulden, 1968: 64-69, figs 29, 30; Smirnov, 1976: 216-222, figs 204, 205.

Material. S.A.: 353—several ephippial females and males. A sample in formalin has been placed in the Australian Museum.

Slides. AM ♀♂ P27756; MGU ♀, ephippial ♀♂ 2951; ♀ 2955; ♂ 2956; ZIN ♀♂ 2965.

Female. The specimens conform in all main characters to the description of this species as summarized by Goulden (1968). They differ, however, from the European form in the short seta of the distal segment of thoracic limb I being shorter (it is well short of reaching the border between the first and second segment of larger setae of this segment, whereas it almost reaches this place in the specimen figures in fig. 30E by Goulden, 1968).

Male. Thoracic limb I with a strong hook and no exopodite. In some juvenile males in the L. Eyre material the distal end of the antennule lacks hooks and the sensory seta is situated a little proximal to the middle of the antennule.

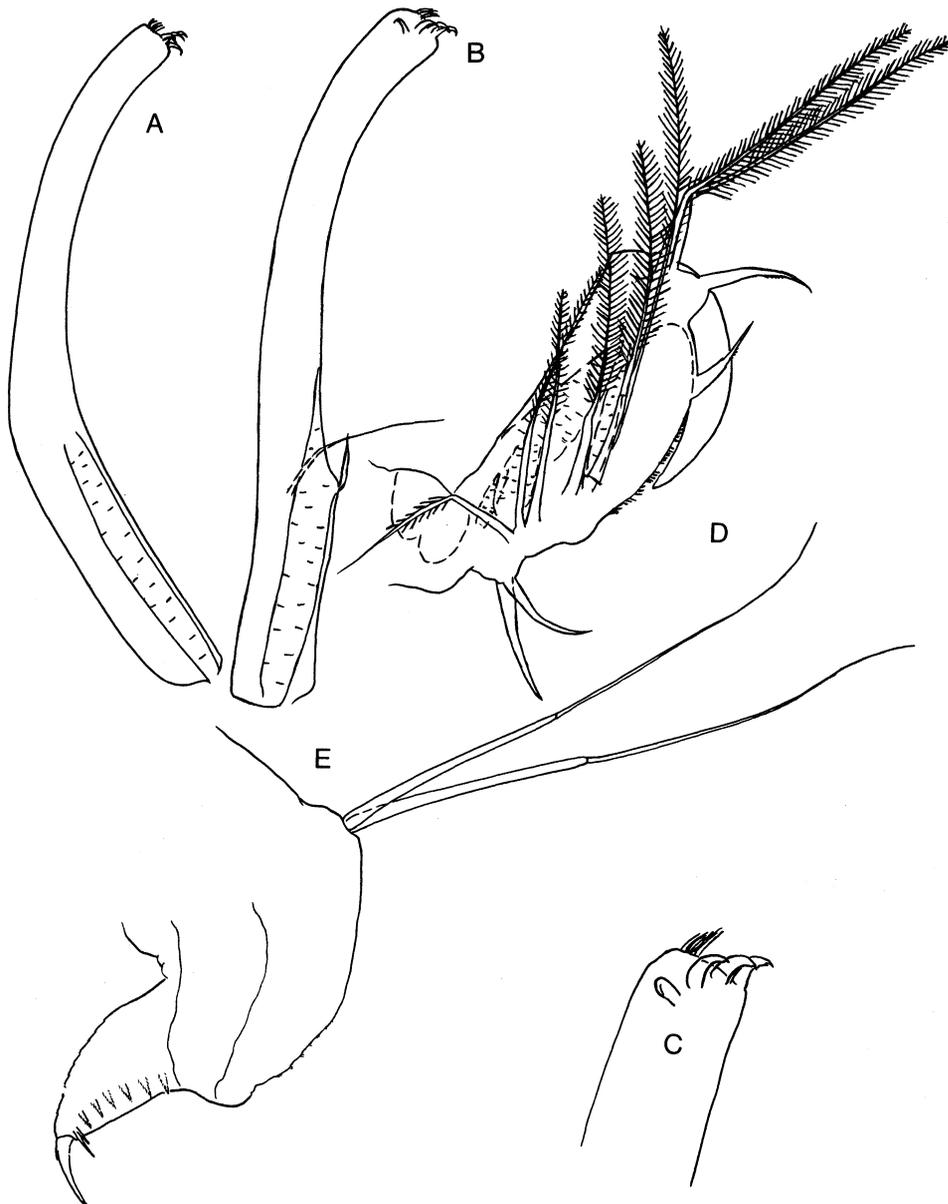


Fig. 102. *Moina mongolica* ♂, Lake Eyre, S.A., 27.ix.74. **A**, antenna (above); **B**, antenna (below); **C**, tip of antenna; **D**, thoracic limb I; **E**, postabdomen. (A slide from 2951, B-D from slide 2956.)

Ecology. Halophilic—Bayly (1976) records a salinity range of 7–39 ‰ in L. Eyre.

Distribution. S.A.—L. Eyre.

Differential diagnosis. The ventral edge of the valve is evenly arched. The antennule is not very long. There is no seta on the anterior side of the penultimate segment of thoracic limb I. The basal part of the concave side of the claw bears small but noticeable spines.

Family BOSMINIDAE Sars, 1865

Small cladocerans, about 1 mm or less. Valves cover trunk and thoracic limbs. Ventro-posterior corner of valve angular or with a spine-like elongation. Antennule of female characteristically fused with rostrum. No ocellus. Intestine not convoluted.

The type genus is *Bosmina* Baird, 1845.

Key to Genera of Bosminidae

1. Antennules fused at their bases;
postabdomen tapers distally
..... *Bosminopsis* Richard, 1895
- Antennules not fused at their bases;
distal end of postabdomen truncated
..... *Bosmina* Baird, 1845

Genus *Bosminopsis* Richard, 1895

Bosminopsis Richard, 1895: 96–98, figs 1–4.
Bosminella Daday, 1903: 594–597.

The type species is *Bosminopsis dietersi* Richard, 1897.

Bosminopsis dietersi Richard, 1897

Fig. 103

Bosminopsis dietersi Richard, 1897: 283.

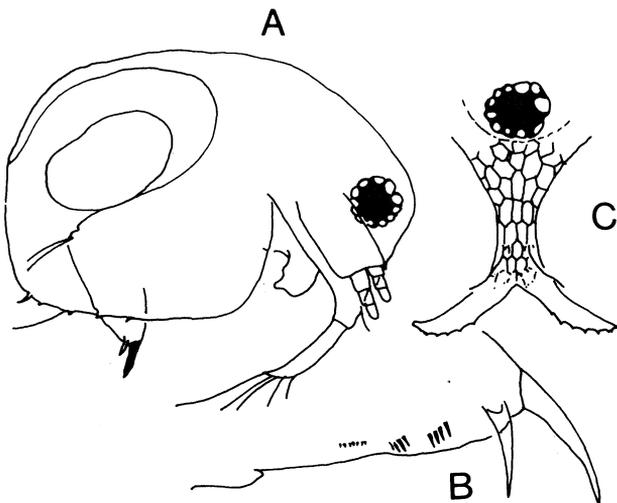


Fig. 103. *Bosminopsis dietersi* ♀, after Rey & Saint-Jean. A, lateral view of whole animal; B, postabdomen; C, frontal view of antennule.

Material. Data from literature.

Distribution. Near Sydney N.S.W.

Genus *Bosmina* Baird, 1845

(Section written by V. Kořínek)

Bosmina Baird, 1845: 149.

Lynceus (partim) O.F. Müller, 1776: 199.

Eunica Koch, 1841: pl. 23.

Garbinia Grochowski, 1910: 343.

Antennules long, sickle-shaped and fixed to a long rostrum forming a beak. Lateral pore on each side of head shield, near antennal or mandibular articulation. Postabdomen quadrangular, with terminal claws on long processes. Males with movable antennules and a strong, hooklike segment on first leg.

The type species is *Bosmina longirostris* (O.F. Müller, 1785).

Bosmina meridionalis Sars, 1904

Figs 104–107

Bosmina meridionalis Sars, 1904: 631–632, figs 3, 3a-c.—Jolly, 1953: 309–312, figs 1–2; Deevey, 1971: 203, fig. 6.

Bosmina rotunda Smith, 1909: 82, pl. 15, fig. 18, n. syn.

Bosmina sorelli Smith, 1909: 83, pl. 16, fig. 2, n. syn.

Bosmina brevisrostris Smith, 1909: 83, pl. 16, fig. 1, n. syn.

Bosmina hagemanni Brehm, 1928: 192–194; 1928: 322–323; 1953: 66–68, fig. 7.

Material. *Qld.*: 15, 31, L. Wendoura, Bee Hive D., via Wallangarra. *N.S.W.*: 76, 81, 123, 131, 178, 179, 187, Grahamstown Res., L. Burragorang, L. Woronora, Avon Res., Cataract Res., Nepean D., Prospect Res. *Vic.*: 226, 227, 228, 233, 234, 239, 243, 252, 257. *Tas.*: 310, 312, 313, 315, 325, 328, Woods L., Arthurs L., L. Petrach, Little Pine Lag. *S.A.*: 362, 384, 393. *W.A.*: 405, 406.

Slides. ZMO ♀ 169/9748, 172/9799, AM ♀ P27682.

Female. Eye small (up to 50 µm in diameter). Lateral head pores circular and situated over mandibular articulation. Reticulation of adjoining part of head shield not well pronounced. Antennules of variable length; turned upward or very short in some cyclomorphic populations (in localities 123, 226, Avon Res., Cataract Res., Lake Woronora, Nepean Res.) (as in S. American *Bosmina tubicen*). Mucrones slender, sometimes with one or several dorsal serrations, and tapering sharply towards end. Postabdomen convex on dorsal side; its terminal claws with a pecten of 4–10 denticles.

Length. Up to 0.8 mm.

Male. Antennules movable, each with two setae near their base. First leg with a large hook, cudgel-like at end, and with two narrow parallel keels; its endopod armed with one tooth or a denticle and also with one seta. Postabdomen strong, female-like with terminal claws shortened with 2–6 denticles in a pecten.

Length. Up to 0.7 mm.

Ecology. Mostly limnetic.

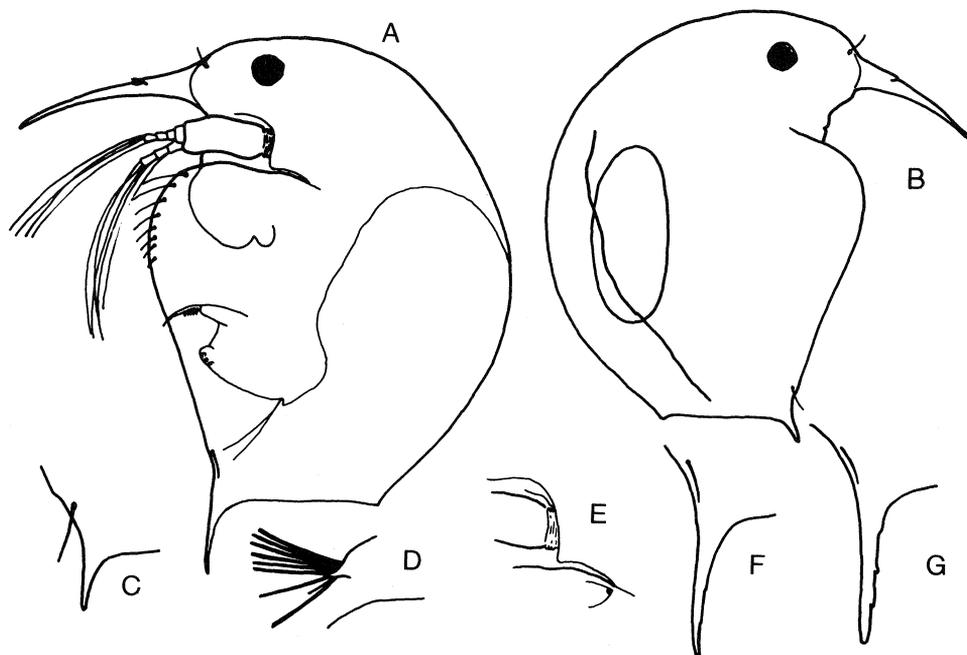


Fig. 104. *Bosmina meridionalis* ♀. A, specimen from L. Wakatipu, N.Z., iv-70; B, ephippial ♀, Mardi Res., N.S.W., 7.x.68; C, seta kurzi and mucro, Burrarorang Res., N.S.W., 8.viii.65; D, sensory setae on antennule, idem; E, lateral head pore, idem; F, mucro, first instar, L. Watatipu, N.Z., iv.70; G, mucro, adult instar, idem.

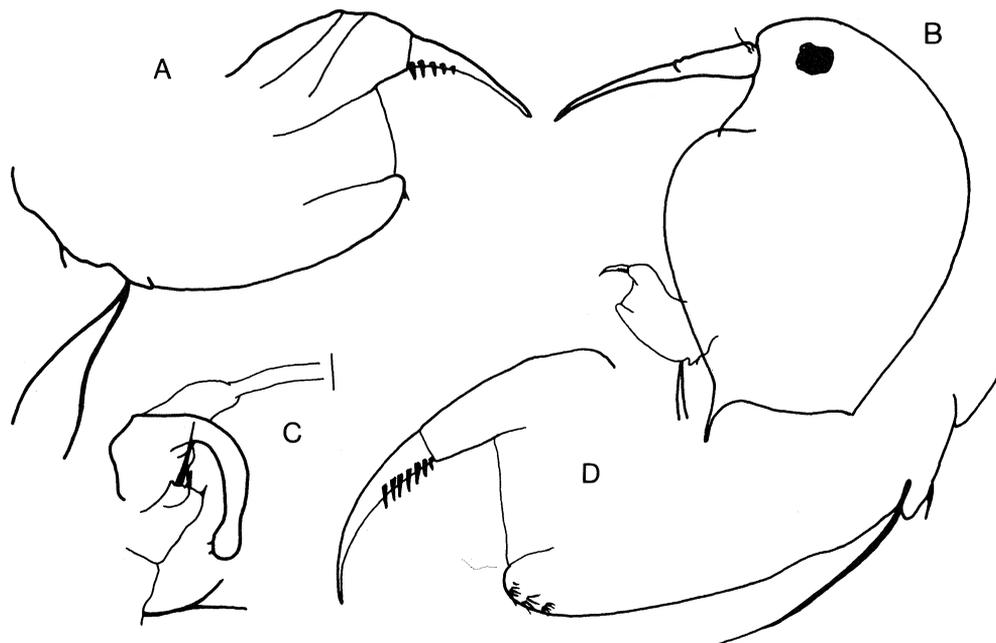


Fig. 105. *Bosmina meridionalis*. A, ♂, postabdomen, Avon Res., N.S.W., 4.x.62; B, ♂, idem; C, ♂, first thoracic limb, clasper, idem; D, ♀, postabdomen, Burrarorang, N.S.W., 8.viii.62.

Type locality. L. Wakatipu, N.Z.

Distribution. Australia-wide. Also New Zealand, Thailand (uncertain record), Ghana.

Differential diagnosis. Within its distributional range *Bosmina meridionalis* could only be mistaken for two other species: *B. longirostris* and *B. fatalis*. Females of *B. meridionalis* are easily distinguished by the pattern

of lateral head pores which in the other two species are located near the margin of the head shield behind the antennal articulation. Males differ in the shape of the clasper of the first leg: in *B. meridionalis* it is cudgel-like with two narrow keels near its end whereas in *B. longirostris* the claspers are sharp with needle-like ends and in *B. fatalis* there is a distinct knob on the base of the clasper.

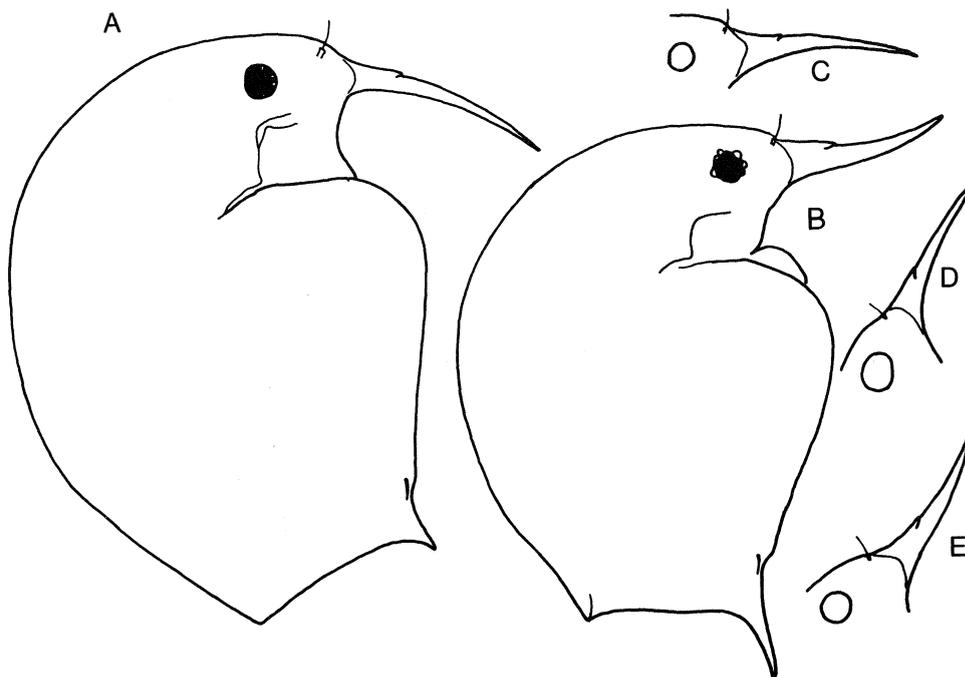


Fig. 106. *Bosmina meridionalis* ♀. A, whole animal, L. St. Clair, Tas., 15.i.75; B, whole animal, Avon Res., N.S.W., 4.x.62; C, antennule, idem; D, antennule, idem; E, antennule, idem.

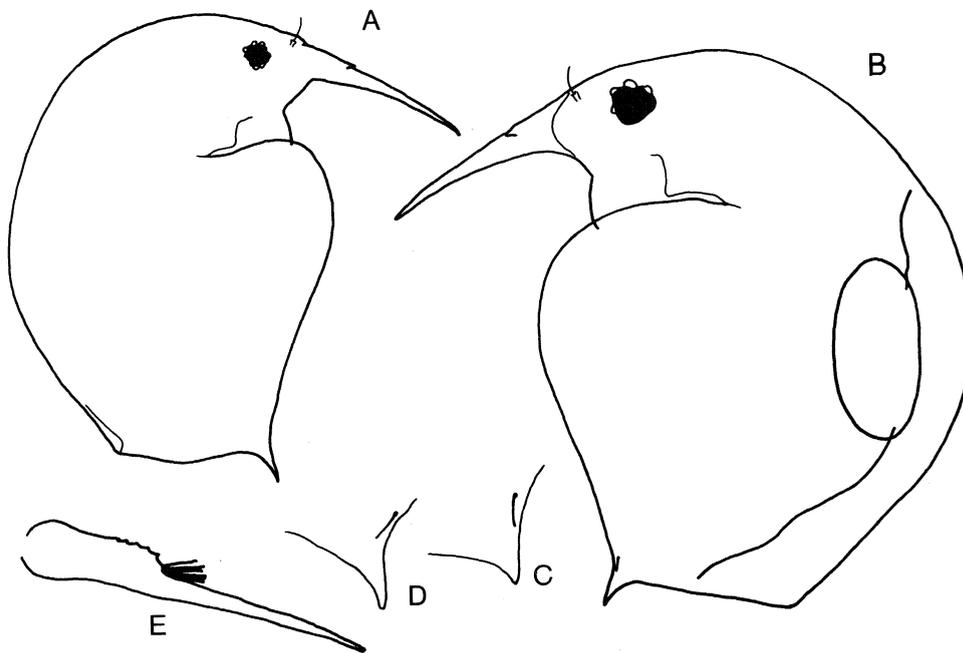


Fig. 107. *Bosmina meridionalis*. A, ♀, L. Sorell, Tas., 15.i.70; B, ehippial ♀, Great Lake, Tas., 19.iv.68; C, ♀, seta kurzi and mucro, idem; D, ♀, seta kurzi and mucro, idem; E, ♂, antennule, Avon Res., N.S.W., 4.x.62.

Family DAPHNIIDAE Straus, 1820

Daphnides Straus, 1820: 155.
Daphnidae Lilljeborg, 1900: 64-65.—Šrámek-Hušek *et al.*,
 1962: 194-195; Brooks, 1966: 604.

Key to the Genera of Daphniidae

- 1. Ventral side of valve convex 2
- Ventral side of valve straight
 *Scapholeberis* Schoedler, 1858

- 2(1). Ventral side of head with a small rostrum .. 3
 — Ventral side of head without a rostrum
 *Ceriodaphnia* Dana, 1852
- 3(2). Head relatively large; postabdomen
 relatively elongated, not indented on its
 anal side 4
 — Head relatively small; postabdomen
 short and wide, indented on its
 distal side *Simocephalus* Schoedler, 1858
- 4(3). Dorsal keel on shell present
 *Daphnia* O.F. Müller, 1785
 — Dorsal keel absent; postabdomen tapers
 towards base of claw
 *Daphniopsis* Sars, 1903

Genus *Daphnia* O.F. Müller, 1785
 (Section written by P.D.N. Hebert)

Subgenus *Daphnia* O.F. Müller, 1785.

Subgenus *Ctenodaphnia* Dybowski & Grochowski, 1895.

Species in the genus *Daphnia* can be readily distinguished from species in other genera of the family Daphniidae. In all *Daphnia* species the head has a pronounced rostrum (absent in *Ceriodaphnia*, *Moina*, *Moinodaphnia*), the ventral carapace margin is curved (straight in *Scapholeberis*) and the carapace markings

are mainly squares or rhomboids (markings are oblique parallel lines in *Simocephalus*).

The type species is *Daphnia longispina* (O.F. Müller, 1785).

Key to the Subgenera of *Daphnia*

1. Dorsal suture between head shield and valves extending anteriorly; fornix projecting laterally; ephippium roughly rectangular with egg chambers placed obliquely to dorsal margin
Ctenodaphnia Dybowski & Grochowski, 1895
- Dorsal suture between head shield and valves extending posteriorly; fornix smoothly arched; ephippium roughly triangular, egg chambers at right angles to the dorsal margin
 *Daphnia* O.F. Müller, 1785

All Australian species belong to the subgenus *Ctenodaphnia* with the apparent exception of *D. jollyi* (Petkovski, 1973a). However, the placement of this species in the subgenus *Daphnia* is questionable as its fornices project laterally and the ephippium was not examined. Moreover the anterior extension of the dorsal suture is very difficult to see in many *Ctenodaphnia* species and particularly so among species in the *D. carinata* complex.

Key to the Australian Species of *Daphnia*

1. Head noticeably enlarged, either anteriorly forming a spine or dorsally forming a hump 2
 — Head not enlarged, anterior surface rounded, dorsal surface nearly straight 9
- 2(1). Small species, carapace length never more than 1.5 mm, reproductive females often less than 1.2 mm 3
 — Large species, carapace length often over 2 mm, reproductive females never less than 1.4 mm 4
- 3(2). Anteriorly projecting spike-shaped crest on head; ventral carapace with about 12 strong spines *D. lumholtzi* Sars, 1885
 — Dorso-anterior helmet; no strong carapace spines *D. projecta* Hebert, 1977
- 4(2). Distance from antennular mound to rostrum less than or barely equal to diameter of eye (including lenses) 5
 — Distance from antennular mound to rostrum much greater than diameter of eye 7
- *5(4). Rostrum acute and not close to ventral carapace margin ... *D. magniceps* (Sars, 1896)
 — Rostrum recurved and in close proximity to ventral carapace margin 6
- *6(5). Helmet unpronounced, centred above the heart and decreasing in size very gradually so that the dorsal margin is smoothly rounded *D. carinata* King, 1853
 — Helmet larger, centred above the cephalic area and rather abruptly joining carapace so that the dorsal margin is sinuate *D. wankeltae* Hebert, 1977

- 7(4). Head length at least 1.4 times greater than carapace length *D. cephalata* King, 1853
 — Head length less than 1.4 times greater than carapace length 8
- *8(7). Well developed spines on dorsal carapace margin, those anterior to tail as long as lens of compound eye; ocellus often absent; helmet dorso-anterior; rostrum relatively wide *D. longicephala* Hebert, 1977
 — Small spines on dorsal carapace, those anterior to tail much shorter than lens length; ocellus always present; helmet dorsal; rostrum narrow *D. cephalata* King, 1853
- 9(1). Small species, carapace length usually less than 1 mm *D. lumholtzi* Sars, 1885
 — Large species, carapace length not less than 1.4 mm 10
- 10(9). Distance from antennular mound to rostrum much greater than diameter of the eye *D. longicephala* Hebert, 1977
 — Distance from antennular mound to rostrum less than or barely equal to the diameter of the eye 11
- 11(10). Postabdominal margin with a distinct bay *D. thomsoni* Sars, 1894
 — Postabdominal margin without bay 12
- 12(11). Head small and incurved strongly below eye; eye nearly touching anterior carapace margin; tail short or absent 13
 — Head larger and not incurved below eye; eye well away from anterior carapace margin; tail usually at least one-half the carapace length 14
- 13(12). Eye very large, in diameter nearly one-half the width of the head; ocellus absent *D. jollyi* Petkovski, 1973
 — Eye smaller, in diameter about one-third the width of the head; ocellus prominent *D. nivalis* Hebert, 1978
- †14(12). Head shape semicircular with the frontal margin smoothly rounded 15
 — Head shape angular, frontal margin distinctly flattened, often with a bump on the carapace anterior to the eye *D. angulata* Hebert, 1977
- 15(14). Rostrum not touching ventral carapace margin *D. magniceps* Sars, 1896
 — Rostrum either touching or in very close proximity to the ventral carapace margin *D. carinata* King, 1853, *D. wankeltae* Hebert, 1977

* Use individuals 1.5–2.5 mm in length.

† Use individuals 2.7–3.3 mm in length. In very dense populations there may be no adults as large as this, but small parthenogenetic females of the four species (*D. angulata*, *D. magniceps*, *D. wankeltae* and *D. carinata*) are very difficult to separate. Males and sexual females are, however, much more useful in recognizing the species (see Hebert, 1977 for details).

***Daphnia lumholtzi* Sars, 1885**

Fig. 108

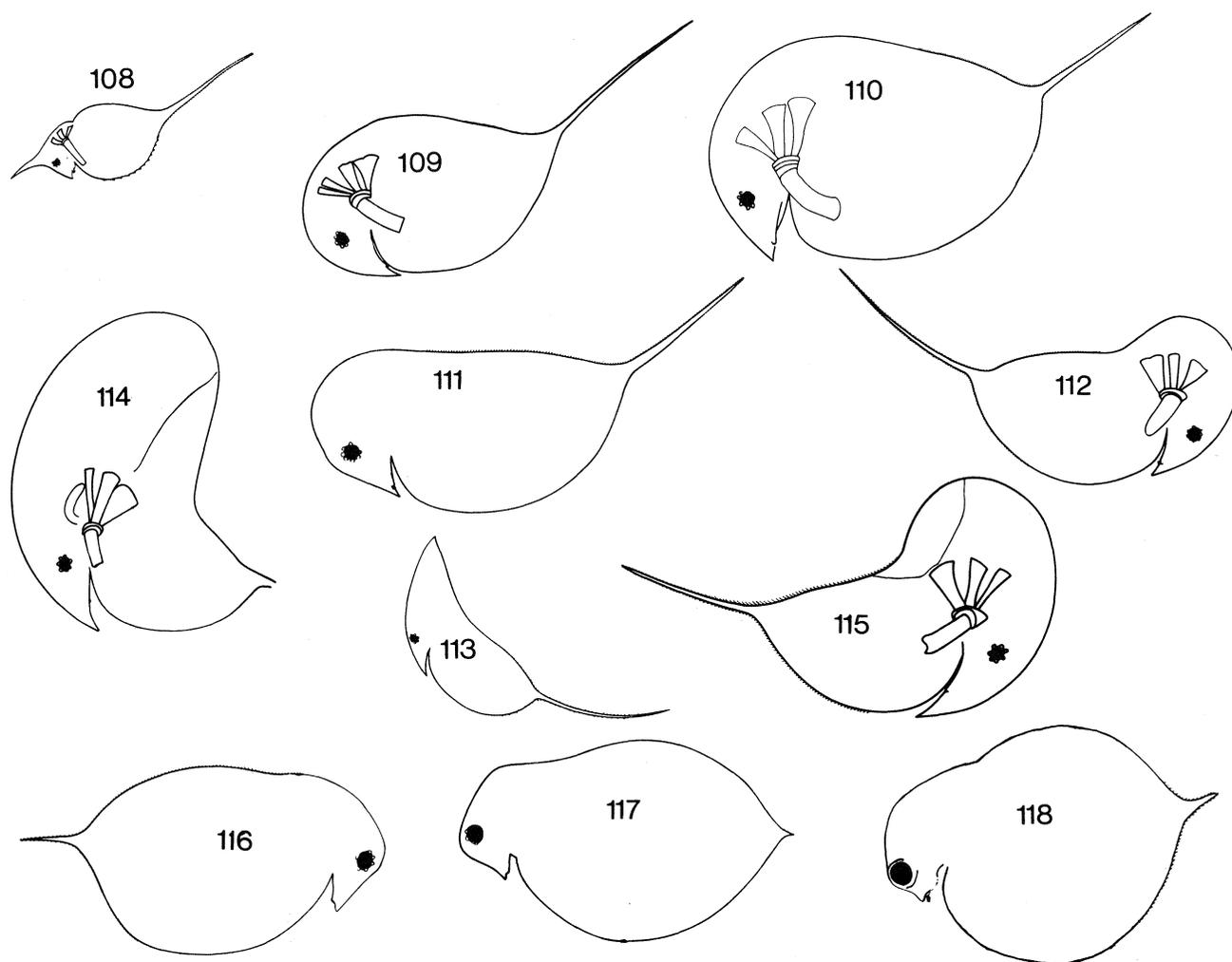
Daphnia lumholtzi Sars, 1885: 18–25, figs 1–10.

Material. *Qld.*: 3, 12, 17. *N.S.W.*: 117, 187, L. Cargelligo, Centennial Pk, Sydney. *Vic.*: 228, 232, 234, 249. *S.A.*: 384. Australian Museum reference series, registration numbers AM P24803 and AM P24804.

Female. Head usually with a narrow, anteriorly projecting crest, but in dense populations this may be absent. Antennular mounds very well developed and situated close to rostrum. Tail varies from one-half to slightly more than carapace length.

Length. Carapace length to 1.3 mm.

Male. Head usually unhelmeted, but a small spike-shaped crest occasionally present. Dorsal postabdominal



Figs 108-118. *Daphnia* spp., all ♀♀ and lengths given from cephalic crest or spine to base of tail spine. **108**, *D. lumholtzi*, 1.8 mm; **109**, *D. carinata*, 5mm; **110**, *D. magniceps*, 5mm; **111**, *D. angulata*, 6 mm; **112**, *D. wankeltae*, 3mm; **113**, *D. projecta*, 4 mm; **114**, *D. cephalata*, 7 mm; **115**, *D. longicephala*, 4.5 mm; **116**, *D. thomsoni*, 4.5 mm; **117**, *D. nivalis*, 2.5 mm; **118**, *D. jollyi*, 3.5 mm.

margin strongly sinuate. Tail about two-thirds of carapace length.

Length of male. Carapace length to 1.0 mm.

Type locality. Gracemere Lag. (11 km west of Rockhampton, Qld).

Distribution. Common in lakes near sea level in both coastal and inland areas of Qld, N.S.W., Vic., and S.A. This species has also been recorded in Africa and Asia.

Differential diagnosis. Adults of this species are much smaller than those of any other Australian species except *D. projecta*. The latter has a different crest shape, and lacks the strong spines along the ventral carapace margin that are present in *D. lumholtzi*.

Daphnia carinata King, 1853

Fig. 109

Daphnia carinata King, 1853a: 246-247, pl. I, fig. A.—Hebert, 1977: 375-378, figs 15-22 (emended description).

Material. From numerous ponds in the vicinity of Campbelltown, N.S.W. and Whittlesea, Vic. Also from lakes including L. Cargelligo, N.S.W., and Jindabyne Reservoir, N.S.W. Australian Museum reference series, registration numbers AM P24777 and AM P24778.

Female. Helmet, when present, small so that dorsal carapace-head margin smoothly rounded. Antennular mounds very small and set close to tip of rostrum. Tail varies from one-half to more than length of carapace.

Length. Carapace length to 4.5 mm.

Male. Head without a helmet. Dorsal postabdominal margin straight. Tail about one-half length of carapace.

Length of male. Carapace length to 1.2 mm.

Ecology. This species is most frequent in ponds, but also occurs in lakes. It seems to prefer low water temperatures as populations around Sydney, N.S.W., die out during the summer months.

Type locality. Near Sydney, N.S.W.

Distribution. This species is probably the most widely distributed *Daphnia* species in Australia, but many literature records undoubtedly pertain to other species of the *D. carinata* complex. However, valid records exist for both inland and coastal areas of N.S.W. and Vic.

Differential diagnosis. Small adult females in very dense populations of this species cannot be distinguished from *D. angulata* or from unhelmeted individuals of *D. magniceps* and *D. wankeltae*. Males of *D. carinata* differ from those of *D. magniceps* and *D. angulata* in having a straight postabdominal margin.

Daphnia magniceps Sars, 1896

Fig. 110

Daphnia carinata var. *magniceps* Sars, 1896: 9–10, pl. I, fig. 4. *Daphnia carinata*.—Hebert, 1977: 378–80, figs 23–32 (emended description).

Material. Ponds in the vicinity of Camden (N.S.W.), Appin (N.S.W.) and Whittlesea (Vic.). Australian Museum reference series, registration numbers AM P24479–AM P24781.

Female. Helmet usually present, and if so, small adults with a sinuate dorsal carapace-head margin. Antennular mounds small and set close to rostrum tip. Tail about half carapace length.

Length. Carapace length to 5.5 mm.

Male. Head without a helmet. Dorsal margin of postabdomen distinctly sinuate. Tail about half carapace length.

Length of male. Carapace length to 1.2 mm.

Ecology. This species is most frequent in pond habitats and seems to prefer low water temperatures as populations around Sydney, N.S.W., normally die out during the summer months.

Type locality. Sydney, N.S.W.

Distribution. Definitely known from the coastal strip of N.S.W. and Vic., but is probably more widely distributed.

Differential diagnosis. Crested individuals of *D. magniceps* are only likely to be confused with crested *D. wankeltae*. However, the tip of the rostrum in *D. wankeltae* is normally in contact with the ventral carapace margin, while in *D. magniceps* the tip is well away from the carapace. Individuals of *D. magniceps* which lack a crest are often impossible to distinguish from uncrested females of *D. angulata*, *D. carinata* and *D. wankeltae*.

Daphnia angulata Hebert, 1977

Fig. 111

Daphnia angulata Hebert, 1977: 380–382, figs 33–40.

Material. Type material in the Australian Museum, registration numbers AM P24795–AM P24798.

Female. Head lacks a helmet, but distinctly angular, large (length > 2.5 mm) individuals with a bulge anterior to eye. Antennular mounds small and set close to rostrum tip. Tail from half to slightly more than carapace length.

Length. Carapace length to 4 mm.

Male. Head lacks a helmet, and rectangular in shape. Dorsal postabdominal margin sinuate. Tail from one-third to two-thirds of carapace length.

Length of male. Carapace length to 1.3 mm.

Ecology. This species is known only from L. Omeo, a large but ephemeral lake situated at an altitude of about 700 m.

Type locality. L. Omeo, Vic.

Differential diagnosis. Large females of *D. angulata* can be recognized by their characteristic head shape. Small females cannot be distinguished from unhelmeted individuals of *D. carinata*, *D. magniceps* and *D. wankeltae*.

Daphnia wankeltae Hebert, 1977

Fig. 112

Daphnia wankeltae Hebert, 1977: 382–384, figs 41–45.

Material. Females from several farm dams near Whittlesea, Vic. Type material in the Australian Museum, registration numbers AM P24801–AM P24802.

Female. Dorsal helmet often present; restricted to cephalic area in young adults, but extending to middle of brood pouch in very large individuals. Antennular mounds small and set further from rostrum tip than in *D. carinata*. Tail usually about two-thirds of carapace length.

Length. Carapace length to 4 mm.

Male. Not known.

Ecology. Collected only in farm dams.

Type locality. Whittlesea, Vic.

Distribution. Known only from the general vicinity of the type locality.

Differential diagnosis. Helmeted individuals are only likely to be confused with *D. magniceps* (see differential diagnosis for this species), but uncrested individuals are often impossible to distinguish from unhelmeted *D. carinata*, *D. magniceps* and *D. angulata*.

Daphnia projecta Hebert, 1977

Fig. 113

Daphnia projecta Hebert, 1977: 384–385, figs 46–50.

Material. Type specimens in the Australian Museum, registration numbers AM P24799–AM P24800.

Female. Prominent anteriorly projecting helmet present. Antennular mounds small and situated well away from tip of rostrum. Tail about same length as carapace.

Length. Carapace length to 1.5 mm.

Male. Not known.

Ecology. This species has been found only in claypan habitats.

Type locality. Tonga Station, western N.S.W.

Distribution. Known only from the general vicinity of the type locality.

Differential diagnosis. This species is morphologically rather similar to juvenile *D. cephalata*. However, in this species reproductive females have a carapace length of at least 1.9 mm, while females of *D. projecta* begin to reproduce when only 0.9 mm long.

Daphnia cephalata King, 1853

Fig. 114

Daphnia carinata var. *cephalata* King, 1853b: 254, pl. 6, fig. B.—Hebert, 1977: 385–388, figs 51–62 (emended description).

Material. Ponds in the vicinity of Whittlesea (Vic.), Camden (N.S.W.), Coffs Harbour (N.S.W.) and Hay (N.S.W.). Reference series in the Australian Museum registration numbers AM P24782–AM P24784.

Female. Prominent dorsal helmet invariably present; projecting dorso-anteriorly in juvenile individuals, but extending posteriorly in older individuals. Antennular mounds very small and situated well away from tip of rostrum. Tail varies from two-thirds to greater than length of carapace.

Length. Carapace length to 6 mm.

Male. Head with prominent dorsal crest. Dorsal margin of postabdomen straight. Tail about half carapace length.

Length of male. Carapace length to 1 mm.

Ecology. This species is restricted to small ponds and dams and is the only Australian species which occurs in weed-filled ponds. It is apparently absent from claypan habitats.

Type locality. Campbelltown, N.S.W.

Distribution. This species is widely distributed in the lowland areas of N.S.W. and Vic. It apparently also occurs in the Oriental region (Heberer, 1923; Daday, 1911).

Differential diagnosis. This species is only likely to be confused with *D. longicephala*. However, in adults of *D. longicephala* the helmet tends to have a distant anterior bulge, while in *D. cephalata* the helmet is dorsal. Spinescence is also well developed along the dorsal carapace margin in *D. longicephala*, but weakly developed in *D. cephalata*.

Daphnia longicephala Hebert, 1977

Fig. 115

Daphnia longicephala Hebert, 1977: 388–391, figs 63–75.

Material. Collections from numerous mud pans in the vicinity of Hay (N.S.W.) and Tilpa (N.S.W.), and from dams

and reservoirs on the Dividing Range in N.S.W. including Jindabyne Res. Type material in the Australian Museum, registration numbers AM P24791–24794.

Female. Prominent helmet normally present, but often absent in dense populations. Antennular mounds small and distant from tip of rostrum. Tail varies from one-half to greater than carapace length.

Length. Carapace length to 5 mm.

Male. Head without a helmet. Dorsal margin of postabdomen straight. Tail usually less than a carapace length.

Length of male. Carapace length to 1 mm.

Ecology. This species seems most prevalent in mud pan habitats, but it also occurs in cool water lakes and ponds on the Dividing Range.

Type locality. Fowlers Gap Research Station, western N.S.W.

Distribution. Inland areas from Qld to Vic.; also on the Dividing Range in N.S.W., but apparently not on the coastal strip.

Differential diagnosis. Crested individuals of *D. longicephala* are most similar to *D. cephalata*, but the two species can be distinguished by their differences in head shape and spinescence (see differential diagnosis for *D. cephalata*). Unhelmeted individuals of *D. longicephala* can be easily recognized for the antennular mounds are distant from the tip of the rostrum, but in close proximity to the tip in other unhelmeted species.

Daphnia thomsoni Sars, 1894

Fig. 116

Daphnia thomsoni Sars, 1894: 5–10, pl. I, figs 18.

Material. Collections from Jindabyne Reservoir (N.S.W.) and numerous ponds on the Monaro Tableland (N.S.W.). Australian Museum reference series, registration numbers AM P24785–AM P24786.

Female. Head without a helmet and weakly indented below eye. Antennular mounds conspicuous and set close to tip of rostrum. Tail often much less than half carapace length.

Length. Carapace length to 3.5 mm.

Male. Head without a helmet. Dorsal postabdominal margin strongly sinuate. Tail short, about one-quarter of carapace length.

Length of male. Carapace length up to 1.5 mm.

Ecology. This species apparently prefers cool water conditions as in eastern Australia it is restricted to habitats on the Dividing Range.

Type locality. South Canterbury, New Zealand.

Distribution. In eastern Australia this species is apparently restricted to low montane habitats, but in W.A. populations occur at sea level (Serventy, 1929). This species also occurs in New Zealand (Sars, 1894) and South Africa (Sars, 1895).

Differential diagnosis. The dorsal postabdominal margin of female *D. thomsoni* has a noticeable

indentation, while the postabdominal margin is straight in all other uncrested Australian species.

Daphnia nivalis Hebert, 1978

Fig. 117

Daphnia alpina Hebert, 1977: 391-393, figs 76-83.

Daphnia nivalis Hebert, 1978:390.

Material. Collections from several ponds and lakes in the Kosciusko National Park including Lakes Cootapatamba and Albina. Type material in the Australian Museum, registration numbers AM P24795-AM P24798.

Female. Head without a helmet and strongly indented below eye. Antennular mounds large and set close to tip of rostrum. Tail spine very short or absent.

Length. Carapace length to 3 mm.

Male. Head without a helmet. Dorsal margin of postabdomen sinuate. Tail is very short or absent.

Length of male. Carapace length up to 1.5 mm.

Ecology. This species is common in most of the lakes and ponds without fish in alpine habitats on the Kosciusko Uplands.

Type locality. Lake Cootapatamba, N.S.W.

Distribution. Known only from the alpine area of the Kosciusko National Park.

Differential diagnosis. *D. nivalis* is most similar to *D. jollyi* in general body shape, but *D. nivalis* has a large ocellus, whereas *D. jollyi* lacks one.

Daphnia jollyi Petkovski, 1973

Fig. 118

Daphnia jollyi Petkovski, 1973a: 134-138, figs 1-16.

Material. Literature.

Female. Head without a helmet and strongly indented below eye. Antennular mounds large and set close to tip of rostrum. Tail spine very short, less than one-quarter of carapace length.

Length. Carapace length to 2.6 mm.

Male. Not known.

Type locality. Granite Pool (East Merridin), W.A.

Distribution. Known only from the type locality.

Differential diagnosis. This species is only likely to be confused with *D. nivalis* (see differential diagnosis for *D. nivalis*).

Genus *Simocephalus* Schoedler, 1858

(Section written by H. Dumont)

Simocephalus Schoedler, 1858: 17.

The type species is *Simocephalus vetulus* (O.F. Müller, 1776).

Body slightly compressed. Head plate wide and pointed posteriorly. Three main connected headpores, transversely orientated, and usually two minute lateral headpores. Valves rounded posteriorly and at times with a caudal outgrowth, but no posterior spine. Inner rim

of ventral edge of valves with spines and setae over its whole length. Head relatively small and with a well defined but typically small rostrum. Eye large and an ocellus also invariably present. Antennule short, cylindrical in its apical two-thirds and widened at level of implant of lateral aesthete. Antenna daphnoid. Trunk limbs also of a generalized daphnoid type. Postabdomen strongly developed, wide and compressed. End claws long, slightly curved and typically bearing four pectens. Dorsal rim of postabdomen with a row of anal teeth, progressively decreasing in size, each one bearing two rows of denticles. Anal opening situated in a rather deep bay. Ephippium with one egg.

Males of similar habitus to females, but smaller and valves more quadrangular in shape. Antennules as in females but bearing two appendages (an aesthete and a bristle). Claspers on first pair of trunk limbs reduced. Vasa deferentia not opening ventral to anus. Postabdominal end claws and teeth similar to those of female.

Norman (1903) suggested that the name *Simocephalus* as used in the Cladocera constitutes an invalid homonym and should be used for a genus of snakes. *Simos* was proposed in replacement. However, Poche (1903) pointed out that the reverse is true. Details are given in Dumont (1977).

Key to Australian Species of *Simocephalus*

1. Postabdominal claw with an outward basal pecten of enlarged spines (Plate 1, 1-2-4) 2
 - Spines on outward basal pecten of postabdominal claw not enlarged (at moderate magnification no pecten visible) ... 3
- 2(1). Frons pointed 5
 - Frons rounded *S. exspinosus australiensis* (Dana, 1852)
- 3(1). Rostrum developed into a prominent 'nose' (Fig. 121); head pores on a tubercle (Plate 2); ocellus rhomboidal *S. latirostris* Stingelin, 1906
 - Rostrum short; head pores not on a tubercle, difficult to see; ocellus elongate 4
- 4(3). Posterior rim of valves with a more or less symmetrical rounded protuberance *S. vetulus elisabethae* (King, 1853)
 - Upper posterior part of valves asymmetrically produced (outgrowth of a brood pouch) *S. vetulus gibbosus* (Sars, 1896)
- 5(2). Posterior rim of valves with a protuberance .. *S. acutirostratus* (King, 1853)
 - Posterior rim of valves evenly rounded *S. victoriensis* n. sp.

Simocephalus vetulus (O.F. Müller, 1776)

Figs 119, 120

Daphne vetula O.F. Müller, 1776: XXVII, 199, 275.

Comments. Acceptance of Müller's name is largely a matter of convenience, as it was poorly characterized. For instance on page XXVII, he writes: "Bivalvia, Antennae ramosae, ped. 8-12, oculus I" and on page 199 "*Daphne vetula*. Antennis dichotomis. Cauda inflexa; testa mutica." As there are no figures, even the generic placement is of questionable validity. In fact, the original description introduced little more than a new name, i.e. *vetula*. His illustrated edition (Müller, 1785: 91, 92, tab. XII, figs 11, 12 (*Daphnia sima*)) does not add much—claws are mentioned, but no details given. There is no differentiated basal pecten on the endclaws in fig. 12, which would seem to exclude confusion with the *S. exspinosus* complex, but since the figure is small and lacks details, one cannot be absolutely certain about this point. Baird (1850: 95-96, tab. X, figs 1, 1a [*Daphnia*]) does not mention a conspicuous pecten

either, although the latter is one of the chief diagnostic characters. Lilljeborg (1900: 166-173, tab. XXIV, figs 8-18, tab. XXV, figs 1-7) was the first to give a good description and definition of what is now generally agreed upon as *Simocephalus vetulus*.

Two components of the *vetulus* group are known for Australia.

Simocephalus vetulus elisabethae (King, 1853)

Figs 119, 120

Daphnia elisabethae King, 1853a: 247-249, pl. II.*Simocephalus elisabethae*.—Sars, 1888: 22-25, pl. 2, figs 6, 7; Haase, 1903: 149-150, fig. 3; Henry, 1919: 465; 1922: 31, pl. V, figs 2, 2A.*Simocephalus dulvertonensis* Smith, 1909: 81, pl. 15, figs 5-7, n. syn.**Material.** *Qld.*: 28, 32, 34. *N.S.W.*: 170. *Tas.*: 315, 326.

Comments. King's description and figures are a mixture of *vetulus* and *exspinosus* forms, e.g. p. 248: "the extremity (of the abdomen) terminates in two long

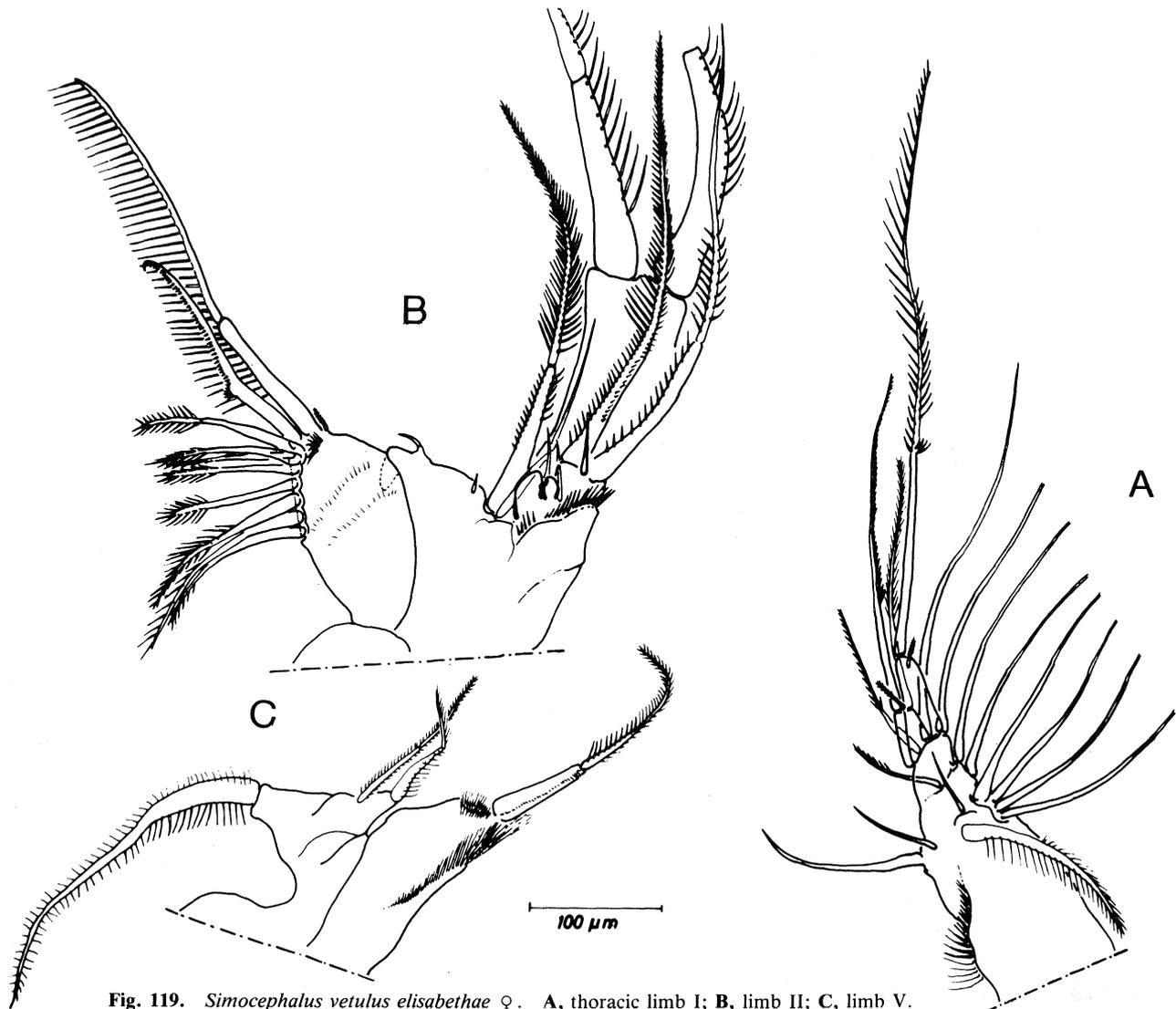


Fig. 119. *Simocephalus vetulus elisabethae* ♀. A, thoracic limb I; B, limb II; C, limb V.

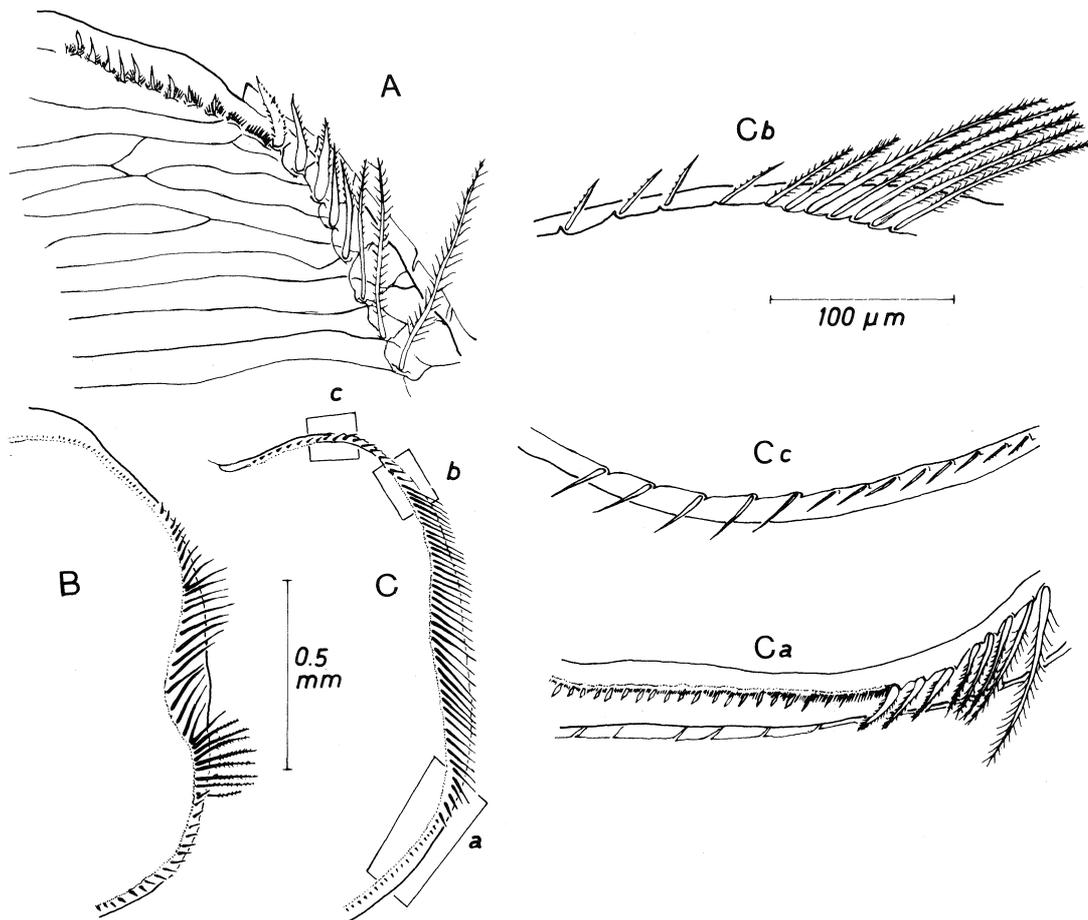


Fig. 120. Ventral edges of valves of various species of *Simocephalus*. **A**, *Simocephalus vetulus gibbosus* ♀, ventral corner of hind border of valves; **B**, *Simocephalus latirostris* ♀, ventrum of valves; **C** & **Ca-c**, *Simocephalus vetulus elisabethae* ♀, ventrum of valves and details of setation.

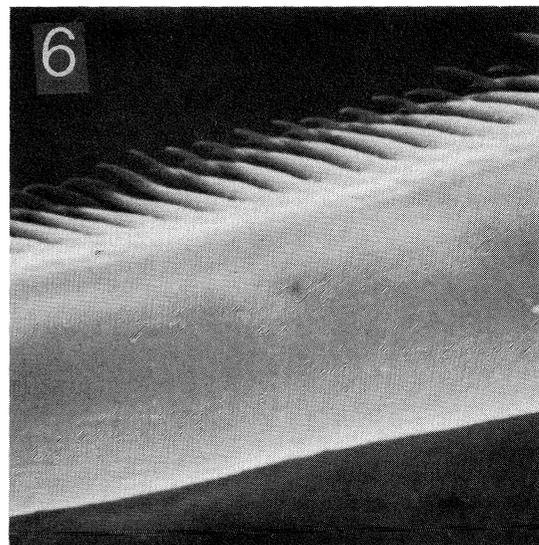
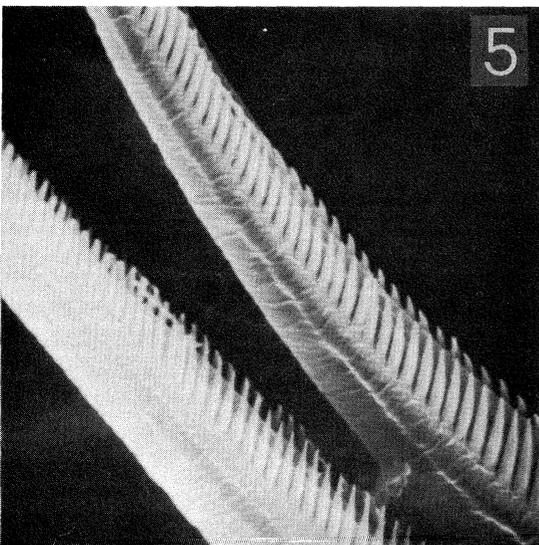
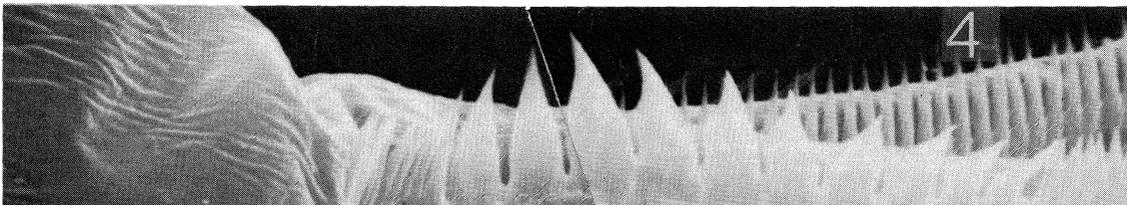
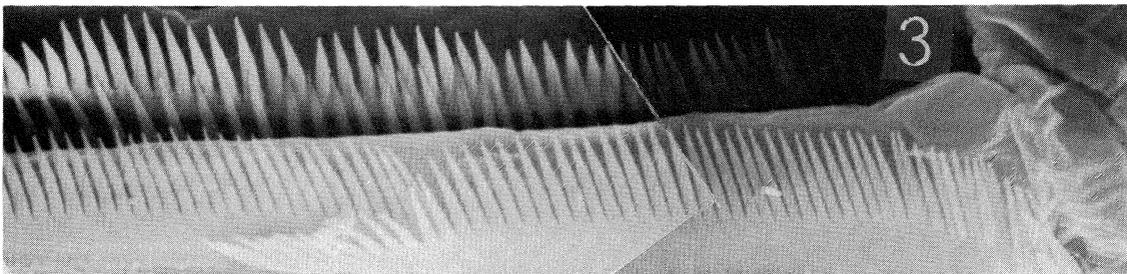
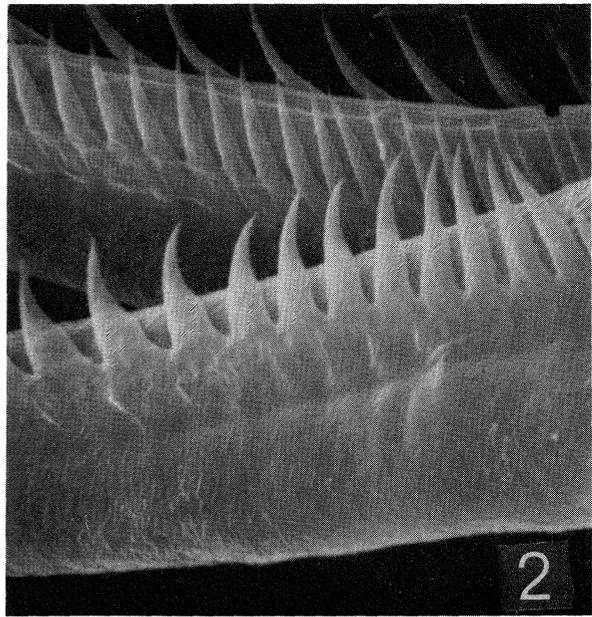
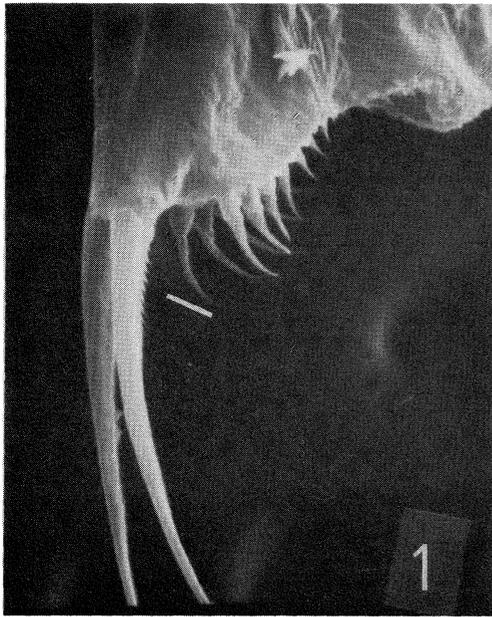
spines, which are sometimes deeply serrated, sometimes plain”, p. 247: “the head is obtuse; beak short, a black spot close to the beak.” Plate II, fig. A shows an animal with a point-shaped ocellus, and a serra (pecten) on the postabdomen. Strictly speaking, one could argue that *Daphnia elisabethae* King is really is a member of the *expinosus* group, and has priority over *Daphnia australiensis* Dana, or alternatively consider it as a species incertae sedis because of the mixed material that served as type material. Since these alternatives cannot be resolved a commonsense solution should be adopted, and the judgment of Sars (1888): “although Mr King would seem to have confounded several distinct species under his name . . .”, as well as his clear redescription of the taxon should be accepted.

This taxon was considered as a good species by many authors. Others, e.g. Harding (1960), synonymized it with *S. v. vetulus*, because it is structurally identical to the latter, except for the presence of a hump on the posterior side of the valves, a character which may be indistinct on rare occasions. It was classified as a distinct subspecies by Dumont and Van de Velde (1977), since in Nepal it occurred at lower altitudes, in a tropical and subtropical climatic zone, while in the higher parts of

the Himalayas it was replaced by the nominal subspecies.

Simocephalus dulvertonensis Smith is a ill-characterized species, which even the describer himself qualified as “not offering any marked characters”. Brehm (1931, 1942, 1953a) repeatedly considered this taxon, strongly suspecting it belonged to the *vetulus* group, but hesitating on evidence of the geniculate aspect of the spines on the postabdomen as drawn by Smith. However, this character may occur in *vetulus* populations from any area of the world and in a rather haphazard way, while, on the other hand, it was not present in a large series of specimens examined from Tasmania. These had the elongate ocellus of the *vetulus* group, the typical shape of trunk limbs I and II as shown in Fig. 119, and a symmetrical posterior hump on the valves. Hence there seems to be no reason to regard *dulvertonensis* as a taxon distinguishable from *elisabethae*.

Female. Anterior part (frons) of head rounded. rostrum small, not prominent. Ocellus elongated, somewhat sinuous. Head pores lie in a small depression of head shield (Pl. 2). Shallow embayment on inner rim of ventral sides of valves. Setation as for genus (Fig.



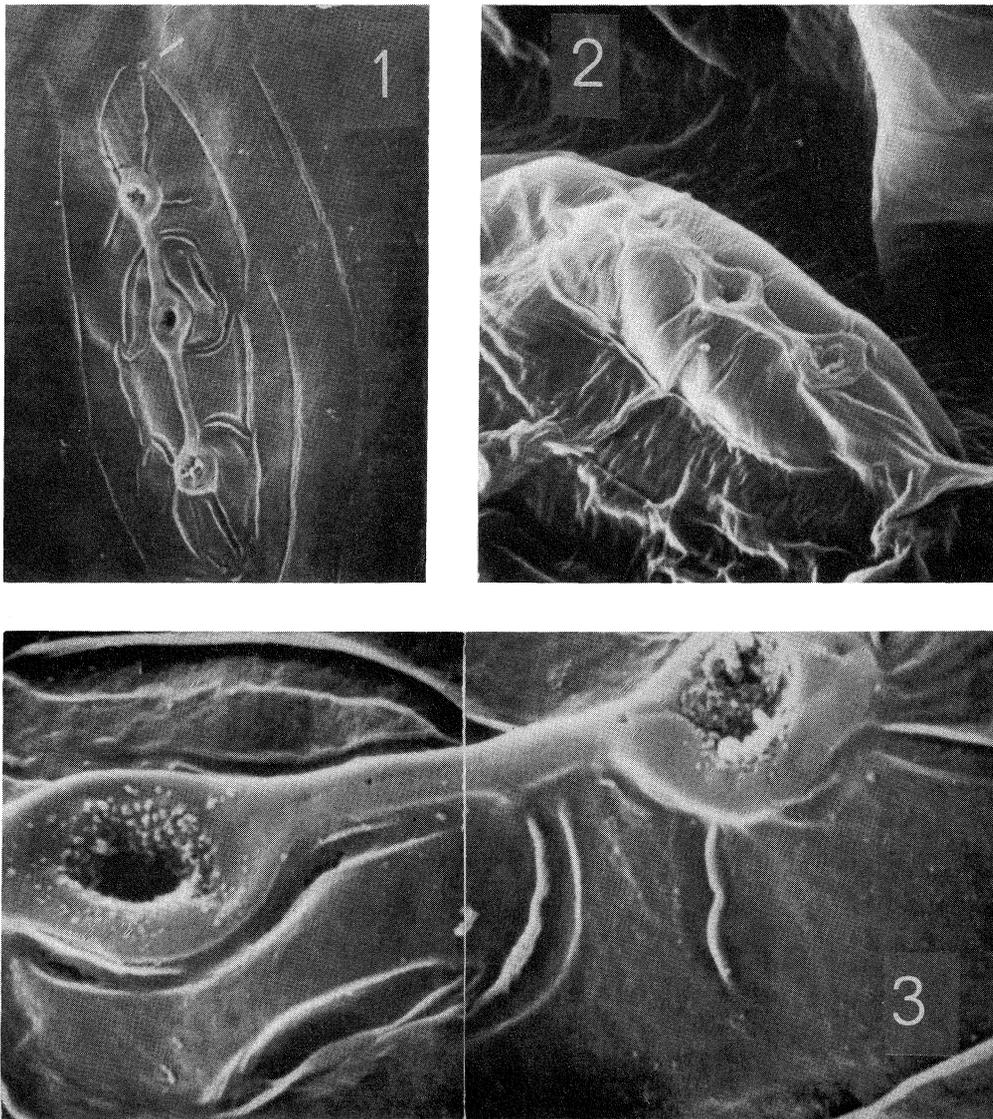


Plate 2. Head pores in *Simocephalus*.

1. *S. acutirostratus* ♀ (Nordellos Lagoon, Qld), head pores (1420X). One of the two minute lateral headpores is indicated by an arrow. 2. *S. latirostris* ♀ (L. Toomba, Qld), head pores situated on a tubercle (2500X). 3. The same, the two upper pores enlarged (7000X).

Plate 1 (facing). Postabdominal claws in *Simocephalus*.

1-2. *S. acutirostratus* ♀ (Nordellos Lagoon, Qld): 1. postabdomen, basal pecten on end claw indicated by arrow (290X). 2. pecten enlarged (1700X). 3. *S. vetulus elisabethae* ♀ (Teewarina Waterhole, Qld), base of postabdominal claw, outward view. The homologue of the enlarged basal pecten in *S. acutirostratus* and *S. exspinosus australiensis* is not different here from the adjacent pecten (2500X). 4. *S. exspinosus australiensis* ♀ (L. Crescent, Tas.), base of abdominal end claw, showing the basal pecten of big, strong teeth (2200X). 5. *S. vetulus gibbosus* ♀ (Aramac Ck., Qld), central sector of postabdominal claws, showing the relative position of the inner and outer pectens (2500X). 6. *S. latirostris* ♀ (L. Toomba, Qld), small zone of postabdominal claws, showing the marginal position of the pectens so that their teeth partly interlock (6500X).

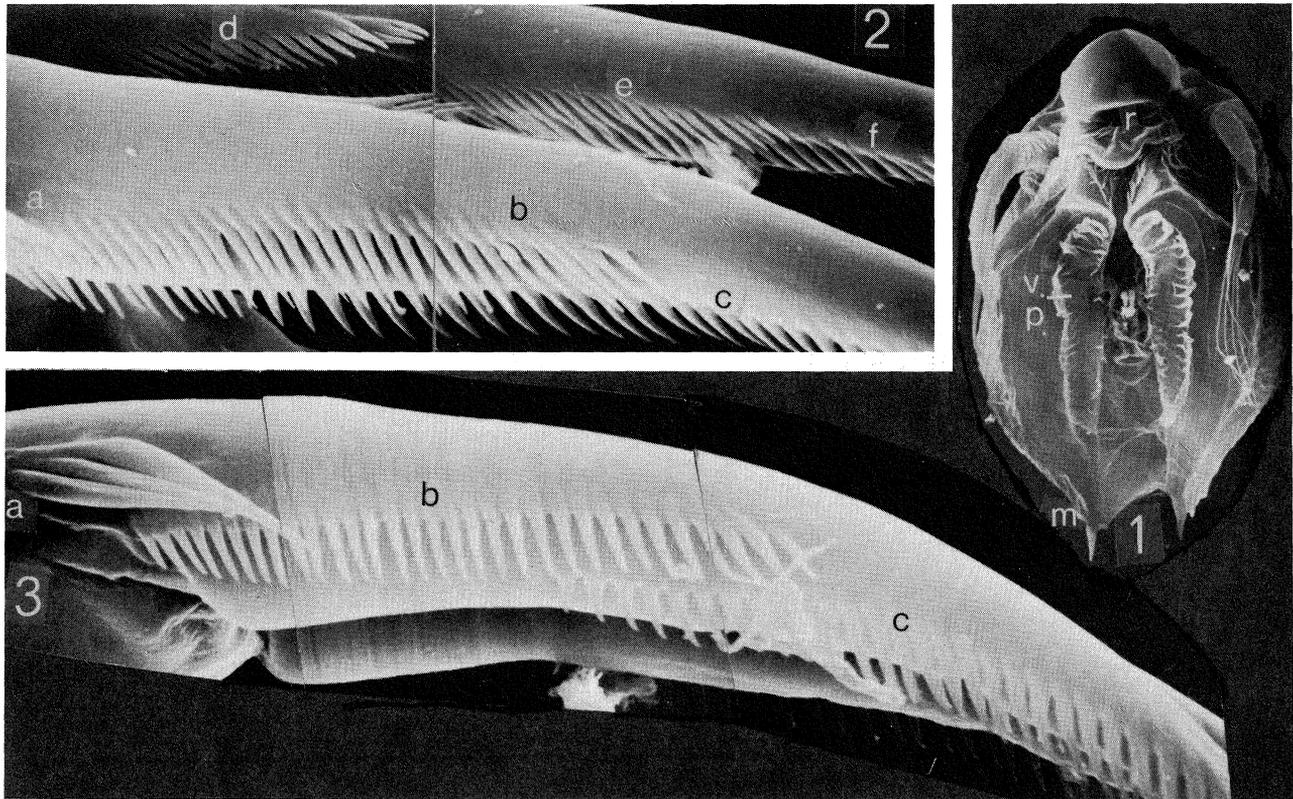


Plate 3. *Scapholeberis kingi* ♀, (Nordellos Lagoon, Qld). **1.** Whole animal in ventral view (155X). *r* = rostrum, *vp* = ventral plate, *m* = mucro. **2 & 3.** end claws. *a-f*, the 6 pectens (2: 4275X, 3: 4070X).

120). Posterior side of valves produced into a hump more or less symmetrical to body axis. Trunk limbs I, II and V as shown in Fig. 119. P_2 with a strong hook between gnathobase and endite. End claws lack a differentiated basal pecten. Inner and outer pectens located well to side of claw.

Length. Up to 2 mm.

Male. Unknown.

Type locality. Ponds near Sydney, Port Stephens, Karua R.

Distribution. Probably more widespread than in Qld, N.S.W. and Tas., where it certainly occurs. Henry (1922) also mentions S.A. and Vic.

Differential diagnosis. The ocellus is elongate, thus separating it from other known species of *Simocephalus* in Australia. The posterior rim of the valves has a symmetrical rounded protuberance in *S.v. elisabethae* whereas it is asymmetrically produced in *S.v. gibbosus*.

***Simocephalus vetulus gibbosus* (Sars, 1896) n. comb.**
Fig. 120, Plate 1

Simocephalus gibbosus Sars, 1896: 15, pl. 2, figs 4-6.—Shepard *et al.*, 1918: 83; Henry, 1922: 32, pl. V, figs 3, 3A; Serventy, 1929: 68.

Material. *Qld.*: 51. *N.S.W.*: 78, 84, 85, 129, 130, 132, 133, 156, 164, 165, 166, 167, 168. *Vic.*: 204, 209, 210, 213, 214,

220, 222, 223, 238, 257. *Tas.*: 291, 292, 294, 295, 300, 307, 312, 313, 316, 319, 320, 321, 322, 324, 325, 327, 329, 330, 332, 333, 334, 337, 338. *S.A.*: 357, 365, 368, 372, 376, 379. *W.A.*: 410, 414. *N.T.*: 452.

Comments. *Simocephalus gibbosus* is undoubtedly a member of the *vetulus*-group. In fact one might question the value of the sole distinctive character (shape of the valves), and it may well be that *gibbosus* is the same animal as *elisabethae* in which the brood pouch is more strongly developed. However regional populations of *elisabethae* examined were typical in habitus on one hand, while *gibbosus*-like populations have not been found outside Australia. Therefore, it may well be that the latter corresponds to an endemic taxon with particular ecological requirements. Since *gibbosus* and *elisabethae* do not seem to co-occur, and in view of their close relationship, they should be considered subspecies rather than good species.

Female. *Simocephalus vetulus gibbosus* is very closely allied to the preceding taxon, with which it agrees in all characters except the shape of the valve (see Key).

Length. Up to 2 mm.

Male. Unknown.

Type locality. Centennial Park, Sydney.

Distribution. Australia-wide, but most common in the south-east.

Differential diagnosis. See differential diagnosis for *S.v. elisabethae*.

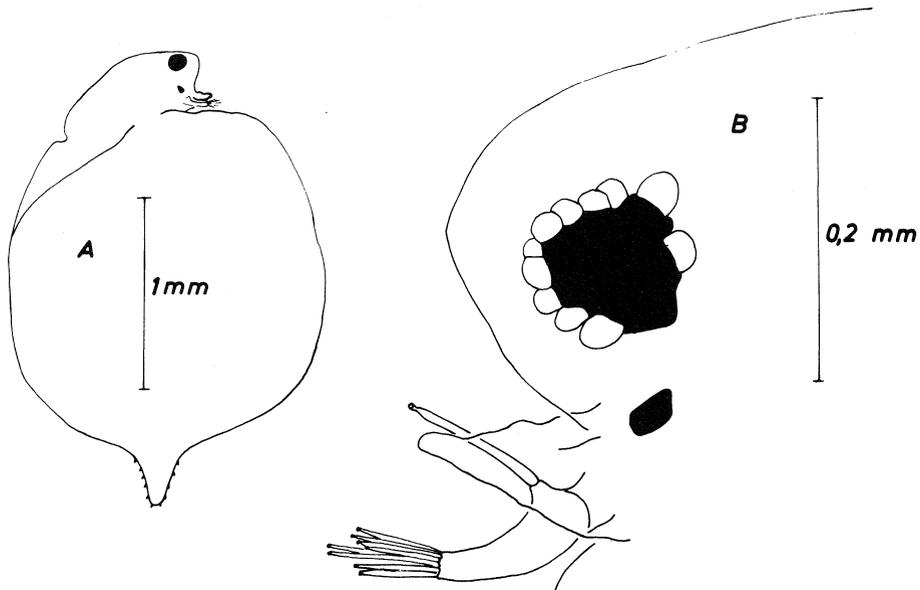


Fig. 121. *Simocephalus latirostris* ♀, River Niger, Mali. A, whole animal; B, head.

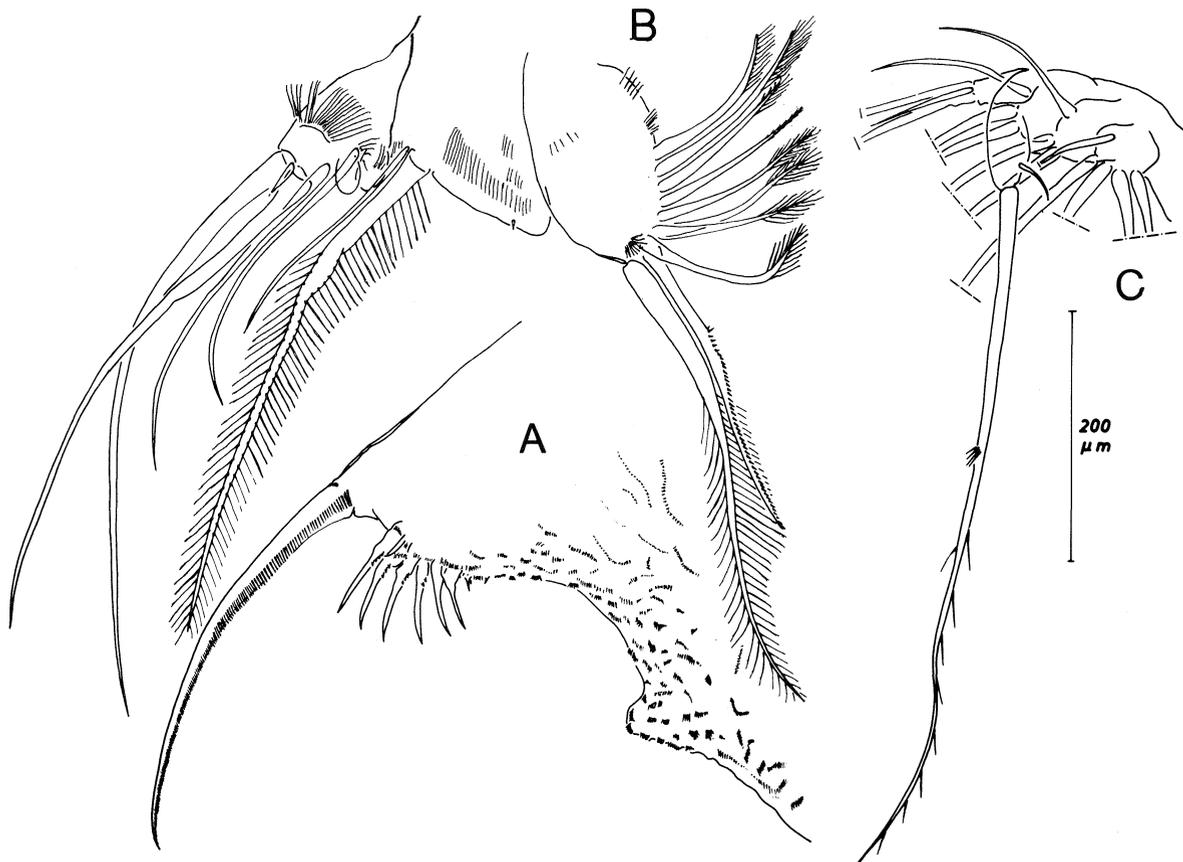


Fig. 122. *Simocephalus latirostris* ♀, River Niger, Mali. A, postabdomen; B, thoracic limb II; C, limb I, whole animal.

Simocephalus latirostris Stingelin, 1906
Figs 120–122, Plate 2

? *Simocephalus iheringi* Richard, 1897: 97.—Henry, 1922: 32.
Simocephalus latirostris Stingelin, 1906: 187, figs 5–7.

Material. *Qld*: 12, 23, 25, 33, 37.

Female. Anterior part of head rounded. Rostrum strongly developed, forming a prominent 'nose', as long as or slightly longer than antennule (Fig. 121). Ocellus

rhomboidal and rather large. Head pores situated on a tubercle (Plate 2). Valves produced posteriorly into a rather sharp point. Inner side of ventral rim of valves with a deep median embayment (Figs 120, 121); its setation typical. P_1 and P_5 typical but P_2 with a very short spine (Fig. 121) between gnathobase and endite. Postabdominal claws without a differentiated basal pecten (Fig. 122). Spines of apical pectens marginally located (Plate 1), but not so laterally placed as in other species.

Length. 1.5–3.0 mm.

Male. Unknown.

Distribution. North Qld.

Differential diagnosis. *Simocephalus latirostris* is the only Australian species with a strongly developed rostrum.

Simocephalus exspinosus australiensis (Dana, 1852)
n. comb.

Plate 1

Daphnia australiensis Dana, 1852b: 1271–1272; 1855, pl. 89, fig. 4.

Simocephalus australiensis Sars, 1888: 15–25, pl. 2, figs 15.—Sars, 1896: II; Smith, 1909: pl. 15, figs 8–9; Henry, 1919: 466; 1922: 31, pl. V, figs I, IA–IC; Serventy, 1929: 68; Brehm, 1953a: 67; 1953b: 9.

Simocephalus exspinosus Flössner, 1972: 184.

Material. N.S.W.: 80, 128, 130, 166, 167. Vic.: 205, 232. Tas.: 296, 302, 303, 323, 336. W.A.: 405, 427.

Comments. Dana's description is insufficient so Sars's (1888) detailed redescription is widely used. However this proposed specific status is questionable, since *S. australiensis* is closely related to several forms of the *exspinosus* group. Of the latter, *S. exspinosus* (Koch) has a short differentiated pecten of 8–12 equally long spines (a comb), and *S. congener* Schoedler has a longer pecten (up to 30 spines) which decreases in size distally. In *S. australiensis* a characteristic short pecten (8–12 spines) is seen; the spines are thick at their base, triangular, and decreasing in size distally (Plate 1).

Female. Head rounded and rostrum short. Ocellus rhomboidal. Head pores not on a tubercle. Caudal side of valves tending to develop a slight hump, somewhat above longitudinal body axis. Only a slight embayment in inner side of ventral margin of valves; its setation typical. Trunk limbs typical of *vetulus* group.

Length. Up to 2.8 mm.

Male. Structurally similar to female, but only half its size, and without a posterior hump. Caudal edge of valves almost quadrangular.

Type locality. Freshwater pools near Sydney, N.S.W.

Distribution. Widely distributed in all states (Sars [1888] provides a record for Qld and Henry [1922] one for S.A.—thus complementing our records).

Differential diagnosis. Like *S. acutirostratus*, this species has large spines on the outward basal pecten of

the postabdominal claw. However, it is distinguishable from the former by its round head (pointed in *S. acutirostratus*).

Simocephalus acutirostratus (King, 1853)

Fig. 124

Daphnia elisabethae var. *acuti-rostrata* King, 1853b: 254, pl. Vic.

Simocephalus paradoxus Schoedler, 1877: 17–18, fig. 8.

Simocephalus acutirostratus Sars, 1888: 67; 1896: 12–15, pl. 2, figs 1–3.—Hase, 1903: 150, fig. 4; Searle, 1917: fig. 6; Henry, 1919: 466; 1922: 31–32, pl. V, figs 4, 4A; Petkovski, 1973a: 138–140, figs 17, 18.

Material. Qld: 26, 63. N.S.W.: 93, 136, 139, 140, 143, 154, 156, 159, 160, 167, 170, 177, 185. W.A.: 415.

Female. Anterior tip of head produced into a sharp point. Rostrum short and ocellus rhomboidal. Head pores not on a tubercle (Plate 2). Ventral margin of valves evenly curved; inner rim moderately embayed. Setation of valve rim and trunk limbs of the usual appearance. Postabdomen very broad with two rather deep embayments, and an anal corner forming a right angle. End claws of postabdomen with a basal pecten consisting of 12–18 strong, tooth-shaped spines (Plate 1). Valves with a strong posterior prominence situated above longitudinal body axis.

Length. Up to 4.2 mm.

Male. Unknown.

Type locality. Ponds at Denham Court, N.S.W.

Distribution. Probably Australia-wide (but not yet reported from Tas., S.A., or N.T.). It is endemic to Australia, where it seems to take the place of *S. serrulatus* (Koch), which is cosmopolitan except for the Australian continent.

Differential diagnosis. This species can only be confused with *S. victoriensis* n. sp., which is the second

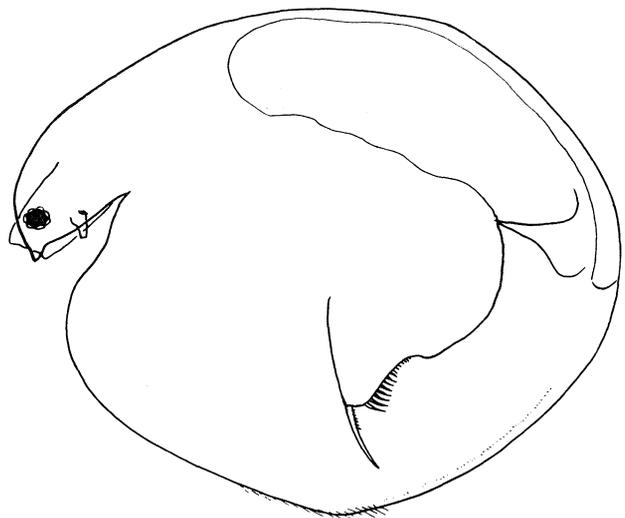


Fig. 123. *Simocephalus victoriensis* ♀, waterhole near Kaniva, Vic., 23.vi.74.

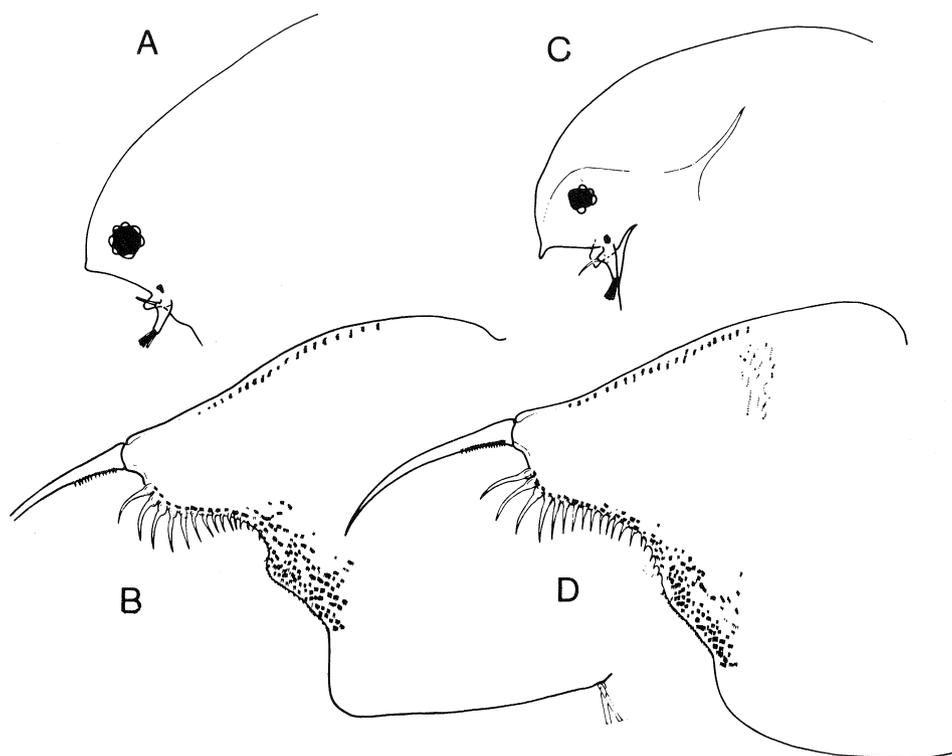


Fig. 124. *Simocephalus acutirostratus* ♀ and *S. victoriensis* ♀. A & B, head and postabdomen respectively of *S. acutirostratus*; C & D: head and postabdomen respectively of *S. victoriensis*.

Australian species with a pointed frons. It differs in details of the general habitus, head and postabdomen (see hereunder).

Simocephalus victoriensis n. sp.

Figs 123, 124

Material. Vic.: 240, 262.

Holotype. AM ♀ P31316.

Paratypes. Numerous females from Vic.—240 and 262 lodged in the reference zooplankton collection of the State University of Gent, Belgium.

Female. Smaller than *S. acutirostratus* (maximum recorded size 3.1 mm). Ratio length: height 1.2. Head bent downwards, over rostrum and antennae. Rostrum produced into a finger-shaped expansion, standing nearly at right angles to longitudinal body-axis. Rostrum more strongly developed than in *S. acutirostratus*. Postabdominal claw with a pecten as in *S. acutirostratus*, and postabdomen broad as in that species, but the two embayments along its margin shallow, and anal corner smoothly rounded.

Male. Not known.

Type locality. A waterhole 25 km from Kaniva, Vic. also found in Loc. 262 (a temporary pond near Edenhope, Vic.) in which it co-occurred with typical *S. acutirostratus*. Intermediate forms were not observed.

Genus *Scapholeberis* Schoedler, 1858

(Section written by H. Dumont)

The type species is *Daphnia mucronata* O.F. Müller, 1785.

Body slightly compressed but with no keel. Head moderate in size with a large eye and a small ocellus. Rostrum well developed and differentiated. Valves rounded dorsally; hind rim straight and ventral rim differentiated into an adhesive plate. This plate widened into a sinuous triangle in front, gently narrowing posteriorly; numerous fine setae and adhesive leaflets on it. Caudal filaments usually longest and sometimes differentiated into feather-shaped fleeces. Ventro-posterior corner of valves with a mucro of variable length. Antennule small and cylindrical; slightly longer in male than in female. Trunk limbs of daphnoid type; first pair in male with a clasper. Postabdomen compressed. End claws relatively short and with a maximum of six pectens, none of which very conspicuous. Two minute head pores may be present and tip of rostrum with elongate pore, except in *S. aurita* Fischer. Ephippium with one egg. Vasa efferentia open ventral to anus.

Scapholeberis kingi Sars, 1903

Plate 3

Daphnia mucronata O. F. Müller, 1785: 84, pl. 13.—King, 1853b: 255–256 pl. VI

Scapholeberis kingii Sars, 1888: 68, nomen nudum.
Scapholeberis kingi Sars, 1903: 8, pl. 1, figs 2a-c.

Material. *Qld.*: 2, 12, 14, 39. *N.S.W.*: 79, 81, 83, 97, 99, 130, 186. *Vic.*: 212, 232. *S.A.*: 370. *W.A.*: 421, 426.

Comments. Dumont (1971) claimed that the circumtropical *S. kingi*, which is the true *kingi* of King and Sars, and the European form reported under that name by Rammner (1928, 1929) might be two distinct species. Scanning Electron Microscope pictures have now shown this to be correct and that the European and Central Asiatic form needs a new name.

Female. Rostrum trilobate (Plate 3); middle lobe evenly rounded, with a narrow hyaline membrane in front, and about half as wide as the head. Head never with a dorsal spine. Antennules project from beyond lateral lobes. At least a rostral head pore present. Postabdomen with 4-6 spines. End claws with six pectens (Plate 3) but usually only the three external pectens visible. Head with broad, shallow canal along its side. In some specimens, dorsal ridge of this canal rather sharp, and may appear as a small auricle in front view, but this is not an infallible character.

Length. 0.6-1.0 mm.

Male. Smaller than female. Dorsoposterior corner of valves more squared than in female.

Type locality. South Ck and Parramatta, N.S.W.

Distribution. Australia-wide but not so common in the south.

Genus *Daphniopsis* Sars, 1903

Daphniopsis Sars, 1903: 171.—Serventy, 1929: 65.

Carapace with no dorsal keel or posterior spine. Head separated on dorsal side by a shallow depression; a cephalic fornix on each side and a rostrum. Antennule immovable and not reaching rostrum tip. Antenna with 9 setae and no spines. Postabdomen tapers towards base of claw and with small anal teeth. Ocellus and eye present.

Daphniopsis is closely related to *Daphnia*; indeed Wagler (1936) included *Daphniopsis tibetana* Sars, 1903 in *Daphnia*. Hebert (personal communication) is of the opinion that it should remain separate until more characters are ascertained. We follow this recommendation.

The type species is *Daphniopsis tibetana* Sars, 1903.

In Australia there is one species, *Daphniopsis pusilla* Serventy, 1929. *D. studeri* Rühle is found in East Antarctica (Akatova, 1964).

Daphniopsis pusilla Serventy, 1929

Fig. 125

Daphniopsis pusilla Serventy, 1929: 65-67, pl. IX.—Bayly and Edward 1969: 21-22.

Material. *Vic.*: 248. *S.A.*: 353, 360, 375, 381. *W.A.*: 402, 408.

Slides. AM ♀ P27731; ehippial ♀ ♂ P27732; MGU ♀ 2963, ehippial ♀ ♂ 2961; ♀ 2968; ♂ 2962; ZIN ♀ 2964; ehippial ♀ ♂ 2958.

Female. Dorsal side of carapace brownish. Antennule not reaching rostrum tip, though its sensory papillae protrude beyond it. This situation is depicted in our figure (Fig. 125) and in Serventy's (1929, pl. IX) and in the latter case is probably the reason for the comment "antennule clearly projecting beyond the rostrum" (Serventy, 1929: p. 65). Antennal setae 0-0-1-3/1-1-3, and no spines. Antenna segments with transverse rows of denticles. Number of anal teeth on postabdomen varies. Hedley (1969) demonstrated a range of 10.6-16.5 (mean 14) for eastern Australian specimens, so that they are similar to western Australian specimens, which also have a mean of 14 anal teeth (Bayly and Edward, 1969).

Length. 1.9 mm.

Male length. 1.23 m.

Ecology. *Daphniopsis pusilla* inhabits shallow saline waters in the range 5-59‰ (Bayly and Williams, 1973). The optimum salinity range is 18-27‰. Further details are given by Bayly (1970, 1976), Bayly and Edwards (1969) and Hedley (1969).

Type locality. A pond on Rottnest I., W.A.

Distribution. Western Vic. (Bayly and Edwards, 1969; Hedley, 1969 and present record), S.A. mainly in the south (Bayly, 1970, 1976 and present records) and south-western W.A. (Bayly and Edwards, 1969; Serventy, 1929 and present records).

Genus *Ceriodaphnia* Dana, 1852

Ceriodaphnia Dana, 1852b: 1273.

Head small and without a rostrum. Shell widely oval. Postabdomen moderately elongated with anal aperture at its distal end. Female size about 1 mm.

The type species is *Ceriodaphnia quadrangula* (O.F. Müller, 1785).

Key to Australian Species of *Ceriodaphnia*

1. Head with an acute beak on ventral side *C. cornuta* Sars, 1885
- Head without a beak 2
- 2(1). Central region of postabdomen the widest 3
- Central region of postabdomen not the widest 4
- 3(2). Frontal and lower margin of head without denticles
 *C. laticaudata* P.E. Mueller, 1867
- Frontal and lower margin of head with denticles *C. rotunda* Sars, 1862

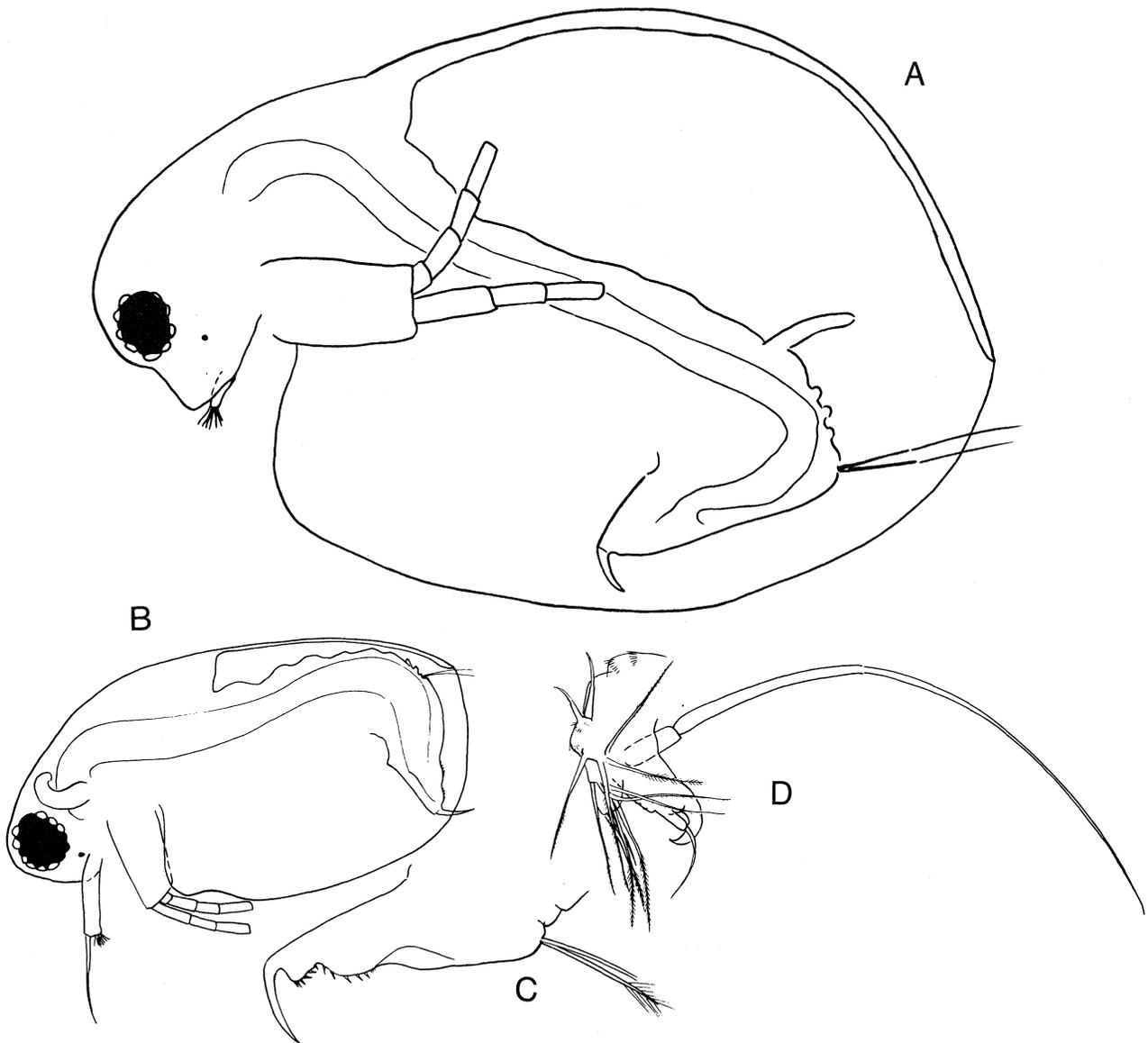


Fig. 125. *Daphniopsis pusilla*. A, ♀, Porters Lagoon, S.A., 16.i.76, length 1.94 mm, from slide 2963; B, ♂, length 1.23 mm, slide 2961; C, ♂ postabdomen, slide 2958; D, ♂ thoracic limb I, slide 2962. (B, C and D from a pond near Kingscote, Kangaroo I., S.A., 9.i.76.)

- 4(2). Fine setules along whole length of concave side of postabdominal claw
..... *C. quadrangula* (O.F. Müller, 1785)
- Very small denticles on proximal half of concave side of claw
..... *C. dubia* Richard, 1894

***Ceriodaphnia quadrangula* (O.F. Müller, 1785)**
Fig. 126

Daphnia quadrangula O.F. Müller, 1785: 90, tab. XIII, figs 3, 4.
Ceriodaphnia hakea Smith, 1909: 80, pl. 15, figs 10-16.
Ceriodaphnia spinata Henry, 1919: 466-467, pl. XL, figs 1, 2., n. syn.

Ceriodaphnia planifrons Smith, 1909: 81, pl. 15, fig. 17. The type locality is L. Sorell in Tasmania. Williams (1974:41) notes the probability of its synonymicity to *C. quadrangula*. Indeed in recent collections (Burrows, 1968) only *C. quadrangula* was found and an examination of Smith's original collections showed it contained specimens having the characteristics of *C. quadrangula*. N. syn.
Ceriodaphnia quadrangula.—Brehm, 1953a: 65, figs 3-6 (*C. quadrangula* and *C. hakea* as synonyms).

Material. Qld: 3, 8, 9. N.S.W.: 129, 133, 136, 138, 140, 145, 151, 153, 155, 160, 162, 167, 183. Vic.: 214, 228, 232, 241, 249, 251, 257, 258. Tas.: 292, 304, 308, 312, 313, 327, 333, 334. S.A.: 361, 364, 388. W.A.: 415, 416, 418, 425.
Slides. AM ♀ P27760, MGU ♀ 2499, ZIN ♀ 2502.

Female. The original description by O. F. Müller is of little value in the differentiation of the species, as

it does not contain any details on the structure of the claw. Smith (1909) published drawings of the thoracic limbs, including I and II. A comparison of these figures and figures in Lilljeborg (1900, pl. XXVII, figs 18, 19) for limbs I and II of *Ceriodaphnia quadrangula* typica reveals no noticeable differences.

In holotype slide P:4327 for *Ceriodaphnia spinata* Henry, 1919 there are only small setules along the concave side of the claw; no small spinules mentioned by Henry are present. Taking into consideration this and the characteristics of the body form and postabdominal structure we define it as being *C. quadrangula*.

Length. Up to 0.8 mm; for "*C. spinata*" Henry, a length of 1.2 mm is indicated (Henry, 1919).

Ecology. Planktonic. In L. Purrumbete (Vic.) seasonal abundance is variable for while Hussainy (1966) notes that it is common except in autumn, during 1969-70 it was only common in June (Timms, 1973).

Distribution. Australia-wide, though uncommon in Qld and restricted to higher altitudes in north Qld.

Differential diagnosis. There are no basal spines on the convex side of the postabdominal claws of the female. This side is smooth (no small denticles). There are small setules along the concave side of the claw. The head has no beak. The postabdomen is not widest in the middle.

Ceriodaphnia dubia Richard, 1894

Fig. 126

Ceriodaphnia dubia Richard, 1894: 570.—Gurney, 1927: 65-66, fig. 1B; Brehm, 1928: 794.

Material. Vic.: 217, 232, 240.

Slides. AM ♀ P27728, MGU ♀ 1947, ZIN ♀ 2209.

Ecology. Planktonic.

Distribution. Southern Qld (Timms and Midgley, 1969), Vic.

Differential diagnosis. There are no well-developed basal spines on the concave side of the postabdomen claw of the female (but there are about 20 bristles). The head has no beak and the postabdomen is not widest in the middle.

Ceriodaphnia laticaudata P.E. Müller, 1867

Figs 127, 128

Ceriodaphnia laticaudata Müller, 1867: 130.

Material. Vic.: 250. W.A.: 412.

Slides. AM ♀ P27729, MGU ♀ 2976, ZIN ♀ 2977.

Female length. 0.93 mm.

Distribution. Localized in Vic. and W.A.

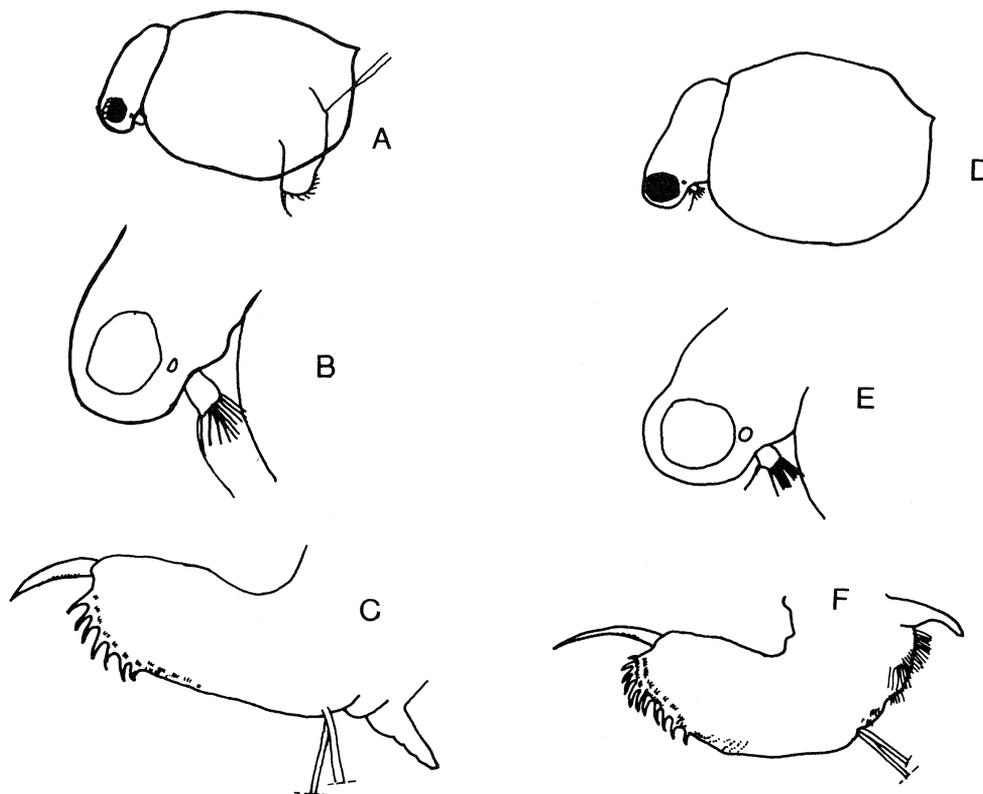


Fig. 126. *Ceriodaphnia* spp. A, B & C, *Ceriodaphnia quadrangula* ♀, after Flössner, 1972. A, lateral view of whole animal, length 0.8 mm; B, details of head and antennule; C, postabdomen; D, E & F, *Ceriodaphnia dubia* ♀, after Flössner, 1972. D, lateral view of whole animal, length 0.9 mm; E, details of head and antennule; F, postabdomen.

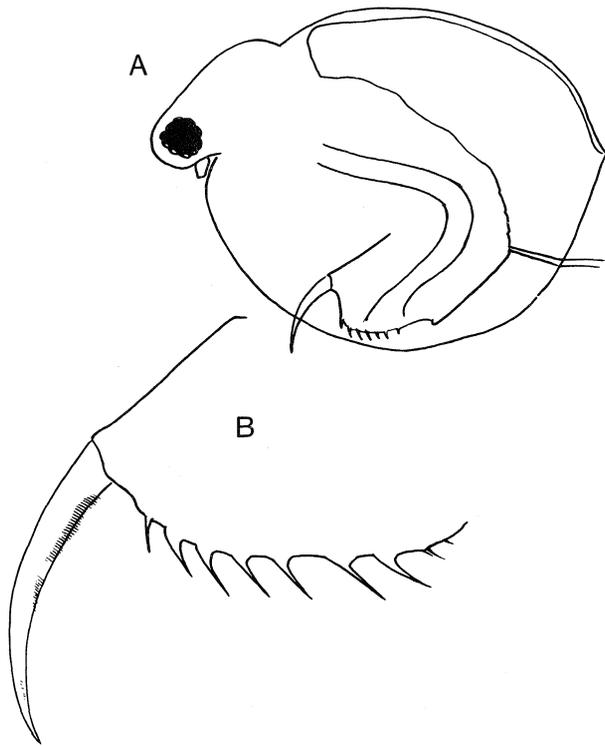


Fig. 127. *Ceriodaphnia laticaudata* ♀, pond between L. Gnotuk and L. Bullenmerri, Vic., 23.i.76, slide 2977. A, lateral view of whole animal, length 0.93 mm; B, postabdomen.

Differential diagnosis. There are no basal spines on the concave side of the postabdominal claw of the female. The postabdomen is widest in its middle. The head has no beak; its frontal margin is rounded and without denticles.

Ceriodaphnia rotunda Sars, 1862

Fig. 128

Ceriodaphnia rotunda Sars, 1862: 275.—Shepard *et al.*, 1918: 83.

Material. Literature.

Distribution. Vic. (Melbourne—Shepard *et al.*, 1918).

Differential diagnosis. There are no basal spines on the concave side of the postabdominal claw of the female. The postabdomen is widest in its middle. The head has no beak. The margin below the eye bears spinules and the frontal and lower margins of the head bear small denticles.

Ceriodaphnia cornuta Sars, 1885

Fig. 128

Ceriodaphnia cornuta Sars, 1885: 26–28, pl. 5, figs 1–3.—Henry, 1922: 32–33, pl. IV, fig. 4.

Ceriodaphnia rigaudi Richard, 1894: 239.

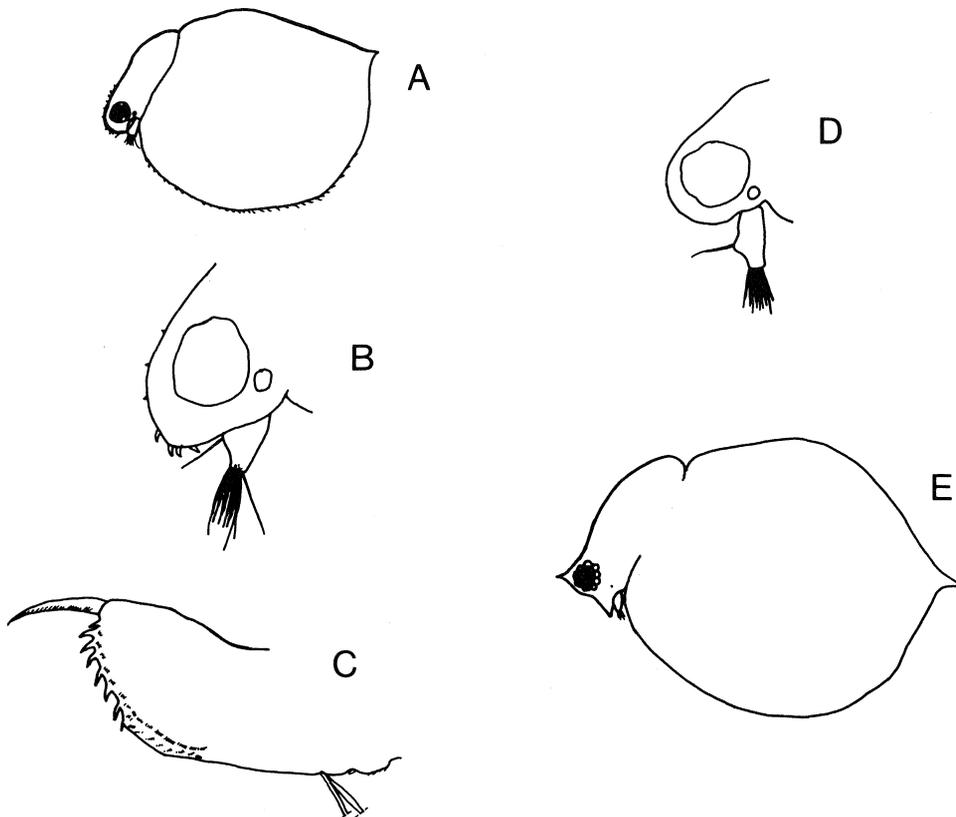


Fig. 128. *Ceriodaphnia* spp. A, B & C, *Ceriodaphnia rotunda* ♀ after Flössner. A, lateral view of whole animal, length 0.8 mm; B, details of head and antennule; C, postabdomen; D, *Ceriodaphnia laticaudata* ♀, after Flössner, details of head and antennule, E, *Ceriodaphnia cornuta* ♀, after Sars, outline of whole animal.

Material. *Qld.*: 2, 3, 7, 9, 12, 15, 23, 28, 31, 38, 64. *N.S.W.*: 80, 85, 95, 131, 156, 169, 173, 180, 187. *Vic.*: 228, 234, 238, 239. *S.A.*: 374, 380, 384.

Slides. AM ♀ P27727, MGU ♀ 1946, ZIN ♀ 1990.

Length. 0.6 mm.

Ecology. Planktonic. In farm dams in the Hunter Valley *C. cornuta* is typically most common in summer (Timms, 1970b). It may occur with its congener *C. quadrangula*. Both species have similar distributions and occur in what seem to be similar habitats. However *C. cornuta* seems to prefer warmer waters than *C. quadrangula* as indicated by (a) its absence in Tasmania, (b) its altitudinal separation from *C. quadrangula* in north-eastern N.S.W. so that it occupies coastal or western waters, not highland lakes (Timms, 1970a), (c) its greater relative abundance in north Qld, (d) differences in seasonal distribution of the two species, and (e) the worldwide distribution of the two species—*C. cornuta* is found in warmer latitudes including south Asia, Africa and Central America, while *C. quadrangula* is basically Holarctic.

Type locality. Gracemere Lag., 10 km west of Rockhampton, Qld.

Distribution. Eastern Australia and S.A. (apparently not in Tas. or W.A.).

Differential diagnosis. This species is distinctive in that the anterior portion of the head is produced into a beak-like acute structure.

Incertae sedis

Daphnia honorata King, 1853a: 249, pl. III; 1853b: 254–255, pl. VI D.—Sars, 1888: 68.

Biocoenology

(a) Assemblages

With few exceptions, the 125 species of inland water Cladocera known for Australia are either euplanktonic or littoral-benthic in habit. Hence typically each is a member of either the open water plankton community or the 'community' (*sensu* Timms, 1973) inhabiting littoral weedbeds. Since a cursory inspection of the distributional data reveals that certain species occur again and again, particularly in circumscribed areas, it could be that there are communities (*sensu lato*) with component species ecologically interdependent. On the other hand any species aggregations may simply be due to chance, or at most, to considerable overlap in their responses to environmental variables.

Because of the low diversity of cladocerans in limnetic communities (Timms [1970a] reports a momentary species composition of 1.1 in 103 sites in north-eastern N.S.W.), it is difficult to ascertain whether there are relationships between and within such communities. However, for littoral cladocerans the situation is different: a number of species (up to 20, mean 4.14—see

later) may co-occur so that analysis of species groupings is possible, despite the fact that the Cladocera comprise only a part of the total 'assemblage' of littoral animals.

Jaccard's (1932) coefficient of community was used in the analyses. By this: $CC = \frac{a}{a + b - c}$, where *a* is the number of species in the first sample, *b* in the second sample, and *c* the number of species occurring in both. It perhaps would have been better to use indices based on quantitative data (e.g. see Kontkanen [1950], Whittaker and Fairbanks [1958]), but the available data are qualitative. Rather than treat each site as an individual, it was decided to consider apparently similar lakes as single entities. This approach was adopted because of (1) the increased probability of recording all species living in an area, and (2) the need to simplify operations. The analyses were further restricted to those lakes which formed natural groups (e.g. flood plain lagoons of the Burdekin delta, sand dune swamp localities in the Myall Lakes area).

Hence for Queensland, of 66 localities sampled, only 24 in 7 groups were considered. Figures for the other states are: N.S.W. 113-35-8, Vic. 63-20-5, S.A. 42-15-3, Tas. 49-17-3 and W.A. 23-0-0.

Because a preliminary examination of the species lists for all the groups suggested that those in northern, southern, and coastal dune areas were quite different, separate matrices of CC were constructed for these three areas, but with some overlap. These are now considered in turn.

I. Qld—Northern N.S.W. (Table 1)

Here there are two 'assemblages':

(a) That of the flood plain lagoons in Nth. Qld—the Powlathanga—Pentland pair, the lagoons along Lolworth Creek; north-west of Charters Towers, and the lagoons on the delta of the Burdekin River. Some components of this 'assemblage' overlap with elements (1) in the lagoons around Dunn Lake (via Aramac Qld), (2) in the Hunter Valley reservoirs in N.S.W. and (3) in the coastal dune lakes.

(b) That of the coastal dune lakes at Cooloola (Qld) and in north-eastern N.S.W.

II. Southern Australia. Part A—Southern Qld, N.S.W. and Vic. (Table 2).

Here there are two 'assemblages' interlinked by the species groupings in the Bombala—Bega lagoons. The first inhabits the lagoons of the Monaro Tableland, N.S.W. Community coefficients for these, particularly those near Cooma, are the highest for the whole analysis. There is some decrease in the values of CC in a gradient running from Cooma, through the Bombala Lagoons, to those around Bega, so that the coastal lagoons around Bega are different, but related to those on the adjacent highland. The second 'assemblage' lives in the Victorian lakes and lagoons, specifically in the floodplain lagoons of the Goulburn River, around Seymour—Alexandra, in the lakes south of Kerang and in some lakes of the western volcanic plains of Victoria.

Table 1. Matrix of community coefficients for lake groups in Queensland—Northern N.S.W.

Hugh	Powl	CT	LB	Rock	Dunn	HV	Min	Cool	Myall	
	15	19	20	10	10	12	—	—	—	Hughenden
		42	44	28	24	17	9	23	22	Powlathanga
			29	38	18	8	7	18	16	Charters Towers
				30	25	20	7	24	17	Lower Burdekin
					23	12	17	16	15	Rockhampton
						19	4	5	3	Dunn
							—	11	7	Hunter Valley
								14	31	Minni-Cook
									29	Coolool
										Myall Lakes

Table 2. Matrix of community coefficients for lake groups in southern Queensland, N.S.W., and Victoria.

Hda	Ctr	AC	Bom	Beg	EG	Rock	HV	WD	Ker	Gou	
	60	38	34	15	0	0	13	7	10	12	Hugundara
		50	45	22	0	12	12	12	15	24	Cootralantra
			45	37	0	12	12	11	22	24	Arable-Carrol
				44	5	5	16	20	28	43	Bombala
					5	15	22	23	37	35	Bega
						11	7	14	6	7	East Gippsland
							12	7	10	6	Rockhampton
								21	22	34	Hunter Valley
									38	31	Western District
										35	Kerang
											Goulburn

Table 3. Matrix of community coefficients for lake groups in Victoria, Tasmania and South Australia.

Goul	Ker	Purr	MtG	Adel	KI	Mid	High	Temp	
	35	31	21	20	32	21	26	5	Goulburn
		38	27	40	22	33	24	14	Kerang
			31	27	11	20	20	8	Purrumbete
				43	31	27	25	15	Mt Gambier
					21	23	17	13	Adelaide
						16	27	6	Kangaroo I.
							30	14	Midland Tas.
								23	Highland Tas.
									Temporary Tas.

The 'assemblage' of the Hunter Valley reservoirs in N.S.W. is sufficiently like those in the Victorian sites to be included with them also. There is some overlap with the species groupings in the Bega—Bombala lagoons and hence with those of the Monaro Tableland.

III. Southern Australia, Part B—Vic., Tas. and S.A. (Table 3).

The 'assemblage' of the Victorian lakes extends into southern South Australia (lakes at Mt. Gambier, dams

around Adelaide and lagoons on Kangaroo Island) and also to Tasmania (lagoons in the Midlands). There is some relationship between the communities in the lagoons of the Midlands, Tasmanian eastern Highlands and Kangaroo I. The 'assemblage' in the temporary lagoons in Tasmania is the most divergent, with closest relationship to highland fauna.

Unpublished data on the lower Murray-Darling river system (R. Shiel, personal communication) suggest there is a distinctive grouping of species there also. Among

Table 4. Matrix of community coefficients for coastal dune lakes

EG	Beg	Bri	Min	Coo	Myl	
	5	14	5	0	0	East Gippsland
		12	15	8	3	Bega
			11	27	20	Bridgewater
				14	31	Minnie-Cook
					29	Cooloola
						Myall Lakes

others, *Pleuroxus inermis*, *Alona macracantha*, *Monospilus diporus* and *M. elongatus* are characteristic.

IV. Coastal Dune Lakes (Table 4).

Among these there is a low degree of similarity between lake groups; only the values between the Myall, Minnie, and Cooloola groups are high enough to suggest a relationship. On initial appraisal this is surprising in view of the known ecological unity of lakes in coastal dunes in eastern Australia (e.g. Bayly, 1964). However, most members in four of the present groups are not typical dune lakes (*sensu* Bayly, 1964). Only two of the Bega group are associated with coastal dunes and then only partly. All except one of the East Gippsland group are atypical (Timms, 1973) and none of the Bridgewater group is typical (Timms, 1977). On other criteria the Myall and Cooloola group contain characteristic dune lakes, while only Cook's Lagoon of the Minnie group is typical (Timms, in prep.). Hence a lack of similarity between all lakes is really expected and some relationship between the more typical dune lakes is not surprising. However, the latter is not as high as might be expected from knowledge of other similarities between typical dune lakes. Perhaps this is associated with the difficulty of obtaining adequate samples of uncommon littoral cladocerans amongst dense beds of littoral sedges.

Further information on cladoceran assemblages in lakes may be obtained by examining the chitinized remains in the superficial layer of profundal mud (Frey, 1960). This approach is often more revealing than studying single samples since the remains represent an integrated sample from all habitats and seasons. The only data available for Australian lakes are presented in Table 5. Of the three maars of the Atherton Tableland, Eacham and Barrine are similar but Euramoo is quite different; this supports previous conclusions based on a physiochemical study (McCarragher & Russel, in prep.) and a survey of their macrobenthos (Timms, 1978). The differences are probably associated with the abundant littoral weedbeds, relative shallowness and dystrophic nature of Euramoo. The western Victorian pair, Purrumbete and Elingamite, are similar to each other and to Eacham and Barrine. They contain a greater variety and proportion of littoral species in keeping with their relatively greater abundance of littoral macrophytes.

(b) Species Groups

In almost all cases (Tables 1 to 4), the values for the coefficient of community are low, indeed, much lower than those accepted by most authors (e.g. Whittaker and Fairbanks, 1958) for the designation of communities and sub-communities. However, the closer relationships of lake groups to some and not to others indicates that the distribution of components of cladoceran communities is not at random. Our data suggest that there are species groups, the members of which *tend* to recur again and again. They cannot be considered as sub-communities or communities because their co-occurrence is irregular and not interdependent. Further their presence in any lake is not necessarily restricted to areas where a particular species group dominates.

Unfortunately the data are unsuitable for an analysis of recurrent species groups (*sensu* Fager, 1957). This is because firstly each sample is not considered to represent

Table 5. Per cent ratios of Cladocera remains in mud samples for five lakes.

	L. Euramoo, via Atherton, Q., from 18 m	L. Eacham, via Atherton, Q., from 63.5 m	L. Barrine, via Atherton, Q., from 64.5 m	L. Purrumbete, Vic., from 35 m	L. Elingamite, Vic., from 6 m
<i>Alona</i> sp.	0	2	0	3	0
<i>Alonella excisa</i>	9	0	0	0	1
<i>Biapertura karua</i>	4	0	0	0	0
<i>Biapertura kendallensis</i>	0	0	0	3	0
<i>Biapertura rigidicaudis</i>	22	0	0	0	0
<i>Biapertura</i> sp.	0	0	4	0	18
<i>Bosmina</i> sp.	0	96	95	85	77
<i>Camptocercus australis</i>	1	0	0	0	0
<i>Chydorus</i> sp.	9	0	0	6	4
Daphniidae, filtering limbs	52	0	0	3	0
<i>Leydigia</i> sp.	0	2	0	0	0
<i>Oxyurella singalensis</i>	3	0	1	0	0

Table 6. Species Groups**1. Northern**

Chydorus barroisi
Chydorus eurynotus
Latonopsis australis
Biapertura karua
Dunhevedia crassa
Echinisca rosea

plus many others not so widely shared.

Monaro

Ceriodaphnia cornuta
Simocephalus acutirostratus
Pleuroxus jugosus

3. Acidic Dune Lakes

Alonella clathratula
Rak obtusus
Biapertura longinqua
Echinisca timmsi
Monope reticulata
Pseudosida australiensis
Rhynchochydorus australiensis

Alonella excisa
Biapertura macrocopa
Moinodaphnia macleayi
Streblocerus serricaudatus
Biapertura intermedia
Scapholeberis kingi

2. Southern

Chydorus sphaericus
Dunhevedia crassa
Pleuroxus aduncus

*Simocephalus vetulus**Alona davidi*

Bega

Chydorus eurynotus

Tasmania

Biapertura rusticoides

non-coastal Vic.

Graptoleberis testudinaria
Pseudochydorus globosus

Alona rectangula

southern S.A.

*Simocephalus gibbosa***4. Calcareous Dune Lakes**

Chydorus sphaericus
Alonella excisa
Biapertura rigidicaudis
Camptocercus australis
Oxyurella tenuicaudis
Pleuroxus aduncus

5. Temporary Ponds*Archepleuroxus baylyi*

the full assemblage of forms thought to live in any one locality; e.g. our data for the Goulburn lagoons record up to 10 species per lagoon but Shiel (1976) in a detailed study of one of them records 31 species. Secondly, when samples are pooled to overcome this problem (see earlier) there are insufficient numbers for a meaningful analysis of recurrent groups. Hence, all that can be attempted is to list the more common species in each grouping of lakes.

Five species groups can be recognized from our data. the dominant forms in each group are given in Table 6 with the interrelationships within the southern group, which is more diffuse and hence more complex than the others. Although dominant forms may also occur as uncommon species in other areas (e.g. *Chydorus barroisi*, the leading dominant for north-eastern Australia, is present but uncommon in acid dune lakes), it is significant that there are very few dominants shared between groups so that they are distinctive.

The most distinctive group occurs in acid dune lakes on siliceous sands of the east coast. All seven major species are either unique to dune lakes or rarely found elsewhere. Further, most of the co-dominants in the group, while not so universally present in dune lakes, are uncommon elsewhere.

The calcareous dune group is erected entirely on evidence from the Bridgewater—Nelson series in western Victoria. It shares two dominants and many species with the southern group and in addition a few species also occur uncommonly in acidic dune lakes. It is possible that further data will show that it is a sub-group of the southern group. If so, this will further emphasize the difference of calcareous from acid dune lakes (see Timms, in prep.).

Another distinctive grouping comprises the species inhabiting temporary ponds in southern Victoria and Tasmania. Morton (1973) has studied such habitats in some detail and records many species there, but the most

Table 7. Numbers of species of Cladocera in various areas of Australia.

Area	Number of species	Momentary Species Composition*
North Queensland	30 species in 14 localities	7.0
Monaro (N.S.W.)	20 species in 19 localities	4.2
Victorian lakes	24 species in 16 localities	4.9
Tasmanian midlands	17 species in 13 localities	4.5
Tasmanian highlands	16 species in 7 localities	5.1
Southern S. Aust.	11 species in 14 localities	3.5
Kangaroo Island	18 species in 13 localities	3.0
Bridgewater (Vic.)	17 species in 6 localities	5.0
Myall (N.S.W.)	31 species in 6 localities	7.6
Minnie-Cook (N.S.W.)	30 species in 6 localities	8.0

* i.e. the average number of species present in all collections from the area.

characteristic one is *Archepleuroxus baylyi* which rarely occurs in other habitats.

The number of species inhabiting northern localities and acid dune lakes is much higher than that in southern areas and in calcareous dune lakes. This is ascertained in general terms by considering the total number of species recorded in the various areas, or more precisely, from the momentary species composition for the various areas (Table 7). This in part reflects the penetration of many 'Holarctic' and circumtropical species only into northern Australia. Further, if speciation is more active in the north than in the south, as it seems (see later), this would also contribute. An exception to this is the coastal dune lakes of the east coast where diversity is the highest and there is the largest number of endemics.

Overall, in the littoral of all localities sampled there is a momentary species composition of 4.14, which compares with an average of 4.9 given by Pennak (1966).

(c) Cladocerans in inland saline waters.

Few species of Cladocera penetrate even moderately saline waters in Australia. Two species live in waters >20‰ compared with five each in Algeria (Beadle, 1943) and Canada (Rawson and Moore, 1944). At lower salinities (1–10‰) the comparative status is somewhat reversed: 14 in Australia, 11 in Canada and 9 in Algeria.

The most notable halophilic species in Australia is *Daphniopsis pusilla* which inhabits shallow, often ephemeral salines. Its field salinity range is 4.4–59‰ (Geddes, 1976; Bayly and Edward, 1969) which is not much different from the laboratory range of 1–50‰ reported by Hedley (1969). As the salinity of its habitat increases, *Daphniopsis pusilla* changes from producing subitaneous to resistant eggs. It is widespread in western Victoria, southern South Australia and south-western Western Australia.

Recently, *Moina mongolica*, which inhabits very saline ponds in the Old World (Goulden, 1968), was found over a salinity range of c.7–40‰ in Lake Eyre (Bayly, 1976). At this stage it is not known whether this species is more widespread, or what its full salinity range is in Australia.

Six species have been recorded with an upper salinity range 5–10‰—*Echinisca capensis capensis* and *Biapertura rigidicaudis* at 8‰, *Daphnia carinata sensu lato* at 7.3‰, *Alona cambouei* and *Alona davidi iheringi* at 6.7‰, and *Moina australiensis* at 5‰. All are known from freshwater though only one of five records of *Echinisca capensis capensis* is from a salinity below 1‰. It is likely that *Moina australiensis* occurs at higher salinities than recorded here.

A further six species typically occur in freshwater but occasionally were encountered in slightly saline waters (up to 4‰). These are *Macrothrix breviseta* and *Echinisca carinata* at 4‰, *Pleuroxus jugosus* at 2.5‰, and *Pleuroxus aduncus*, *Simocephalus vetulus elisabethae* and *Ceriodaphnia quadrangula* at 2.3‰.

Curiously, some widespread species recorded in saline waters overseas have not yet been found at similar salinities in Australia. These are *Simocephalus exspinosus* and *Alona rectangula* at c. 12‰ in Algeria (Beadle, 1943), *Chydorus sphaericus* at 20‰, *Ceriodaphnia quadrangula* at 10‰, and *Pleuroxus denticulatus* and *Alona costata* at 5‰, all in Canada (Rawson and Moore, 1944).

In summary, it seems that in permanent lakes in Australia, a few species are adapted for very low salinities. Three, notably, *Echinisca capensis capensis*, *Daphnia carinata sensu lato* and *Moina australiensis*, can live at somewhat higher salinities (to 10‰), but only two species are adapted for salinities higher than this. Of these, *Daphniopsis pusilla* is the most widespread and successful, but where fish predation is likely to be significant it is replaced by *Moina mongolica* (e.g. Lake Eyre), or no species are present (e.g. Lake Corangamite) (Bayly, 1976).

Faunal Composition and Zoogeography

The total number of cladoceran species now known to occur in Australia is 125 (excluding marine species); this compares with 114 for Europe and 134 for North America (Table 8), the only other sizeable areas for which comprehensive data are available.

Table 8. Composition of the cladoceran faunas in inland waters of various areas of the world.

Taxon	Number of species in				
	Australia	New Guinea	New Zealand	Philippines	Malaysia
Sididae	5	2	0	5	6
Holopedidae	0	0	0	0	0
Chydoridae	68	9	22	31	42
Macrothricidae	21	3	6	7	8
Moinidae	6	0	2	3	2
Bosminidae	2	1	1	3	1
Daphniidae	23	2	10	5	5
<i>Daphnia</i>	11	0	3	0?	1
<i>Simocephalus</i>	5	1	3	2	2
<i>Scapholeberis</i>	1	0	1	2	1
<i>Ceriodaphnia</i>	5	1	3	1	1
<i>Daphniopsis</i>	1	0	0	0	0
Polyphemidae	0	0	0	0	0
Cercopagidae	0	0	0	0	0
Leptodoridae	0	0	0	0	0
TOTAL	125	17	41	54	64
Number of endemics	44	?	1	2?	?
Source of Data†	(1)	(2),(3),(4)	(5)	(6), (7)	(8)

Table 8 contd.

	South America	North America	Europe*	Africa to south of Sahara	Asia
Sididae	13	8	6	7	10
Holopedidae	1	2	1	0	1
Chydoridae	60	63	54	63	80
Macrothricidae	25	18	11	13	27
Moinidae	6	8	4	5	7
Bosminidae	6	4	2	3	6
Daphniidae	21	29	33	16	26
<i>Daphnia</i>	8	15	16	6	10
<i>Simocephalus</i>	6	3	5	3	5
<i>Scapholeberis</i>	2	2	4	1	3
<i>Ceriodaphnia</i>	5	9	8	6	7
<i>Daphniopsis</i>	0	0	0	0	1
Polyphemidae	0	1	1	0	1
Cercopagidae	0	0	1	0	1
Leptodoridae	0	1	1	0	1
TOTAL	132	134	114	107	160
Number of endemics	41	25	15	26	24
Source of data†	(9),(10),(11),(7) (12),(13),(14)	(15),(10),(16) (7),(12)	(17),(16) (18),(7),(12)	(19),(20) (7),(12),(21)	(22),(23) (7),(12)

*If endemic Ponto-Caspian Polyphemoidea are considered (Mordukhai-Boltovskoi, 1968b), then the total is 141 species with 35 endemic.

†(1) Present work, (2) Daday, 1901, (3) Brehm, 1959, (4) Ball & Gluckman, 1978, (5) Chapman & Lewis, 1976, (6) Mamaril, 1977, (7) Smirnov, 1971b, (8) C.H. Fernando, pers. comm., (9) Begamin, 1939, (10) Deevey & Deevey, 1971, (11) Harding, 1955, (12) Smirnov, 1976, (13) Paggi, 1976, (14) Paggi & Paggi, 1974, (15) Brook, 1966, (16) Goulden, 1968, (17) Flossner, 1972, (18) Sramek-Husek *et al.*, 1962, (19) Dumont, 1979, (20) Sars, 1916, (21) Rey & Saint-Jean, 1968, (22) Manuilova, 1964, (23) Mordukhai-Boltovskoi, 1968b.

The main difference between the three faunas, in addition to the difference in endemics (see later), is the absence in Australia of four families—the Holopedidae, Polyphemidae, Cercopagidae, Leptodoridae—and of many widespread genera e.g. *Sida*, *Acantholeberis*, *Euryercus*. Compared to North America, an area of similar size to Australia, the Australian fauna is not quite as diverse, for besides the lack of four families, there are also fewer genera in a majority of families. However, in some genera (e.g. *Biapertura*, *Echinisca*) and subfamilies (e.g. Chydorinae) there has been considerable speciation, so that species numbers at the family level in the Macrothricidae and Chydoridae are not significantly different.

In analysing the composition and origin of the Australian cladoceran fauna it is necessary to consider the presence or absence of members of the three phylogenetic stems of the Cladocera: the Ctenopoda Sars, 1865 (Sididae, Holopedidae), the Anomopoda Sars, 1875 (Macrothricidae, Chydoridae, Bosminidae, Moinidae, Daphniidae), and the Gymnomera Sars, 1865 (Polyphemidae, Podonidae, Cercopagidae, Leptodoridae).

Among the Anomopoda it is of special interest to consider the presence or absence in Australia of morphologically ancestral forms (*sensu* Fryer, 1974) in the Macrothricidae and Chydoridae. These two families comprise mainly littoral and benthic forms and are claimed to be the cladocerans most similar to their conchostracan ancestors (Fryer, 1968, 1974). Of the primitive genera, Australasia has the endemic *Saycia* (1 species) and the widespread (Holarctic, Ethiopian) *Ilyocryptus* (3 species) but lacks *Acantholeberis* and *Euryercus* (both Holarctic).

In the more general sense all families comprising the phylogenetic series Anomopoda (Macrothricidae—Chydoridae—Bosminidae—Moinidae—Daphniidae) are present in Australian inland waters. The Macrothricidae are represented by 6 of the known 17 genera, Chydoridae by 22 of the known 31 genera, and Bosminidae, Moinidae, and Daphniidae by all known genera.

At the generic level Australasia has two endemic genera of Macrothricidae (*Neothrix*, *Pseudomoina*) six of Chydoridae (*Saycia*, *Archepleuroxus*, *Rhynchochydorus*, *Rak*, *Australochydorus*, *Monope*), but no endemic genera of Bosminidae, Moinidae or Daphniidae. By contrast, the Holarctic has many endemic genera of Macrothricidae (*Acantholeberis*, *Ophyryoxus*, *Bunops*, *Drepanothrix*, *Wlassicsia*), a few genera of Chydoridae (*Rhynchotalona*, *Anchistropus*), and no endemic genera of Bosminidae, Moinidae, or Daphniidae.

For the Moinidae Goulden (1968: 93) has noted: "Because *Moina tenuicornis* and *australensis* are the most generalized species of the family it seems probable that they represent the oldest species or at least have retained many primitive characters. These two species now have their centers of distribution in Australia—*tenuicornis* also occurs in South Africa."

In Daphniidae, the presence of *Daphniopsis* is noteworthy. This genus includes three species—one in Australia, one in Antarctica (Akatoa, 1964) and Kerguelen Islands (Rühe, 1914), and another in Central Asia (Sars, 1903). The genus *Daphnia* is represented by two different forms in Australia—*Daphnia lumholtzi* having a very elongated and narrow helmet and posterior shell spine, both being produced in the anterior-posterior axis, and *Daphnia carinata sensu lato*, which has a cephalic helmet developed mostly in a ventro-dorsal direction. Hebert (1977) has described the peculiar forms in the *Daphnia carinata* complex. It may be mentioned that Wagler (1936) supposed that *Daphnia* originated in Central Asia.

Turning to the Ctenopoda, which separated from the main phylogenetic stem in remote time, the Holarctic Holopedidae are absent from Australia, while the Sididae are represented by only 3 of the 6 known genera. The Gymnomera are not present in inland waters of Australia, but are widely distributed in the Holarctic.

From the above it is apparent that the Australian fauna of Cladocera is more different from its Northern Hemisphere counterpart than is indicated in Table 8. Indeed, there are basic differences in the distribution of primitive taxa, and in addition a number of endemic highly specialized forms occur in inland waters of Australia. However, there are also many species of extensive world distribution in Australia, so that before the full significance of the peculiarities can be realized, it is necessary to examine general zoogeographical relationships.

In their zoogeographical relationships, the Australian Cladocera can be considered to comprise five groups. First, there are cosmopolitan species, e.g. *Chydorus sphaericus*, *Moina micrura*, *Simocephalus vetulus*. This group is not as numerous as indicated by some previous authors, for instance for the Chydoridae it is only 26% of the total.

The next two groups comprise species distributed throughout appreciable areas of the world as well as in Australia. There are circumtropical forms such as *Latonopsis australis*, *Chydorus hermanni*, *Biapertura karua*. Many species in this group are restricted to, or are most common in, northern Australia. The presence of a number of cosmopolitan and circumtropical species may be considered a secondary event caused by distribution by waterfowl, wind and other means and related to the eurybiontic qualities of these species. Migrations of waterfowl between Eurasia and Australia have been recorded by banding (Lebedeva and Tamkovich, 1977; Mikheev, 1971).

A third group is composed of species common in the Palaearctic or Holarctic, but also occurring in Australia, e.g. *Streblocerus serricaudatus*, *Acroperus alonoides*, *Biapertura setigera*, *Moina mongolica*, and in limited areas elsewhere (e.g. *Pleuroxus similis*, *Alona archeri*). Similar bipolar distributions are known for many other groups besides the Cladocera (Darwin, 1872; Berg, 1947). The disjunct distribution of bipolar cladocerans may be due to dispersal by bipolar migratory birds, but

Table 9. The distribution of Gondwanaland Cladocera.

Taxon	Australia	India ¹	Ethiopian Region ²	South America ³	Other Lands ⁴
<i>Diaphanosoma excisum</i>	+	+	+	+	
<i>Chydorus eurynotus</i>	+	+	+	+	
<i>Chydorus hybridus</i>	+			+	N. America
<i>Dadaya macrops</i>	+	+	+	+	East Indies, southern USA
<i>Pseudochydorus globosus</i>	+	+	+		
<i>Euryalona orientalis</i>	+	+	+	+	N. America
<i>Alonella clathratula</i>	+		+	+	East Indies
<i>Alona cambouei</i>	+		+	+	Middle East, southern asiatic USSR
<i>Alona poppei</i>	+			+	
<i>Alona pulchella</i>	+		+		Tibet
<i>Alona davidi iheringi</i>	+		+		Southern asiatic USSR
<i>Alona davidi punctata</i>	+		+		
<i>Alona rectangula novae-zealandiae</i>	+		+		
<i>Camptocercus australis</i>	+		+	+	
<i>Leydigia ciliata</i>	+		+	+	Kazakhstan Rep., USSR, China
<i>Leydigia australis</i>	+		+		
<i>Kurzia longirostris</i>	+		+		China
<i>Oxyurella singalensis</i>	+		+		
<i>Graptoleberis testudinaria occidentalis</i>	+		+		
<i>Ilyocryptus brevidentatus</i>	+			+	
<i>Moina tenuicornis</i>	+		+		
<i>Daphnia lumholtzi</i>	+	+	+		
<i>Simocephalus latirostris</i>	+		+	+	
<i>Ceriodaphnia cornuta</i>	+	+	+		

¹ ex Smirnov, 1971b, 1976.² ex Goulden, 1968; Monakov, 1969; Naylor, 1971; Smirnov, 1971b, 1976.³ ex Paggi, 1972; Smirnov, 1971b, 1976; Stingelin, 1906; Thomasson, 1963.⁴ ex Brooks, 1966; Smirnov, 1971b, 1976.

present restricted distributions could be a relict of a wider distribution in the past, changed by long term fluctuation in climates (Berg, 1947). It has been suggested (e.g. Darwin, 1872; Berg, 1947; Lindberg, 1955, 1972) that during Pleistocene glaciation, the temperate zones migrated to and from the present equator and that there were considerable changes in sea level. The fauna of the zones went with them, but it is not clear why (Berg, op. cit; Lindberg, op. cit). Further, Berg (1947) is of the opinion that it was mainly northern species that migrated southwards at such times.

A similar explanation may well explain the present distribution of *Moina australiensis* (restricted to Australasia) and *Moina tenuicornis* (found in Australia and South Africa) (Goulden, 1968). Goulden's suggestion that they originated in Australia is improbable, since it is unlikely that stem forms of a

relatively specialized family would have originated in a land isolated from the main stream of cladoceran evolution. Indeed the presence of *M. tenuicornis* in South Africa, as pointed out by Goulden (1968), suggests that a relict distribution is likely.

The fourth group includes those almost exclusively found in the southern continents (including India and Sri Lanka); they are Gondwanaland forms. However, only 4 of the 24 forms listed in Table 9 are known from all four land masses, but it should be noted that the cladoceran faunas of South Africa and South America are poorly known. Many species are apparently absent from India or South America, or both, while a few (e.g. *Indialona globulosa* syn. *Alona globulosa* Daday, 1898, *Chydorus ventricosus*) are present in South America, South Africa, and India, but not in Australia. There are some species, e.g. *Dadaya macrops*, which are

distributed slightly beyond the Gondwanaland continents.

The fifth group comprises the endemics (Table 10). These are comparatively more numerous than in either Europe or North America (Table 8). As indicated above, there are 8 endemic genera in Australia and New Zealand, four of which (all in the subfamily Chydorinae) are known only from Australia. Speciation has been most extensive in *Biapertura* (7 species), *Macrothrix* (3 species), *Echinisca* (7 species), and *Daphnia* (7 species). In a comparative sense, a large number of endemic Daphniids is not unusual (cf. situation in North America—Brooks, 1957), but it is atypical for *Biapertura* and *Echinisca* (and closely related *Macrothrix*) to have several endemic species.

The majority of Australian endemics occur in the south-east, northern Qld and south-western W.A. (14 in W.A., 3 in S.A., 11 in Tas., 16 in Vic., 26 in N.S.W., 16 in Qld), with the most in coastal N.S.W. (18 species). The genus *Biapertura* is most diverse in this coastal region while three of the four endemic genera (*Rak*, *Rhynchochydorus*, *Monope*) are found in it exclusively. Within this area speciation is greatest in the acidic waters of the north-east coast (9 out of 17 species including

the three endemic genera). North Queensland also contains some of the endemic species of *Biapertura*, but more notably the majority of endemic species of *Macrothrix* and *Echinisca* occur there. It is not apparent why these two areas are especially important, though it might be due to more intensive collecting in them, but it is notable that cladocerans, unlike calanoid copepods (Bayly, 1967), have diversified in the unusual environment provided by coastal dune lakes. This difference is likely to be associated with comparative niche availability; there few niches available to planktonic forms, but many for littoral-benthic animals.

Overall the Australian cladoceran fauna is quite different from that of other major land masses. It is even considerably different from that of its nearest neighbours in south-east Asia. From the somewhat inadequate data available for Malaysia (C.H. Fernando, personal communication) and Philippines (Mamaril, 1977), the fauna of these countries is composed mainly of species from the first three zoogeographic groups (i.e. cosmopolitan, circumtropical, Palaearctic/Holarctic) with a few Gondwanaland and endemic forms. In sum their fauna is much less diverse than Australia's. Interestingly, both lack, in common with Australia, representatives of the Holopedidae, Polyphemidae,

Table 10. List of endemic taxa of Australasia.

Endemic genera

Saycia—Australia, New Zealand
Rak n. gen.—Australia
Archepleuroxus n. gen.—Australia
Australochydorus n. gen.—Australia
Monope—Australia
Rhynchochydorus n. gen.—Australia
Neothrix—Australia, New Zealand
Pseudomoina—Australia, New Zealand

Endemic species

Latonopsis brehmi—Australia
Pseudosida australiensis—Australia
Diaphanosoma unguiculatum—Australia
Saycia cooki—Australia, New Zealand
Archepleuroxus baylyi n. sp.—Australia
Pleuroxus hastirostris—New Zealand
Pleuroxus jugosus—Australia
Rak obtusus n. sp.—Australia
Rak labrosus n. sp.—Australia
Chydorus clelandi—Australia
Monope reticulata—Australia
Australochydorus aporus n. sp.—Australia
Rhynchochydorus australiensis n.sp.—Australia
Alona clathrata—Australia
Alona laevis—Australia
Alona macracantha—Australia
Alona investis—Australia
Alona setuloides n. sp.—Australia
Acroperus sinuatus—Australia
Camptocercus australis—Australia, New Zealand
Leydigia laevis—Australia
Biapertura kendallensis—Australia

Biapertura longinqua—Australia
Biapertura rigidicaudis—Australia
Biapertura macrocopa—Australia
Biapertura abbreviata—Australia
Biapertura duoodonta—Australia
Biapertura rusticoides n. sp.—Australia (Tasmania)
Monospilus diporus n. sp.—Australia
Monospilus elongatus n. sp.—Australia
Macrothrix breviseta n. sp.—Australia
Macrothrix longiseta—Australia
Macrothrix hystrix—Australia
Echinisca schauinslandi—Australia (Tasmania), New Zealand
Echinisca hardingi—Australia
Echinisca carinata—Australia
Echinisca flagellata n. sp.—Australia
Echinisca pectinata—Australia
Echinisca timmsi—Australia
Echinisca williamsi n. sp.—Australia
Pseudomoina lemnae—Australia, New Zealand
Neothrix armata—Australia, New Zealand
Moina australiensis—Australia, New Zealand
Moina flexuosa—Australia
Daphnia magniceps—Australia
Daphnia angulata—Australia
Daphnia wankeltae—Australia
Daphnia projecta—Australia
Daphnia longicephala—Australia
Daphnia nivalis—Australia
Daphnia jollyi—Australia
Simocephalus victoriensis—Australia
Daphniopsis pusilla—Australia

Endemic subspecies

Alona davidi vermiculata n. ssp.—Australia

Cercopagidae and Leptodoridae, all widespread Holarctic families.

The New Zealand cladoceran fauna has recently been reported on by Chapman and Lewis (1976). They record 37 species to which we add four more: *Alonella brachycopa* Brehm, *Biapertura setigera* (syn. *Alona guttata* var. *setigera* Brehm) (in Brehm, 1931) and *Biapertura longinqua* and *Ceriodaphnia quadrangula* from Dr I.A.E. Bayly's slide collection. This depauperate fauna is expected in view of New Zealand's isolation. Significantly, almost all of the species occur in Australia as well, mostly only in the south of the continent, suggesting that the majority reached New Zealand from southern Australia.

It is of special interest to note the restriction to Australia and New Zealand of a primitive species *Saycia cooki*, the only member of the subfamily Sayciinae in the Chydoridae. It has formed two subspecies, one in each country (Frey, 1971).

The large islands (e.g. Tasmania, Kangaroo I.) adjacent to the southern Australian coast have faunas only slightly less diverse than those in adjacent mainland areas. There are even two endemics (*Biapertura rusticoides*, *Echinisca flagellata*) in Tasmania. The cladoceran fauna of smaller islands such as King and Flinders is unknown, but only three species (*Pleuroxus aduncus*, *Chydorus sphaericus*, and *Macrothrix hirsuticornis*), which are widely distributed throughout the world, have been recorded on Macquarie Island, 1500 km south-east of Tasmania. This low diversity must largely be due to its isolation, but lack of habitat diversity may also be important.

The above facts suggest that faunal composition and speciation of the Australian Cladocera are associated with the separation of Australia from other continents in the course of continental drift some 160 million years ago (Wegener, 1925, 1966; Tarling and Tarling, 1971; Zonenshein and Gorodnitskiy, 1976). Many other Gondwanaland distributions are known for

invertebrates of inland waters, e.g. Diptera (Brundin, 1966) and Plecoptera (Illies, 1965). Curiously, most Gondwana species are not found in all the component continents, but only in some. For the cercopagid copepods the distribution is South America and Australia (Sewell, 1956), and for cladocerans present incomplete data suggest it tends to be South Africa and Australia.

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Appendix 1

List of localities sampled

Code to collectors:

IAEB Dr I.A.E. Bayly, Monash University.
 GB Dr G. Brand, Ministry of Conservation, Victoria.
 DE Dr D. Edward, University of Western Australia.
 MG Dr M. Geddes, Adelaide University.
 VJ Dr V. Jolly, deceased.
 HM Mr H. Midgley, Nambour, Qld.
 GM Mr G. Monteith, University of Queensland.
 DM Mr D. Morton, Monash University.
 AR Dr A. Richardson, University of Tasmania.
 RS Dr R. Shiels, Adelaide University.
 BT author
 KT Mr K. Tonkin, student, Avondale College.
 PT Dr P. Tyler, University of Tasmania.
 KW Dr K. Walker, Adelaide University.
 WDW Prof. W.D. Williams, Adelaide University.

QUEENSLAND

1. L. Bronto, Cape York, 17.iv.73, GM, 10°46'S, 142°34'E.
2. Nordellos Lag., 15 km S Mareeba, 11.vii.74, BT, 17°03'S, 145°09'E.
3. Tinaroo Res., via Atherton, 8.vii.74, BT, 17°10'S, 145°53'E.
4. L. Euramoo, via Atherton, 3.vii.74, BT, 17°10'S, 145°38'E.
5. L. Eacham, via Atherton, 4.vii.74, BT, 17°17'S, 145°38'E.
6. Leslie Ck, via Yungaburra, 7.vii.74, BT, 17°19'S, 145°35'E.
7. Salt L., 160 km N Hughenden, 23.vi.74, BT, 19°57'S, 144°06'E.
8. Agnes L., 160 km N Hughenden, 23.vi.74, BT, 19°57'S, 144°06'E.
9. Louisa L., 160 km N Hughenden, 24.vi.74, BT, 19° 58'S, 144°06'E.
10. Unnamed ck, 22 km E Richmond, 25.vi.74, BT, 20°47'S, 143°29'E.
11. Sw. at Pentland, 25.vi.74, BT, 20°31'S, 145°28'E.
12. L. Powlathanga, 35 km W Charters Towers, 26.vi.74, BT, 20°15'S, 145°58'E.
13. Horseshoe Lag., 95 km NW Charters Towers, 20.vi.74, BT, 20°03'S, 145°29'E.
14. Dry Lag., 90 km NW Charters Towers, 20.vi.74, BT, 20°03'S, 145°30'E.
15. L. Toomba, 85 km NW Charters Towers, 20.vi.74, BT, 20°00'S, 145°35'E.
16. Toomba Sw., 80 km NW Charters Towers, 21.vi.74, BT, 19°58'S, 145°36'E.
17. L. Reeves, 70 km NW Charters Towers, 19.vi.74, BT, 19°53'S, 145°50'E.
18. F.D., Mingela, 47 km E Charters Towers, 15.vii.74, BT, 19°53'S, 146°50'E.
19. Lagoon Cr., 24 km S Townsville, 15.vii.74, BT, 19°30'S, 146°50'E.
20. A lagoon on Townsville Common, 15.vii.74, BT, 19°15'S, 146°44'E.
21. Swamp 5 km W Brandon, 12.viii.73, BT, 19°34'S, 147°19'E.
22. Mulgvia Lag., 2 km E Brandon, 12.viii.73, BT, 19°32'S, 147°24'E.
23. Hutchings, Lag., 2 km W Ayr, 12.viii.73, BT, 19°36'S, 147°23'E.
24. Sheepstation Lag., 5 km W Ayr, 14.vi.74, BT, 19°35'S, 147°20'E.
25. Gladys Lag., 40 km SW Ayr, 18.vi.74, BT, 19°54'S, 147°12'E.
26. Roadside pool at Merinda, nr Bowen, 30.vi.74, BT, 20°01'S, 148°10'E.
27. Goose Lag., North Mackay, 30.vi.74, BT, 20°07'S, 149°12'E.
28. Teewarrina Lag., via Charters Towers, 15.vii.74, BT, 21°01'S, 146°05'E.

29. Cauckingburra Sw., 3 km N L. Buchanan, 16.vii.74, BT, 21°29'S, 145°53'E.
30. L. Buchanan, c. 180 km S Charters Towers, 16.vii.74, BT, 21°35'S, 145°52'E.
31. L. Galilee, c. 90 km NE Aramac, 17.vii.74, BT, 22°22'S, 145°48'E.
32. Pond on Lake Dunn Station, via Aramac, 17.vii.74, BT, 22°29'S, 145°38'E.
33. Swamp on Lake Dunn Station, via Aramac, 17.vii.74, BT, 22°29'S, 145°38'E.
34. L. Dunn, c. 70 km NE Aramac, 17.vii.74, BT, 22°36'S, 145°40'E.
35. Aramac Ck at Aramac, 17.vii.74, BT, 22°58'S, 145°14'E.
36. F.D., Bogantungan, 18.vii.74, BT, 23°39'S, 147°16'E.
37. A billabong 10 km W Anakie, 18.vii.74, BT, 23°36'S, 147°38'E.
38. F.D. at Anakie, 18.vii.74, BT, 23°35'S, 147°45'E.
39. Gracemere Lag., 10 km W Rockhampton, 11.vi.74, BT, 23°26'S, 150°27'E.
40. Woolwash Lag., 8 km S Rockhampton, 11.vi.74, BT, 23°26'S, 150°32'E.
41. Larcom Vale Ck, nr Mt. Larcom, 11.vi.74, BT, 23°48'S, 150°59'E.
42. F.D. 15 km N Gin Gin, 11.vi.74, BT, 24°54'S, 151°50'E.
43. A billabong 30 km S Rolleston, 20.vii.74, BT, 24°41'S, 148°28'E.
44. F.D. near Gayndah, 29.x.64, BT, 25°37'S, 151°43'E.
45. F.D. near Wonga Lower, 29.x.64, BT, 26°04'S, 152°29'E.
46. "AB" Lake, Fraser I., ? IAEB, 25°12'S, 153°13'E.
47. L. Wabby, Fraser I., xii.75, IAEB, 25°28'S, 153°08'E.
48. L. Freshwater, Cooloola, 16.vii.75, BT, 26°00'S, 153°08'E.
49. Swamp at Cooloola, 16.vii.75, BT, 26°07'S, 153°03'E.
50. Upper Tewah Ck, nr Cooloola, 15.vii.75, BT, 26°02'S, 153°00'E.
51. Noosa R., nr Cooloola, 15.vii.75, BT, 26°02'S, 153°00'E.
52. Borumba Dam, 40 km SW Gympie, see Timms and Midgley (1969), 26°31'S, 152°35'E.
53. F.D. nr Kenilworth, 15.v.65, BT, 26°36'S, 152°43'E.
54. Obi Obi Ck, Maleny, 15.v.65, BT, 26°45'S, 152°51'E.
55. Brown L., Stradbroke I., 13.x.59, IAEB, 27°30'S, 153°26'E.
56. University Pond, St. Lucia, Brisbane, see Timms (1967) 27°30'S, 153°00'E.
57. South Pine R., nr Samford, 18.vii.65, BT, 27°21'S, 152°53'E.
58. Cedar Ck, nr Samford, 1.viii.65, BT, 27°20'S, 152°52'E.
59. Pond at Sherwood, Brisbane, 1.v.59, IAEB, 27°31'S, 152°58'E.
60. Pool at Enogerra Res., Brisbane, 1.v.59, IAEB, 27°27'S, 152°55'E.
61. Gold Ck, Res., Brisbane, 1.v.59, IAEB, 27°28'S, 152°53'E.
62. Manchester Res., via Ipswich, 15.viii.59, IAEB, 27°29'S, 152°46'E.
63. Swamp at Helidon,—, IAEB, 27°33'S, 152°08'E.
64. Atkinsons Lag., via Ipswich, 10.vi.59, IAEB, 27°26'S, 152°27'E.
65. F.D. at Wildash, via Warwick, 16.v.65, BT, 28°22'S, 152°03'E.
66. Storm King Dam, via Stanthorpe, 9.xi.64, BT, 28°44'S, 152°00'E.

NEW SOUTH WALES

76. Wilson's Ck Res., via Mullumbimby, 3.i.68, BT, 28°35'S, 153°27'E.
77. Emigrant Ck, 10 km N Ballina, 18.viii.65, BT, 28°48'S, 153°31'E.
78. Dune pond nr Evans Head, 11.ix.77, BT, 29°11'S, 153°22'E.
79. Cooks Lag., via Evans Head, 10.viii.75, BT, 29°12'S, 153°22'E.
80. Swamp, via Brooms Head, 18.viii.77, BT, 29°38'S, 153°19'E.
81. L. Minnie Water, via Grafton, 24.viii.67, BT, 29°50'S, 153°17'E.

82. Swamp near Red Rock Nat. Pk, 25.iii.77, BT, 29°54'S, 153°15'E.
83. Dune Sw., near Red Rock Nat. Pk, 25.iii.77, BT, 29°54'S, 153°15'E.
84. Swamp, Red Rock Nat. Pk, 28.iii.77, BT, 29°58'S, 153°15'E.
85. Blue Lagoon, Red Rock Nat. Pk, 27.iii.77, BT, 29°58'S, 153°15'E.
86. Pond, 20 km W Grafton, 8.i.67, BT, 29°39'S, 152°46'E.
87. Kiel's I.D., 10 km NE Macksville, 24.viii.67, BT, 30°40'S, 152°58'E.
88. Clybucca Sw., 20 km NE Kempsey, 25.viii.67, BT, 30°57'S, 152°57'E.
89. Pond, 4 km W Port Macquarie, 18.viii.65, BT, 31°27'S, 152°54'E.
90. Allens I.D., 6 km E Wauchope, 8.vii.67, BT, 31°28'S, 152°47'E.
91. Mining Pond 3 km N North Haven, 16.iv.74, BT, 31°27'S, 152°50'E.
92. Lansdowne Res., via Taree, 8.viii.67, BT, 31°47'S, 152°32'E.
93. Ellis F.D., 6 km W Stratford, 21.iii.76, BT, 32°07'S, 151°58'E.
94. Myall L., at Shelly Pt, Bungwahl, 9.ix.73, BT, 32°28'S, 152°22'E.
95. Myall R., nr Broadwater, 15.iv.74, BT, 32°32'S, 152°15'E.
96. Eurunderee Lag., Myall Lakes Nat. Pk, see Timms In Prep., 32°32'S, 152°20'E.
97. Swamp, nr Eurunderee Lag., Myall Lakes Nat. Pk, see Timms In Prep., 32°32'S, 152°20'E.
98. Swamp, nr Johnsons Hill, Myall Lakes Nat. Pk, see Timms In Prep., 32°32'S, 152°20'E.
99. Swamp, nr Bombah Pt, Myall Lakes Nat. Pk, see Timms In Prep., 32°32'S, 152°17'E.
100. Swamp, nr Sugar Pt, Myall Lakes Nat. Pk, see Timms In Prep., 32°32'S, 152°16'E.
101. Mining Pond, Myall Lakes Nat. Pk, 24.iii.74, BT, 32°36'S, 152°16'E.
102. Herding Yard Ck, via Amosfield, 14.iv.65, BT, 28°39'S, 152°04'E.
103. Four Mile Ck, via Deepwater, 8.viii.65, BT, 29°23'S, 151°54'E.
104. Beady Waters Res., Glen Innes, 18.viii.67, BT, 29°45'S, 151°47'E.
105. Llangothlin Lagoon via Guyra, 17.viii.67, BT, 30°04'S, 151°46'E.
106. Guyra Water Supply Res., via Guyra 17.viii.67, BT, 30°10'S, 151°43'E.
107. Doughboy Ck, via Ebor, 8.viii.65, BT, 30°19'S, 152°12'E.
108. Gara Dam, via Armidale, 16.viii.67, BT, 30°32'S, 151°48'E.
109. MacDonald R., Bendemeer, 9.viii.65, BT, 30°53'S, 151°10'E.
110. Keepit Res., via Gunnedah, 9.viii.65, BT, 30°54'S, 150°30'E.
111. Manilla Res., at Manilla, 4.viii.67, BT, 32°38'S, 151°36'E.
112. Pond at Tocal, via Paterson, 20.vi.67, BT, 32°38'S, 151°36'E.
113. Maitland Power Station Res., via Maitland, 4.ix.66, BT, 32°45'S, 151°30'E.
114. Kitchener Colliery Res., via Cessnock, 13.viii.67, BT, 32°53'S, 151°23'E.
115. Abernethy Res., via Cessnock, 11.viii.66, BT, 32°53'S, 151°25'E.
116. Ellalong Lag., via Cessnock, 11.ix.66, BT, 32°56'S, 151°18'E.
117. Richmond Main Res., via Kurri Kurri, 11.ix.66, BT, 32°52'S, 151°31'E.
118. Redhead Lag., at Dudley, Newcastle, 16.xi.75, BT, 32°59'S, 151°44'E.
119. F.D. 3 km W Cooranbong, 4.ix.67, BT, 33°03'S, 151°25'E.
120. Pond, 1 km W Cooranbong, 9.ix.67, BT, 33°04'S, 151°27'E.
121. F.D. 8 km W Cooranbong, 4.ix.66, BT, 33°02'S, 151°25'E.
122. Morisset Hospital Res., 2 km S Morisset, 15.viii.67, BT, 33°08'S, 151°29'E.
123. Mardi Res., via Wyong, 27.viii.67, BT, 33°18'S, 151°22'E.
124. Mt. Misery Res., via Liverpool, ?, ?, ?, ?.
125. Picton L., via Thirlmere, 10.v.75, BT, 34°14'S, 150°32'E.
126. Roadside Pond at Dunmore, 15.v.75, BT, 34°37'S, 150°51'E.
127. Pond at Nowra, 15.v.75, BT, 34°53'S, 150°35'E.
128. Lake nr Corunna L., via Narooma, 14.v.75, BT, 36°17'S, 150°08'E.
129. Swamp, at Bega, 14.v.75, BT, 36°41'S, 149°52'E.
130. Pond nr Bondi L., 14.v.75, BT, 36°48'S, 149°58'E.
131. Bondi L., via Bega, 14.v.75, BT, 36°49'S, 149°58'E.
132. Swamp at Pambula, 14.v.75, BT, 36°57'S, 149°53'E.
133. Tarago Lag., 30 km S Goulburn, 10.v.75, BT, 34°54'S, 149°31'E.
134. L. George, via Canberra, 10.v.75, BT, 35°05'S, 149°25'E.
135. Muddah L., 16 km N Cooma, 13.v.75, BT, 36°07'S, 149°02'E.
136. Unnamed lake No. 1, 18 km W Cooma, 12.v.75, BT, 36°15'S, 148°58'E.
137. Island L., 25 km W Cooma, 13.v.75, BT, 36°14'S, 148°56'E.
138. Unnamed lake No. 2, 28 km W Cooma, 13.v.75, BT, 36°15'S, 148°53'E.
139. Unnamed lake No. 3, nr L. Cootralantra, via Cooma, 13.v.75, BT, 36°16'S, 148°53'E.
140. Unnamed lake No. 4, nr L. Cootralantra, via Cooma, 13.v.75, BT, 36°16'S, 148°52'E.
141. Unnamed lake No. 5, nr L. Cootralantra, via Cooma, 13.v.75, BT, 36°17'S, 148°53'E.
142. Sandy Ck, 15 km N Berridale, 13.v.75, BT, 36°17'S, 148°48'E.
143. Hugundara Lag., 16 km N Berridale, 13.v.75, BT, 36°17'S, 148°47'E.
144. Kiah L., 10 km NW Berridale, 13.v.75, BT, 36°20'S, 148°47'E.
145. L. Bullenbalong, 22 km NW Berridale, 13.v.75, BT, 36°19'S, 148°42'E.
146. Blue L., Mt Kosciusko, 24.ii.69, IAEB, 36°24'S, 148°19'E.
147. L. Albina, Mt Kosciusko, 8.ii.77, BT, 36°26'S, 148°16'E.
148. Pond nr L. Albina, Mt Kosciusko, 8.ii.77, BT, 36°26'S, 148°16'E.
149. Unnamed lagoon 6, 12 km S Cooma, 14.v.75, BT, 36°19'S, 149°06'E.
150. Unnamed pond 7, 17 km S Cooma, 14.v.75, BT, 36°20'S, 149°04'E.
151. L. Arable, 20 km S Cooma, 14.v.75, BT, 36°20'S, 149°02'E.
152. Unnamed lake 8, 22 km SW Cooma, 14.v.75, BT, 36°20'S, 149°01'E.
153. Unnamed lake 9, 30 km SW Cooma, 14.v.75, BT, 36°20'S, 148°59'E.
154. Unnamed pond 10, 10 km E Berridale, 14.v.75, BT, 36°22'S, 148°58'E.
155. Carrolls Lake, 10 km E Berridale 14.v.75, BT, 36°22'S, 148°56'E.
156. Unnamed pond 11, nr Wullwey Ck, 14.v.75, BT, 36°23'S, 148°54'E.
157. Buckley's Lag., 16 km SE Berridale, 14.v.75, BT, 36°27'S, 148°58'E.
158. Maffra L., 18 km E Dalgety, 14.v.75, BT, 36°32'S, 149°00'E.
159. Unnamed pond 12, 19 km E Dalgety, 14.v.75, BT, 36°32'S, 149°00'E.
160. Unnamed lake 13, at Bungarby, 14.v.75, BT, 36°40'S, 149°02'E.
161. Barkers L., near Bungarby, 14.v.75, BT, 36°42'S, 149°02'E.
162. Boundary L., 18 km W Nimmitabel, 15.v.75, BT, 36°32'S, 149°08'E.
163. Wyuna L., 11 km W Nimmitabel, 15.v.75, BT, 36°30'S, 149°11'E.
164. Unnamed L. 14, 21 km N Bombala, 15.v.75, BT, 36°43'S, 149°16'E.
165. Black L., 5 km SE Bibbenluke, 15.v.75, BT, 36°50'S, 149°18'E.
166. Green L., 6 km SE Bibbenluke, 15.v.75, BT, 36°50'S, 149°18'E.
167. Unnamed swamp 15, 4 km S Cathcart, 15.v.75, BT, 36°53'S, 149°25'E.
168. Unnamed lake 16, 1 km N Cathcart, 15.v.75, BT, 36°52'S, 149°25'E.
169. F.D. 2 km W Lightning Ridge, 22.vii.74, BT, 29°26'S, 147°59'E.
170. Narran L., via Brewarrina, 22.vii.74, BT, 29°52'S, 147°19'E.

171. Castlereagh R. at Coonabarabran, 10.viii.65, BT, 31°16'S, 149°17'E.
172. Ulan Power Station Res., via Ulan, 14.xii.73, BT, 32°17'S, 149°45'E.
173. F.D. 12 km NE Mudgee, 14.xii.73, BT, 32°31'S, 149°41'E.
174. F.D. 30 km NE Gulgong, 13.xii.73, BT, 32°23'S, 149°14'E.
175. Coan Waterhole, Trangie, 13.xii.73, BT, 32°02'S, 147°59'E.
176. Nyngan Res., at Nyngan, 13.xii.73, BT, 31°35'S, 147°11'E.
177. Unnamed swamp, 35 km E Cobar, 12.xii.73, BT, 31°31'S, 146°13'E.
178. Old Cobar Res., at Cobar, 12.xii.73, BT, 31°29'S, 145°52'E.
179. Bulla Bulla Tank, 100 km W Cobar, 12.xii.73, BT, 31°34'S, 144°38'E.
180. Unnamed swamp, 70 km E Wilcannia, 12.xii.73, BT, 31°43'S, 144°02'E.
181. Darling R. Wilcannia, 12.xii.73, BT, 31°34'S, 143°22'E.
182. Irrigation Canal at Copi Hollow, Mendindee, 11.xii.73, BT, 32°16'S, 142°23'E.
183. Umberumberka Res., via Broken Hill, 10.xii.73, BT, 31°50'S, 141°13'E.
184. L. Albert, Wagga Wagga, 29.xi.73, BT, 35°10'S, 147°23'E.
185. Rice paddy, 8 km E Yanco, 17.xii.75, BT, 34°40'S, 146°29'E.
186. Unnamed billabong, 7 km S Yanco, 17.xii.75, BT, 34°38'S, 146°22'E.
187. L. Yanga, via Balranald, 17.xii.75, BT, 34°43'S, 143°36'E.
188. L. Cowndilla, Menindee Lakes, 22.v.78, RS, 32°28'S, 142°15'E.
232. Goulburn R. near Alexandra, see Shiel 1976, RS, 37°13'S, 145°42'E.
233. Alexandra, see Shiel 1976, RS, 37°13'S, 145°42'E.
234. L. Culluleraie, via Mildura, 18.xii.75, BT, 34°16'S, 141°35'E.
- 234a. L. Culluleraie, via Mildura, 8.ix.78, RS, 34°16'S, 141°45'E.
235. L. Hawthorn via Mildura, 10.xii.73, BT, 34°12'S, 142°06'E.
236. L. Boga, at L. Boga township, 9.xii.73, BT, 35°28'S, 143°39'E.
237. L. Charm via Kerang, 9.xii.73, BT, 35°37'S, 143°51'E.
238. L. Boort at Boort, 9.xii.73, BT, 36°08'S, 143°44'E.
239. Teddington Res., via St. Arnaud, 9.xii.73, BT, 36°50'S, 143°16'E.
240. Pond near Kaniva, 23.vi.74, DM, 36°37'S, 141°16'E.
241. Roadside pond near Horsham, 24.v.74, DM, 36°50'S, 142°24'E.
242. Taylors L., via Horsham, no date given, IAEB, 36°50'S, 142°23'E.
243. Beaufort Res., at Beaufort, 9.xii.73, BT, 37°27'S, 143°24'E.
244. Pool nr L. Goldsmith, 9.xii.73, BT, 37°32'S, 143°24'E.
245. F.D., Monmot, 9.xii.73, BT, 37°39'S, 143°23'E.
246. Missens F.D., via Beeac, 25.i.76, BT, 38°10'S, 143°39'E.
247. L. Coragulac, via Colac, 25.i.76, BT, 38°15'S, 143°31'E.
248. West Twin L., via Colac, 26.i.76, BT, 38°15'S, 143°30'E.
249. L. Purrumbete, via Camperdown, see Timms 1973b, BT, 38°17'S, 143°14'E.
250. Pond nr L. Gnotuk, via Camperdown, 26.i.76, BT, 38°13'S, 143°06'E.
251. L. Elingamite, via Cobden, 26.i.76, BT, 38°21'S, 143°01'E.
252. Cobrico Sw., via Cobden, 26.i.76, BT, 38°20'S, 143°01'E.
253. L. Mumblin, via Terang, 14.xi.71, BT, 38°20'S, 142°55'E.
254. Tower Hill L., via Warrnambool, ii.68, GB, 38°20'S, 142°23'E.
255. L. Surprise, via Macarthur, 28.ii.72, BT, 38°04'S, 141°55'E.
256. Bridgewater L., via Portland, 18.viii.72, BT, 38°19'S, 141°24'E.
257. Swan L., via Portland, 17.viii.72, BT, 38°13'S, 141°19'E.
258. "Pine Forest Lag." via Nelson, 11.viii.72, BT, 38°08'S, 141°13'E.
259. Cains Hut S.W., via Nelson, 11.viii.72, BT, 38°08'S, 141°13'E.
260. Sheepwash Lag., via Nelson, 11.viii.72, BT, 38°08'S, 141°13'E.
261. Temporary pond, 7 km W Edenhope, 19.x.78, DM, 37°01'S, 141°13'E.
262. L. Mulwala, via Yarrowonga, 20.v.77, RS, 36°01'S, 146°00'E.
- VICTORIA
201. L. Barracoota, via Mallacoota, see Timms 1973a, BT, 37°32'S, 149°53'E.
202. L. Elusive, via Cann R. Township, see Timms 1973a, BT, 37°45'S, 149°28'E.
203. L. Beadle, via Orbost, see Timms 1973a, BT, 37°46'S, 148°26'E.
204. Roadside pool, 8 km S Buchan, 18.vii.73, DM, 37°37'S, 148°08'E.
205. Roadside pool, 9 km N Sale, 19.vii.73, DM, 38°01'S, 147°03'E.
206. Pool, Gifford West, via Sale, 22.viii.61, VJ, 38°23'S, 146°58'E.
207. L. Omeo, via Omeo 1.xi.70, BT, 36°58'S, 147°41'E.
208. Roadside pool nr Yarram, 9.v.74, DM, 38°36'S, 146°40'E.
209. Pond, nr Traralgon, 17.vii.73, DM, 38°11'S, 146°45'E.
210. Pond, nr Cape Liptrap, 8.ix.74, DM, 38°53'S, 145°58'E.
211. F.D. nr Cape Liptrap, 8.ix.74, DM, 38°54'S, 145°58'E.
212. F.D. nr Tarwin, 9.v.74, DM, 38°37'S, 145°57'E.
213. Pond, nr Bunyip R, 8.viii.73, DM, 38°16'S, 145°29'E.
214. Roadside pool, Tooradin, 26.vi.73, DM, 38°13'S, 145°22'E.
215. Roadside pool, Cranbourne, 24.v.73, DM, 38°06'S, 145°17'E.
216. Pond, nr Cardinia, 27.vi.73, DM, 38°07'S, 145°24'E.
217. F.D. nr Cardinia, 27.vi.73, DM, 38°08'S, 145°25'E.
218. Belgrave Reservoir, 11.x.62, WDW, 37°55'S, 145°21'E.
219. Pool Monash University, Clayton, DM, 37°54'S, 145°08'E.
220. Swamp, Churchill Nat. Pk, via Dandenong, 24.vi.66, IAEB, 37°57'S, 145°E.
221. Pond, Churchill Nat. Pk, via Dandenong, 24.vi.66, IAEB, 37°57'S, 145°16'E.
222. Above Masons Falls, Kinglake Nat. Pk, 23.vii.73, IAEB, 37°34'S, 145°22'E.
223. Pond at Glenburn, 31.viii.73, DM, 37°26'S, 147°27'E.
224. Johnsons Sw., Wodonga, 11.viii.76, RS, 36°07'S, 147°00'E.
225. Snowdons Lag. Wodonga, 11.viii.76, RS, 36°07'S, 147°00'E.
226. L. Kerferd, via Beechworth, 30.xi.73, BT, 36°22'S, 146°44'E.
227. L. Catani, Mt. Buffalo, 2.xii.73, BT, 36°44'S, 146°49'E.
228. L. Eildon, via Alexandra, 18.ii.76, RS, 37°14'S, 145°56'E.
229. Unnamed lag. via Seymour, 2.xii.73, BT, 36°59'S, 145°08'E.
230. Unnamed lag. via Yea, 2.xii.73, BT, 37°13'S, 145°25'E.
231. Goulburn Bb, via Alexandra, see Shiel 1976, RS, 37°13'S, 145°42'E.
291. Pond 12 km E Marrawah, 18.viii.74, DM, 40°15'S, 144°84'E.
292. Pond nr Smithton, 17.viii.74, DM, 40°51'S, 145°08'E.
293. Pond nr Parrawe, 18.viii.74, DM, 41°18'S, 145°34'E.
294. Unnamed Res. at Waratah 19.viii.74, DM, 41°27'S, 145°33'E.
295. F.D. 5 km W Ulverstone, 17.viii.74, DM, 41°08'S, 146°07'E.
296. Pool nr Devonport Airport, 27.viii.74, DM, 41°11'S, 146°26'E.
297. Swamp at Hawley Beach, 27.viii.74, DM, 41°09'S, 146°32'E.
298. Pool 2 km N Westbury 27.viii.74, DM, 41°31'S, 146°51'E.
299. Roadside pool, 13 km E Bridport, 26.viii.74, DM, 41°00'S, 147°23'E.
300. Swamp nr Big Waterhouse L., 26.viii.74, DM, 40°53'S, 147°37'E.
301. Big Waterhouse L., 26.viii.74, DM, 40°53'S, 147°37'E.
302. F.D. 7 km N Scotsdale, 26.viii.74, DM, 41°08'S, 146°14'E.
303. Unnamed L. 1 km E Derby 26.viii.74, DM, 41°09'S, 147°48'E.
304. Perched L., Gordon R., 25.i.76, AR, 42°30'S, 145°40'E.
305. Pond, 10 km E Derwent Bridge, 20.viii.74, DM, 42°08'S, 146°14'E.
306. Bronte Lag., 20.viii.74, DM, 42°12'S, 146°29'E.
307. Pond nr L. Echo, 20.viii.74, DM, 42°14'S, 146°37'E.
308. L. Echo, 20.viii.74, DM, 42°10'S, 146°37'E.
309. Unnamed L. west side of Great L., 24.viii.74, DM, 41°55'S, 146°40'E.
310. Great L., 24.viii.74, DM, 41°53'S, 146°45'E.
311. Pond nr Steppes, 23.viii.74, DM, 42°06'S, 146°53'E.
- TASMANIA

312. Lagoon of Islands, 22.viii.74, DM, 46°06'S, 146°57'E.
 313. L. Sorrell, 9.v.76, BT, 42°07'S, 147°10'E.
 314. Hazelwoods Lag., 9.v.76, BT, 42°10'S, 147°08'E.
 315. Lake Crescent, 9.v.76, BT, 42°11'S, 147°10'E.
 316. F.D. 9 km N Cleveland, 24.viii.74, DM, 41°45'S, 147°20'E.
 317. Cleveland Lag., 25.viii.74, DM, 41°48'S, 147°24'E.
 318. F.D. 3 km S Conara Junction, 25.viii.74, DM, 41°51'S, 147°28'E.
 319. Unnamed Lag. nr Campbell Town, 9.v.76, BT, 41°55'S, 147°29'E.
 320. Reedy Lag., via Ross 9.v.76, BT, 42°63'S, 147°21'E.
 321. Pump Lag., via Ross, 9.v.76, BT, 42°05'S, 147°21'E.
 322. Bells Lag., via Ross, 9.v.76, BT, 42°06'S, 147°21'E.
 323. Pond 5 km ESE Ross, 25.viii.74, DM, 42°03'S, 147°30'E.
 324. F.D. 22 km E L. Leake, 25.viii.74, DM, 42°08'S, 148°00'E.
 325. L. Leake, via Campbell Town, 25.viii.75, DM, 42°01'S, 147°49'E.
 326. Whites Lag., via Tunbridge, 12.x.72, BT, 42°06'S, 147°26'E.
 327. Pool on Kitty R., via Oatlands, 9.v.76, BT, 42°15'S, 147°32'E.
 328. Winspears Lag., via Oatlands, 9.v.76, BT, 42°17'S, 147°39'E.
 329. Johnnys Lag., via Oatlands, 9.v.76, BT, 42°18'S, 147°38'E.
 330. Ashgrove Lag., via Oatlands, 9.v.76, BT, 42°20'S, 147°30'E.
 331. Pond 1 km N Tunbridge, 22.viii.74, DM, 42°08'S, 147°25'E.
 332. Weedling's Lag., via Oatlands, 9.v.76, BT, 42°17'S, 147°22'E.
 333. L. Dulverton, at Oatlands, 9.v.76, BT, 42°17'S, 147°21'E.
 334. L. Tiberas, via Oatlands, 22.viii.74, DM, 42°26'S, 147°22'E.
 335. Pond nr Moulting Lag., via Swansea, 25.viii.74, DM, 41°59'S, 148°14'E.
 336. F.D., 14 km E Sorell, 22.viii.74, DM, 41°49'S, 147°41'E.
 337. F.D. 2 km N Richmond, 23.viii.74, DM, 42°44'S, 147°28'E.
 338. Pond, 3 km NE Longley, 22.viii.74, DM, 42°57'S, 147°12'E.
 339. Various lakes, Macquarie I. xi.76, PT, 54°45'S, 158°35'E.

SOUTH AUSTRALIA

351. Pool, Hamilton Homestead, 3.x.75, KW, 26°43'S, 135°04'E.
 352. Bubbler Mound Spring, 30.ix.75, KW 28°18'S, 135°33'E.
 353. L. Eyre, 27.ix.74, IAEB, 28°30'S, 137°15'E.
 354. Pool in Frome R. at Mulroorina Station, ix.74, IAEB, 29°15'S, 137°55'E.
 355. Aroona Res. via Copley, ix.74, IAEB, 30°35'S, 138°22'E.
 356. Quorn Railway Dam, 18.i.76, BT, 32°31'S, 138°02'E.
 357. Pekina Ck at Orrooroo, 16.i.76, BT, 32°43'S, 138°37'E.
 358. Yongala Res., via Jamestown, 16.i.76, BT, 33°08'S, 138°45'E.
 359. Bundaleer Res., via Spalding, 18.i.76, BT, 33°28'S, 138°33'E.
 360. Porter's Lag., via Burra, 16.i.76, BT, 33°50'S, 138°53'E.
 361. Pond nr Black Springs, ix.74, IAEB, 33°54'S, 138°54'E.
 362. Torrens R., Gumeracha, 2.vii.76, RS, 34°50'S, 138°51'E.
 363. Sewage Pond, Gumeracha, 2.vii.76, RS, 34°50'S, 138°51'E.
 364. Torrens Gorge Weir, 21.vii.76, RS, 34°52'S, 138°45'E.
 365. Torrens R., Adelaide, 14.i.76, BT, 34°55'S, 138°37'E.
 366. Cock's F.D., Ashton, 14.i.76, BT, 34°56'S, 138°44'E.
 367. Pool nr Reynella, 6.i.76, BT, 35°06'S, 138°33'E.
 368. F.D., Lower Inman Valley, 6.i.76, BT, 35°30'S, 138°32'E.
 369. Rocky R., Kangaroo I., 9.i.76, BT, 35°56'S, 136°44'E.
 370. Stunsail Boom R., Kangaroo I., 9.i.76, BT, 35°59'S, 137°00'E.
 371. F.D. Harriet R., Kangaroo I., 9.i.76, BT, 36°00'S, 137°09'E.
 372. Edward's Lag., Kangaroo I., 8.i.76, BT, 35°49'S, 137°01'E.
 373. F.D. 5 km W Parndana, Kangaroo I., 8.i.76, BT, 35°48'S, 137°14'E.
 374. F.D. nr Agricultural Research Station, Kangaroo I., 9.i.76, BT, 35°48'S, 137°31'E.
 375. Unnamed lagoon N of Eleanor R., Kangaroo I., 11.i.76, BT, 35°57'S, 137°15'E.
 376. Eleanor R., Kangaroo I., 11.i.76, BT, 35°57'S, 137°15'E.
 377. L. Ada, Kangaroo I., 9.i.76, BT, 35°55'S, 137°22'E.
 378. F.D. nr Tea Tree Lag., Kangaroo I., 9.i.76, BT, 35°53'S, 137°33'E.
 379. Billabong at "Yarrabee", Kangaroo I., 9.i.76, BT, 35°44'S, 137°31'E.
 380. Lagoon on Cygnet R., floodplain, Kangaroo I., 9.i.76, BT, 35°43'S, 137°29'E.
 381. Pond, 8 km W Kingscote, Kangaroo I., 9.i.76, BT, 35°38'S, 137°30'E.
 382. Currency Ck, via Goolwa, 6.i.76, BT, 35°27'S, 138°45'E.
 383. F.D., Wistow, via Mt Barker, 6.i.76, BT, 35°07'S, 138°53'E.
 384. L. Bonney at Barmera, 18.xii.75, BT, 34°15'S, 140°28'E.
 385. Murray R., Teal Flat, 29.vi.76, RS, 34°52'S, 139°32'E.
 386. Murray R., Greenway's Landing, 9.viii.76, RS, 34°40'S, 139°35'E.
 387. Murray R., Tailern Bend, 29.vi.76, RS, 35°15'S, 139°28'E.
 388. L. Leake, via Mt Gambier, 13.viii.72, BT, 37°37'S, 140°35'E.
 389. L. Edward, via Mt Gambier, 14.viii.72, BT, 37°38'S, 140°36'E.
 390. Browne L., Mt Gambier, 21.i.76, BT, 37°51'S, 140°46'E.
 391. Valley L., Mt Gambier, 15.viii.72, BT, 37°51'S, 140°46'E.
 392. Leg of Mutton L., Mt Gambier 21.i.76, BT, 37°51'S, 140°46'E.
 393. L. Alexandrina, via Goolwa, 7.vi.76, MG, 35°26'S, 139°10'E.
 394. Murray R., Mannum, 28.xii.77, RS, 34°55'S, 139°19'E.

WESTERN AUSTRALIA

401. Hamelin Homestead Pool, via Shark Bay, 20.viii.73, IAEB, 26°26'S, 114°11'E.
 402. Salt pool, 43 km W Hamelin Homestead, 21.viii.73, IAEB, 26°37'S, 113°50'E.
 403. Ponds N of Geraldton, 22.viii.73, IAEB, c. 27°30'S, 114°40'E.
 404. Ponds S of Geraldton, 19.viii.73, IAEB, c. 28°55'S, 114°40'E.
 405. L. Jindalup, via Perth, 11.viii.76, KT, 31°45'S, 115°47'E.
 406. L. Gnaranga, via Perth, 11.viii.76, KT, 31°47'S, 115°52'E.
 407. L. Coollelal, via Perth, 11.viii.76, KT, 31°49'S, 115°49'E.
 408. Swamp E of Airport, Rottne I., 11.viii.73, IAEB, 32°01'S, 115°32'E.
 409. Temporary pool, Rottne I., 11.viii.73, IAEB, 32°01'S, 115°30'E.
 410. Pond at Gosnells, Perth, 5.ix.60, DE, 32°05'S, 116°00'E.
 411. Pond at Kelmescott, Perth, 5.ix.60, DE, 32°07'S, 116°01'E.
 412. Temporary pool, nr Forrestdale, 17.viii.73, IAEB, 32°10'S, 115°57'E.
 413. L. Coolongyp, via Kwinana, 17.viii.73, IAEB, 32°18'S, 115°47'E.
 414. Temporary swamp nr L. Walyungup, 17.viii.73, IAEB, 32°19'S, 115°47'E.
 415. Temporary pond nr Dandalup, 17.viii.73, IAEB, 32°34'S, 115°57'E.
 416. Temporary pond nr Yunderup, 17.viii.73, IAEB, 32°34'S, 115°47'E.
 417. Granite rock pool on Sullivan Rock, 8.vi.77, IAEB, 32°25'S, 116°18'E.
 418. Swamp nr C. Leeuwin, 8.vii.76, KT, 34°22'S, 115°09'E.
 419. Lefroy Brook weir, via Pemberton, 19.vi.77, IAEB, 34°27'S, 116°01'E.
 420. Granite rock pool on Muirillup Rock via Northcliffe, 18.vi.77, IAEB, 34°32'S, 116°03'E.
 421. Pond 6 km S Northcliffe, 17.vi.76, IAEB, 34°41'S, 116°07'E.
 422. Swamp nr Shannon, 8.vii.76, KT, 34°35'S, 116°25'E.
 423. Granite rock pool, Tutanning Reserve nr Pingelly, 24.vi.77, IAEB, 32°33'S, 117°18'E.
 424. Bolganup Dam, via Mt Barker, 24.v.77, IAEB, 24°40'S, 117°52'E.
 425. L. Gardiner, via Albany 9.vii.76, KT, 34°58'S, 118°11'E.
 426. Roadside pool, 11 km S Northcliffe, 2.vii.77, IAEB, 34°44'S, 116°05'E.
 427. Humified roadside pond, Albany, 3.vii.77, IAEB, 35°01'S, 117°53'E.

NORTHERN TERRITORY

451. Anthony Lag. vii.75, HM, 17°59'S, 135°33'E.
 452. Waterhole at Glen Helen, 160 km W Alice Springs, 28.ix.62, WDW 23°23'S, 132°13'E.
 453. Wrigleys Waterhole, 11 km N Alice Springs, 26.ix.62, WDW, 23°37'S, 133°52'E.
 454. Rock pool at Simpsons Gap, 18 km W Alice Springs, 25.ix.62, WDW, 28°43'S, 133°43'E.

Appendix 2

List of new taxa (including those recently described elsewhere)

Genera nova

Archepleuroxus, *Australochydorus*, *Monope* (Smirnov, 1977),
Rak, *Rhynchochydorus*.

Species novae

Alona macracantha, *Alona setuloides*, *Archepleuroxus baylyi*, *Australochydorus aporus*, *Biapertura rusticoides*, *Echinisca carinata* (Smirnov, 1976), *Echinisca flagellata*, *Echinisca pectinata* (Smirnov, 1976), *Echinisca timmsi* (Smirnov, 1976), *Echinisca williamsi*, *Macrothrix breviseta* (Smirnov, 1976), *Macrothrix longiseta* (Smirnov, 1976), *Monope reticulata*, *Monospilus diporus*, *Monospilus elongatus*, *Pseudosida australiensis*, *Rak labrosus*, *Rak obtusus*, *Rhynchochydorus australiensis*, *Simocephalus victoriensis*.

Subspecies nova

Alona davidi vermiculata.

Mas novus

Pleuroxus jugosus.

New combinations

Biapertura abbreviata (syn. *Alona abbreviata* Sars, 1896), *Biapertura duodonta* (syn. *Alonella duodonta* Henry, 1922), *Biapertura macrocopa* (syn. *Alona macrocopa* Sars, 1895), *Biapertura setigera* (syn. *Alona guttata* var. *setigera* Brehm, 1931), *Monope reticulata* (syn. *Monoporus henryae* Smirnov, 1977), *Pleuroxus jugosus* (syn. *Chydorus jugosus* Henry, 1922), *Simocephalus vetulus gibbosus* (syn. *Simocephalus gibbosus* Sars, 1896), *Simocephalus exspinosus australiensis* (syn. *Simocephalus australiensis* Dana, 1852).

Synonymy

Acroperus avirostrus (= *A. neglectus* Lilljeborg, 1900), *Alona longirostris* (= *Biapertura affinis* [Leydig, 1860]), *Alona microtata* (= *A. guttata* Sars, 1862), *Alona wallaciana* (= *Oxyurella tenuicaudis* [Sars, 1862]), *Alonella nasuta* (= *Pleuroxus aduncus* [Jurine, 1820]), *Bosmina brevirostris* (= *B. meridionalis* Sars, 1904), *Bosmina rotunda* (= *B. meridionalis* Sars, 1904), *Bosmina sorelli* (= *B. meridionalis* Sars, 1904), *Ceriodaphnia planifrons* (= *C. quadrangula* [O. F. Müller, 1785]), *Ceriodaphnia spinata* (= *C. quadrangula* [O. F. Müller, 1785]), *Chydorus unispinus* (= *Pleuroxus aduncus* [Jurine, 1820]), *Macrothrix burstalis* (= *E. schauinslandi* [Sars, 1904]), *Simocephalus dulvertonensis* (= *S. vetulus elisabethae* [King, 1853]).

Appendix 3

List of species indicated for Australia for the first time in the course of the present study (some indications have already been published; they are referenced)

SIDIDAE

Pseudosida australiensis n.sp.

CHYDORIDAE

Archepleuroxus baylyi n. sp., *Pleuroxus denticulatus* (Smirnov, 1971), *Pleuroxus inermis*, *Alonella excisa*, *Alonella exigua*, *Rak labrosus* n. sp., *Rak obtusus* n. sp., *Chydorus barroisi* (Smirnov, 1971; Timms, 1967, 1968, 1972), *Chydorus hybridus*, *Dadaya macrops* (Smirnov, 1966, 1971), *Australochydorus aporus* n. sp., *Rhynchochydorus australiensis* n. sp., *Alona inreticulata*, *Alona macracantha* n. sp., *Alona poppei*, *Alona setuloides* n. sp., *Acroperus harpae*, *Acroperus alonoides* (Smirnov, 1971), *Kurzia latissima*, *Kurzia longirostris* (Timms, 1972), *Leydigia acanthocercoides* (Smirnov, 1971), *Leydigia ciliata* (Smirnov, 1971), *Leydigia leydigi*, *Biapertura intermedia*, *Biapertura longinqua* (Smirnov, 1971), *Biapertura rigidicaudis* (Smirnov,

1971), *Biapertura rusticoides* n. sp., *Biapertura setigera*, *Monospilus diporus* n. sp., *Monospilus elongatus* n. sp., *Oxyurella singalensis*, *Oxyurella tenuicaudis*, *Euryalona orientalis*.

MACROTHRICIDAE

Ilyocryptus brevidentatus, *Macrothrix breviseta* (Smirnov, 1976), *Macrothrix longiseta* (Smirnov, 1976), *Echinisca carinata* (Smirnov, 1976), *Echinisca flagellata* n. sp., *Echinisca pectinata* (Smirnov, 1976), *Echinisca rosea*, *Echinisca timmsi* (Smirnov, 1976), *Echinisca williamsi* n. sp., *Streblocerus serricaudatus*.

MOINIDAE

Moina mongolica (Bayly, 1976).

DAPHNIIDAE

Simocephalus latirostris, *Simocephalus victoriensis* n. sp.

Appendix 4

List of species common in Australian inland waters (i.e. occurred in many samples, and often as many individuals)

SIDIDAE

Latonopsis australis, *Diaphanosoma excisum*, *Diaphanosoma unguiculatum*

CHYDORIDAE

Pleuroxus aduncus, *Pleuroxus denticulatus*, *Alonella clathratula*, *Chydorus barroisi*, *Chydorus eurynotus*, *Chydorus sphaericus*, *Dunhevedia crassa*, *Pseudochydorus globosus*, *Alona cambouei*, *Alona costata*, *Alona davidi*, *Alona costata*, *Alona rectangula* s.l., *Alona pulchella*, *Graptoleberis testudinaria*, *Camptocercus australis*, *Biapertura affinis*, *Biapertura karua*, *Biapertura kendallensis*, *Biapertura rigidicaudis*, *Biapertura setigera*.

MACROTHRICIDAE

Ilyocryptus spinifer, *Macrothrix spinosa*.

MOINIDAE

Moina micrura.

BOSMINIDAE

Bosmina meridionalis.

DAPHNIIDAE

Daphnia carinata, *Daphnia cephalata*, *Daphnia lumholtzi*, *Simocephalus vetulus* s.l., *Simocephalus exspinosus*, *Ceriodaphnia quadrangula*, *Ceriodaphnia cornuta*.

Appendix 5

List of species rare in Australian inland waters (i.e. only found in a few samples or valid species only once reported in the literature)

SIDIDAE

Latonopsis brehmi, *Pseudosida australiensis*.

CHYDORIDAE

Saycia cooki, *Pleuroxus inermis*, *Alonella exigua*, *Chydorus herrmanni*, *Rak labrosus*, *Rak obtusus*, *Australochydorus aporus*, *Monope reticulata*, *Rhynchochydorus australiensis*, *Alona archeri*, *Alona clathratula*, *Alona inreticulata*, *Alona*

macracantha, *Alona poppei*, *Alona quadrangularis*, *Acroperus alonoides*, *Acroperus negectus*, *Acroperus harpae*, *Kurzia longirostris*, *Leydigia acanthocercoides*, *Leydigia laevis*, *Leydigia leydigi*, *Biapertura abbreviata*, *Biapertura duodonta*, *Biapertura intermedia*, *Biapertura longinqua*, *Biapertura rusticoides*, *Monospilus aporus*, *Monospilus elongatus*, *Oxyurella singalensis*, *Oxyurella tenuicaudis*, *Euryalona orientalis*.

MACROTHRICIDAE

Ilyocryptus brevidentatus, *Macrothrix breviseta*, *Macrothrix hirsuticornis*, *Macrothrix hystrix*, *Macrothrix longiseta*, *Echinisca burstalis*, *Echinisca flagellata*, *Echinisca hardingi*,

Echinisca pectinata, *Echinisca rosea*, *Echinisca timmsi*, *Echinisca williamsi*, *Pseudomoina lemnae*, *Streblocerus serricaudatus*.

MOINIDAE

Moina australiensis, *Moina flexuosa*, *Moina mongolica*, *Moina tenuicornis*.

BOSMINIDAE

Bosminopsis deitersi.

DAPHNIIDAE

Daphnia angulata, *Daphnia jollyi*, *Simocephalus victoriensis*, *Ceriodaphnia laticaudata*, *Ceriodaphnia rotunda*.

References

- Akatova, N.A., 1964. Occurrence of *Daphniopsis studeri* Rühle (Cladocera) in a lake of "oasis" Westfal (East Antarctica). In 'Isseledovaniya fauny morey', 1, IX: 185-8 (In Russian).
- Arnott, G.H. 1974. Studies on the zooplankton of Port Phillip Bay and adjacent waters with special reference to Copepoda. Ph.D. Thesis, Monash University, Melbourne.
- Baird, W., 1843. The natural history of the British Entomostraca VI. Annals and Magazine of Natural History 11: 81-95.
- 1845. Arrangement of the British Entomostraca. History of the Berwickshire Naturalists' club, 1845: 145-158.
- 1850. The natural history of the British Entomostraca. Royal Society, London. 364 pp.
- Ball, E., & J. Gluckman, 1978. Limnological studies of Lake Wisdom, a large New Guinea caldera lake with a simple fauna. Freshwater Biology 8:455-468.
- Bayly, I.A.E., 1964. Chemical and biological studies on some acidic lakes of east Australian sandy coastal lowlands. Australian Journal of Marine and Freshwater Research 15:56-72.
- 1967. The general biological classification of aquatic environments with special reference to those in Australia. In 'Australian Inland Waters and their Fauna: Eleven Studies' (ed. A.H. Weatherley), A.N.U. Press, Canberra.
- 1970. Further studies on some saline lakes of South-East Australia. Australian Journal of Marine and Freshwater Research 21: 117-124.
- 1976. The plankton of Lake Eyre. Australian Journal of Marine and Freshwater Research 27: 661-665.
- & D.H. Edward, 1969. *Daphniopsis pusilla* Serventy: a salt-tolerant cladoceran from Australia. Australian Journal of Science 32: 21-22.
- Bayly, I.A.E., & W.D. Williams, 1973. Inland waters and their ecology. Longman, Melbourne.
- Beadle, L.C., 1943. An ecological survey of some inland saline waters of Algeria. Journal of the Linnean Society, Zoology 41: 218-242.
- Behning, A.L., 1927. Ueber *Penilia schmackeri* aus dem Schwarzen Meer. In 'Collected papers dedicated to N.M. Knipovich'. Moscow. pp 345-350.
- 1941. Cladocera of the Caucasus. Tbilisii. (In Russian.)
- Berg, L.S., 1947. Climate and life. Moscow. (In Russian.)
- Bergamin, F., 1939. Os Cladocera. Revista de Industria Animal, Sao Paulo 2(3): 62-68, 2(4): 87-92.
- Birabén, M., 1939. Los Cladoceros de la familia "Chydoridae". Physis, Buenos Aires 17: 651-671.
- Birge, E.A., 1879. Notes on Cladocera. Transactions of the Wisconsin Academy of Science, Arts and Letters IV: 77-109.
- Brady, G.S., 1886. Notes on Entomostraca collected by Mr A. Haly in Ceylon. Journal of the Linnean Society, Zoology 19: 293-317.
- Brehm, V., 1931. Cladoceran aus Neuseeland. Archiv für Hydrobiologie 23: 491-501.
- 1933. Die Cladoceren der Deutschen limnologischen Sunda-Expedition. Archiv für Hydrobiologie, Suppl. XI: 631-771.
- 1942. Ueber *Simocephalus dulverttonensis* Smith. Zoologischer Anzeiger 140: 59-60.
- 1948. Datos para la fauna de agua dulce de Cuba. Instituto de Biología Aplicada, Barcelona 5: 95-112.
- 1953a. Contributions to the freshwater microfauna of Tasmania. Part 2. Daphnidae, Bosminidae, Chydoridae, Cytheridae. Papers and Proceedings of the Royal Society of Tasmania 87: 63-72.
- 1953b. Report No.2 from Professor T. Gislen's expedition to Australia in 1951-1952: Bericht über Cladoceren und Copepoden. Acta Universitet, Lund, new series 49(7): 1-11.
- 1959. Cladoceren und calanoide Copepoden aus Neu Guinea. Nova Guinea, new series 10: 1-10.
- Brooks, J.L., 1957. The systematics of North American Daphnia. Memoirs of the Connecticut Academy of Arts and Sciences 13: 1-180.
- 1966. Cladocera. In 'Freshwater Biology', 2nd Edit. (ed. W.T. Edmondson). John Wiley and Sons, New York. Pp. 587-656.
- Brundin, L., 1966. Transantarctic relationships and their significance, as evidenced by chironomid midges. Almqvist and Wilsell, Stockholm, 472 pp.
- Burrows, G.B., 1968. A comparative study of the major zooplankton species in Lake Sorrell and Lake Crescent, Tasmania. B.Sc. Honours Thesis, University of Tasmania.
- Calman, W.T., 1908. Notes on a small collection of plankton from New Zealand. Annals and Magazine of Natural History Series 8(1): 232-241.

- 1917. Stomatopoda, Cumacea, Phyllocarida, and Cladocera. Natural History Report. British Antarctic Terra Nova Expedition, 1910. Zoology 3, Arthropoda, 137-162.
- Caporiacco, L., 1938. Cladocères marins recueillis pendant les croisières du Prince Albert de Monaco. Bulletin Institut Oceanographique, Monaco 740: 1-12.
- Chapman, M.A., & M.H. Lewis, 1976. An introduction to the freshwater Crustacea of New Zealand. Collins, Auckland and London. 261 pp.
- Claus, C., 1877. Zur Kenntnis des Baues und der Organisation der Polyphemiden. Denkschriften der Akademie der Wissenschaften, Wien 37: 137-160.
- Daday, E. von, 1898. Mikroskopische Süßwassertiere aus Ceylon. Természetrzaji Füzetek 21: 1-123.
- 1901. Mikroskopische Süßwassertiere aus deutsch Neu-Guinea. Természetrzaji Füzetek 24: 1-56.
- 1902. Mikroskopische Süßwassertiere aus Patagonien. Természetrzaji Füzetek 25: 201-310.
- 1905. Untersuchungen über die Süßwassermikrofauna Paraguays. Zoologica Sao Paulo 18, 44: 1-374.
- 1911. Egy ug Cladocero-faj Keletindiabol. Allatani Közlemenyek 10: 63-68.
- Dakin, W.J., & A.N. Colefax, 1940. Plankton of the Australian coastal waters off New South Wales. Part I. Monograph No. 1, Department of Zoology, University of Sydney.
- Dana, J., 1852a. Conspectus Crustaceorum in orbis terrarum circumnavigatione C. Wilkes classe Reipublicae foederata duce collectorum. Proceedings of the American Academy of Arts and Sciences 2: 47.
- 1852b. United States Exploring Expedition during the years 1838-42 under Charles Wilkes. Vol 13: Crustacea Part II. Sherman, Philadelphia.
- Darwin, C., 1872. The origin of species. Oxford University Press, Oxford. 592 pp.
- Deevey, E.S. Jr., and G.B. Deevey, 1971. The American species of *Eubosmina* Seligo (Crustacea, Cladocera). Limnology and Oceanography 16: 201-218.
- Delachaux, T., 1919. Cladocères des Andes Péruviennes. Bulletin de la Société Neuchâteloise des Sciences Naturelles 43: 18-38.
- Dolgopolskaya, M.A., 1958. The marine Cladocera of the Black Sea. Trudy Sevastopolskaya Biologicheskaya Stantsiya 10: 27-75.
- Dumont, H.J., 1971. On "*Scapholeberis kingi*" G.O. Sars (Crustacea: Cladocera). Biologisch Jaarboek 39: 207-220.
- 1977. On the validity of the genus name *Simocephalus* Schoedler, 1858 (Crustacea: Cladocera). Crustaceana 32: 106-107.
- 1979. Limnologie van Sahara en Sahel. Rijksuniversiteit, Gent. 557 pp.
- & I. Van De Velde, 1977. Report on a collection of Cladocera and Copepoda from Nepal. Hydrobiologia 53: 55-65.
- Dybowski, B., & M. Grochowski, 1894. O Lynceidach czyli Tonewkach fauny krajowej. Kosmos, Lvov 19: 376-383.
- & M. Grochowski, 1895. Spis systematyczny wioslerek (Cladocera) krajowych. Kosmos, Lvov 20: 139-165.
- Eckman, S., 1904. Die Phyllopoden, Cladoceren und freilebenden Copepoden der nordschwedischen Hochgebirge. Zoologische Jahrbücher. Abteilung für Systematik, Ökologie und Geographie der Tiere 21: 1-170.
- Fager, E.W., 1957. Determination and analysis of recurrent groups. Ecology, 38: 586-595.
- Fischer, S., 1849. Abhandlung über eine neue Daphnienart *Daphnia aurita* und über *Daphnia laticornis* Jurine. Byulleten' Imperatorskago Moskovskago Obshchestva Ispytatelei Prirody 22:38.
- 1850. Ergänzungen, Berichtigungen und Fortsetzung zu der Abhandlung über die in der Umgebung von St. Petersburg vorkommenden Crustaceen. Mémoires Présentés à l'Academie Imperiale des Sciences de St.-Petersburg par Divers Savants 7: 1-14.
- 1851. Bemerkungen über einige weniger genau gekannte Daphnienarten. Byulleten Imperatorskago Moskovskago Obshchestva Ispytatelei Prirody 24: 96-108.
- 1854. Abhandlung über einige neue oder nicht genau gekannte Arten von Daphniden und Lynceiden als Beitrag zur Fauna Russlands. Byulleten Imperatorskago Moskovskago Obshchestva Ispytatelei Prirody. 27: 433-434.
- Flössner, D., 1972. Kiemen- und Blattfüßer, Branchiopoda, Fischlaue, Branchiura. Tierwelt Deutschlands und der Angrenzenden Meeresteile 60: 1-501.
- Frey, D.G., 1960. The ecological significance of cladoceran remains in lake sediments. Ecology. 41: 785-790.
- 1965. Differentiation of *Alona costata* Sars from two related species (Cladocera, Chydoridae). Crustaceana 8: 159-173.
- 1967. Phylogenetic relationships in the family Chydoridae (Cladocera). Marine Biological Association of India. Symposia series Part I :29-37.
- 1971. Worldwide distribution and ecology of *Eurycercus* and *Saycia* (Cladocera). Limnology and Oceanography 16: 254-308.
- 1976. Redescription of *Chydorus pigroides* Lilljeborg, 1900, and allocation to *Pleuroxus* (Cladocera, Chydoridae). Crustaceana 30(1): 89-97.
- 1980. On the plurality of *Chydorus sphaericus* (O.F. Müller) (Cladocera, Chydoridae), and designation of a neotype from Sjaelso, Denmark. Hydrobiologia 69: 83-123.
- 1982. Relocation of *Chydorus barroisi* and related species (Cladocera, Chydoridae) to a new genus and description of two new species. Hydrobiologia 86: 231-269.
- Fryer, G., 1968. Evolution and adaptive radiation in the Chydoridae (Crustacea: Cladocera): a study in comparative functional morphology and ecology. Philosophical Transactions of the Royal Society, London B 254(No. 795): 221-385.
- 1974. Evolution and adaptive radiation in the Macrothricidae (Crustacea:Cladocera): a study in comparative functional morphology and ecology. Philosophical Transactions of the Royal Society, London B 269(No. 898): 137-274.
- Gauthier, H., 1939. Contribution à l'étude de la faune dulcaquicole de la région du Tchad et particulièrement des Branchiopodes et des Ostracodes. Bulletin, Institut Fondamental d'Afrique Noire, Dakar 1: 110-244.
- Geddes, M.C., 1976. Seasonal fauna of some ephemeral saline waters in Western Victoria with particular reference to *Parartemia zietziana* Sayce (Crustacea:Anostraca). Australian Journal of Marine and Freshwater Research 27: 1-22.
- Goulden, C.E., 1968. The systematics and evolution of the Moinidae. Transactions of the American Philosophical

- Society, new series 58: 1-101.
- & D.G. Frey, 1963. The occurrence and significance of lateral head pores in the genus *Bosmina* (Cladocera). Internationale Revue der Gesamten Hydrobiologie 48: 513-522.
- Guerne, J. de., & J. Richard, 1893. *Cantocamptus grandidieri*, *Alona cambouei*, nouveaux entomostracés d'eau douce de Madagascar. Memoires, Société Zoologique de France 6: 234-244.
- Gurney, R., 1927. Some Australian freshwater Entomostraca reared from dried mud. Proceedings of the Zoological Society, London, 1927. 59-79.
- Haase, J.F., 1903. Records of some Victorian Entomostraca. Victorian Naturalist (Melbourne) 19: 148-150.
- Harding, J.P., 1955. Percy Sladen Trust Expedition XIX. Crustacea: Cladocera. Transactions of the Linnean Society, London 1: 329-354.
- 1957. Crustacea: Cladocera. Explor. Hydrobiol. Lac Tanganyika. Result Scientifique 3, 6: 55-89.
- 1961. Some South African Cladocera collected by Dr A.D. Harrison. Annals of the South African Museum 46: 35-46.
- 1972. Review of Smirnov, N.N., "Chydoridae of the world's fauna." Crustaceana 23: 316.
- Harmsworth, R.V., 1968. The development history of Bleham Tarn (England) as shown by animal microfossils, with special reference to the Cladocera. Ecological Monographs 38: 223-241.
- Heberer, G., 1923. Über eine Population von *Daphnia cephalata* aus Flores. Verhandlungen der Deutschen Zoologischen Gesellschaft 32: 70-78.
- Hebert, P.D.N., 1977. A revision of the taxonomy of the genus *Daphnia* in southeastern Australia. Australian Journal of Zoology 25: 371-398.
- 1978. The population biology of *Daphnia* (Crustacea: Daphniidae). Biological Reviews 53: 387-426.
- Hedley, M.E., 1969. Studies on *Daphniopsis pusilla* Serventy. B.Sc. Honours Thesis, Monash University, Melbourne.
- Hellich, B., 1877. Über die Cladocerenfauna Böhmens. Sitzungsberichte der K. Böhmisches Gesellschaft der Wissenschaften 7: 205-220.
- Henry, M., 1919. On some Australian Cladocera. Journal and Proceedings of the Royal Society of New South Wales 52: 463-485.
- 1922. A monograph of the freshwater entomostraca of New South Wales. Proceedings of the Linnean Society of New South Wales 47: 26-52.
- Herrick, C.L., 1882. Papers on the Crustacea of the fresh waters of Minnesota 2. Geology and Natural History Survey of Minnesota 10th Annual report: 235-52.
- 1887. Contribution to the fauna of the Gulf of Mexico and the South. List of the freshwater and marine Crustacea of Alabama. Memoirs of the Denison Scientific Association 1: 1-56.
- Hudendorff, A., 1876. Beitrag zur Kenntniss der Süßwasser Cladoceren Russlands. Byulleten' Imperatorskago Moskovskago Obschestva Ispytatelei Prirody 50: 26-61.
- Hussainy, S.U., 1969. Ecological studies on some microbiota of lakes in western Victoria. Ph.D. Thesis, Monash University, Melbourne.
- Illies, J., 1965. Phylogeny and zoogeography of the Plecoptera. Annual Review of Entomology 10: 117-140.
- Jaccard, P., 1932. Die statistisch-floristische Methode als Grundlag der Pflanzensoziologie. Handbuch der Biologischen Arbeitsmethoden 11: 165-202.
- Jurine, L., 1820. Histoire des Monocles, qui se trouvent aux environs de Genève. Paris. 260 pp.
- King, R.L., 1853a. On some species of Daphnidae found in New South Wales. Papers and Proceedings of the Royal Society of Tasmania 2: 243-253.
- 1853b. On Australian Entomostracans—in continuation. Papers and Proceedings of the Royal Society of Tasmania 2: 253-263.
- 1866. On the anatomy of certain forms of Australian Entomostraca. Transactions of the Entomological Society of New South Wales, 1865: 162-166.
- Kontkanen, P., 1950. Sur les diverses méthodes de groupement des récoltes dans la biocénotique animale. Vie et Milieu 1: 121-130.
- Kořínek, V., 1971. Comparative study of head pores in the genus *Bosmina* Baird (Crustacea: Cladocera). Vestník Československe Společnosti Zoologické 35: 225-296.
- Korovchinsky, N.M., 1981. Taxonomic and faunistic revision of Australian *Diaphanosoma* (Cladocera: Sididae). Australian Journal of Marine and Freshwater Research 32: 813-831.
- Kott, P., 1955. The zooplankton of Lake Macquarie 1953-54. Australian Journal of Marine and Freshwater Research 6: 429-442.
- 1957. Zooplankton of East Australian waters, 1953-54. C.S.I.R.O. Australian Division of Fisheries and Oceanography Report No. 14.
- Kramer, A., 1895. On the most frequent pelagic Copepoda and Cladocera of the Mauraki Gulf. Transactions and Proceedings of the New Zealand Institute, new series 10, 27: 214-223.
- Kurz, W., 1875. Dodekas neuer Cladoceren nebst einer kurzen Übersicht der Cladocerenfauna Böhmens. Sitzungsberichte der Akademie der Wissenschaften in Wien 70: 7-88.
- Leach, W.E., 1816. Annulosa. Supplement to the 4th edition of Encyclopaedia Britannica: 406.
- Lebedeva, M., & P. Tamkovich, 1977. Ringing of birds in Australia. Okhota i okhotnichye Khozyaystvo 7: 40-41. (In Russian).
- Leuckart, R., 1859. Über das Vorkommen eines saugnafartigen Haftapparates bei den Daphniden und verwandten Krebsen. Archiv für Naturgeschichte 25: 262-265.
- Leydig, F., 1860. Naturgeschichte der Daphniden (Crustacea, Cladoceren). Tübingen. 252 pp.
- Liévin, F., 1848. Die Branchiopoden der Danziger Gegend. Ein Beitrag zur Fauna der Provinz Preussen. Schriften der Naturforschenden Gesellschaft, Danzig 4: 1-52.
- Lilljeborg, W., 1853. Om de inom Skane förekommande Crustaceer af Ordningarne. Cladocera, Ostracoda och Copepoda. Lund. 222 pp.
- 1900. Cladocera Sueciae. Nova Acta Regiae Societatis Scientiarum Upsaliensis, Ser. 3, 19: 1-701.
- Lindberg, G.U., 1955. Quaternary in light of biogeographic data. Leningrad. Publications of the U.S.S.R. Academy of Sciences. 334 pp. (In Russian.)
- 1972. Big fluctuations in ocean level during Quaternary. Leningrad. Publications of the USSR Academy of Sciences. 548 pp. (In Russian.)
- Lochhead, J.H., 1954. On the distribution of a marine cladoceran, *Penilia avirostris* Dana (Crustacea,

- Branchiopoda), with a note on its reported bioluminescence. *Biological Bulletin* 107: 92-105.
- Löffler, H., 1968. Die Crustaceenfauna der Binnengewässer ostafrikanischer Hochgebirge. *Hochgebirgorschung* 2: 107-170.
- Lovén, S., 1836. *Evadne nordmanni* ett hittills okänt Entomostrakon. *Kungliga Svenska Vetenskapsakademiens Handlingar*, 1835.
- Mamaril, A., 1977. Freshwater zooplankton of the Philippines. Thesis, University of Waterloo, Canada.
- Manuylova, Y.F., 1964. Cladocera of the U.S.S.R. Fauna. *Opredeliteli po Faune SSSR izdavaemye Zoologicheskim Muzeem Akademii Nauk* 88: 328-655. (In Russian).
- Markina, N.P., 1975. Planktonic communities in the Great Australian Bight. *Hydrobiological Journal* 11: 13-8.
- Megard, R.O., 1967. Three new species of *Alona* (Cladocera, Chydoridae) from the United States. *Internationale Revue der Gesamten Hydrobiologie* 52: 37-50.
- Mikheev, A.V., 1971. Migration of birds. Moscow, *Lesnaya Promyshlennost*. 208 pp. (In Russian).
- Monakov, A.V., 1969. The zooplankton and zoobenthos of the White Nile and adjoining waters in the Republic of the Sudan. *Hydrobiologia* 33: 161-185.
- Mordukhai-Boltovskoi, P.D., 1968a. On the taxonomy of the Polyphemidae. *Crustaceana* 14: 197-209.
- 1968b. Cladocera in 'Atlas bespozvonochnykh Kaspiskogo moria', pp 120-160. Moscow.
- 1969. Subclass Branchiopoda, Order Cladocera. *Opredeliteli Chernogo i Azovskogo Morey* 2:12-31.
- Morton, D.W., 1973. Studies on some temporary Victorian waters with special reference to the microcrustacea. Honours Thesis, Monash University, Melbourne.
- Müller, O.F., 1776. *Zoologiae Danicae prodromus*. Havniae. Pp. XXXII + 282.
- 1785. Entomostraca seu insecta testacea quae in aquis Daniae et Norvaegiae reperit, descripsit et iconibus illustravit. Lipsiae et Havniae. 135 pp.
- Müller, P.E., 1867. Denmarks Cladocera. *Naturhistorisk Tidsskrift*, Copenhagen 3: 53-240.
- Nayar, C.K., 1971. Cladocera of Rajasthan. *Hydrobiologia* 37: 509-519.
- Neale, I.M., & I.A.E. Bayly, 1974. Studies on the ecology of the zooplankton of four estuaries in Victoria. *Australian Journal of Marine and Freshwater Research* 25: 337-350.
- Norman, C.A.M., 1903. New generic names for some Entomostraca and Cirripedia. *Annals and Magazine of Natural History*, Series 7, 11: 367-372.
- Norman, C.A.M., & G.S. Brady, 1867. A monograph of the British Entomostraca belonging to the families Bosminidae, Macrothricidae and Lynceidae. *Transactions of the Natural History Society of Northumberland* 1: 354-408.
- Paggi, J.C., 1972. Nota sistemática acerca de algunos Cladoceros del género *Chydorus* Leach, 1843 de la República Argentina. *Physis*, Buenos Aires 31: 222-236.
- 1976. Cladoceros Macrothricidae nuevos para la fauna Argentina. *Physis*, Buenos Aires 35: 103-112.
- & S.J. Paggi, 1974. Primeros estudios sobre el zooplankton de las aguas loticas del Parana Medio. *Physis*, Buenos Aires 33: 91-114.
- Pennak, R.W., 1966. Structure of zooplankton populations in the littoral macrophyte zone of some Colorado lakes. *Transactions of the American Microscopical Society* 85: 329-349.
- Petkovski, T., 1973a. Zur Cladoceren-Fauna Australiens. I. Daphnidae und Chydoridae. *Acta Musei Macedonici Scientiarum Naturalium* 13: 133-157.
- 1973b. Zur Cladoceren-Fauna Australiens. II. Sididae und Macrothricidae. *Acta Musei Macedonici Scientiarum Naturalium* 13: 161-192.
- Playfair, G.I., 1914. Contributions to a knowledge of the biology of the Richmond River. *Proceedings of the Linnean Society of New South Wales* 39: 93-151.
- Poche, F. 1903. Einige nothwendige Änderungen in der herpetologischen Nomenclatur. *Zoologischer Anzeiger* 26: 698-703.
- Poggenpol, M., 1872. List of Copepoda, Cladocera and Ostracoda of Moscow and surroundings. *Izvēstiya Imperatorskago Obshchestva Lyubitelei Estestvoznaniya Antropologii i Etnografii pri Imperatorskom Moskovskom Universitetē* 10: 69-77.
- Poppe, S.A., 1889. Ein neuer Podon aus China nebst Bemerkungen zur Synonymie der bisher bekannten *Podon*-Arten. *Abhandlungen herausgegeben vom Naturwissenschaftlichen Verein zu Bremen* 10: 295-300.
- Rammner, W., 1928. Ein Vorkommen von *Scapholeberis kingi* G.O. Sars in Deutschland. *Zoologischer Anzeiger* 77: 325-336.
- 1929. Zur Systematik der Cladoceren-Gattung *Scapholeberis* Schoedler. *Zoologischer Anzeiger* 80: 280-288.
- Rawson, D.S., & J.E. Moore, 1944. The saline lakes of Saskatchewan. *Canadian Journal of Research (Series D)* 22: 141-201.
- Rey, J. & L., Saint-Jean, 1968. Les Cladocères (Crustacés, Branchipodes) du Tchad. *Cahiers ORSTOM, Série Hydrobiologie* II: 79-118.
- Richard, J., 1894. Cladocères recueillis par le Dr. Theod. Barrois en Palestine, en Syrie et en Égypte. *Revue Biologique du Nord de La France*, Lille 6: 360-378.
- 1895. Sur quelques Entomostracés d'eau douce d'Haiti. *Memoires Société Zoologique de France* 8: 188-199.
- 1895. Revision des Cladocères I. *Annales des Sciences Naturelles, Zoologie, Series 7*, 18: 279-389.
- 1897. Entomostracés de l'Amérique du Sud, recueillis par M.M. U. Deiters, H. von Ihering, G.W. Müller et C.O. Poppe. *Mémoires de la Société Zoologique de France* 10: 263-301.
- Rühe, F.E., 1914. Monographie des genus *Bosmina*. A. *Bosmina coregoni* im baltischen Seengebiet. *Zoologica* 63: 1-141.
- Sars, G.O., 1862a. Meddeelte en af talrige Afbildninger ledsaget oversigt af de ham i Omegnen af Christiania iagtagne Crustacea Cladocera. *Forhandlinger i Videnskabs-Selskabet i Christiania*, 1861: 144-167.
- 1862b. Fortsatte sit Foredrag over de af ham i Omegnen af Christiania iagttanne Crustacea. *Forhandlinger i Videnskabs-Selskabet i Christiania*, 1861: 250-302.
- 1885. On some Australian Cladocera raised from dried mud. *Forhandlinger i Videnskabs-Selskabet i Christiania*, 1885, 1-46.
- 1888. Additional notes on Australian Cladocera raised from dried mud. *Forhandlinger i Videnskabs-Selskabet i Christiania*, 1888, 1-74.
- 1894. Contributions to knowledge of the freshwater Entomostraca of New Zealand as shown by artificial hatching from dried mud. *Forhandlinger i*

- Videnskabs-Selskabet i Christiania, 1894, 1-62.
- 1895. On some South African Entomostraca raised from dried mud. Videnskabs-Selskabet Skrifter I. Mathematisk-naturviden Klases 8: 1-56.
- 1896. On freshwater Entomostraca from the neighbourhood of Sydney. Archiv for Matematik og Naturvidenskab, Oslo 18: 1-81.
- 1897. On some West-Australian Entomostraca raised from dried sand. Archiv for Matematik og Naturvidenskab, Oslo, 19: 1-35.
- 1901. Contributions to the knowledge of the freshwater Entomostraca of South America, as shown by artificial hatching from the dried material. Archiv for Matematik og Naturvidenskab, Oslo, 23: 1-102.
- 1903. On the Crustacean fauna of central Asia. Ezhegodnik Zoolicheskago Muzeya Imperatorskoi Akademii Nauk, St. Petersburg 8: 157-264.
- 1904a. On a remarkable new Chydorid *Saycia orbicularis* G.O. Sars, from Victoria, South Australia. Archiv for Matematik of Nasturvidenskab, Oslo 26: 1-15.
- 1904b. Pacifische Plankton-Crustaceen. Zoologische Jahrbücher 5: 629-646.
- 1911. On the problematic form "*Moina lemnae* King" and its true relations. Archiv for Matematik og Naturvidenskab, Oslo, 32; 1-13.
- 1914. *Daphnia carinata* King and its remarkable varieties. Archiv for Matematik og Naturvidenskab, Oslo, 34; 1-14.
- 1916. The freshwater Entomostraca of Cape Province (Union of South Africa). Part I. Cladocera. Annals of the South African Museum 15: 303-351.
- Schoedler, J.E., 1862. Die Lynceiden und Polyphemiden der Umgegend von Berlin. Jahresbericht Dorotheen Realschule. 56 pp.
- 1863. Neue Beiträge zur Naturgeschichte der Cladoceren. Berlin. 80 pp.
- 1877. Zur Naturgeschichte der Daphnoiden. Abhandlung Jahresbericht Dorotheen Realschule, 24 pp.
- Scott, T., 1895. The inland waters of the Shetland Islands. Notes on the species represented by the drawings on plate V. Annual report of Fishery Board of Scotland, XIII, Part III, Scientific investigations: 174-90.
- Searle, J., 1917. The pond and its inhabitants. Victorian Naturalist (Melbourne) 34: 6-10.
- Serventy, D.L., 1929. Records of Cladocera (Crustacea) from the South-West province of Australia. Journal of the Royal Society of Western Australia, 15: 63-69.
- Sewell, R.B.S., 1956. The continental drift theory and the distribution of the Copepoda. Proceedings of the Linnean Society, London 166: 149-177.
- Sheard, K., 1949. Plankton characteristics at the Cronulla onshore station, New South Wales, 1943-46. CSIRO (Australia) Bulletin 246: 1-23.
- Shen Chia-jui, Sung Ta-hsiang & Chen Kuo-hsiao, 1964. Studies on the Cladocera of Peking. Acta Zoologica Sinica 16: 61-69.
- Shepard, J., J. Searle, & J. Strickland, 1918. One year's collection of microfauna, Botanic Garden's Lake, Melbourne. Victorian Naturalist (Melbourne) 35: 79-84.
- Shiel, R.J., 1976. Associations of Entomostraca with weedbed habitats in a billabong of the Goulburn River, Victoria. Australian Journal of Marine and Freshwater Research 27: 533-549.
- Smirnov, N.N., 1966a. Taxonomic significance of the trunk limbs of the Chydoridae (Cladocera). Hydrobiologia 27: 337-347.
- 1966b. *Pleuroxus* (Chydoridae): morphology and taxonomy. Hydrobiologia 28: 161-194.
- 1966c. *Alonopsis* (Chydoridae, Cladocera): morphology and taxonomic position. Hydrobiologia 27: 113-136.
- 1971a. Morpho-functional grounds of mode of life of Cladocera. V. Morphology and adaptive modifications of trunk limbs of Anomopoda. Hydrobiologia 37: 317-345.
- 1971b. Chydoridae of the world's fauna. Fauna of the USSR, Rakoobraznye, Vol 1(2), new series, No. 101. Leningrad. 531 pp. (In Russian).
- 1975. Biology of Cladocera. Itogi Nauki i Techniki, Zoologia Bespozvonochnykh, 3, Moscow. 117 pp. (In Russian).
- 1976. Macrothricidae and Moinidae of the World. Fauna of the USSR. Leningrad. (In Russian).
- 1977. Quattuor species novae Cladocerorum Australiae. Crustaceana 32: 119-128.
- Smith, G.W., 1909. The freshwater Crustacea of Tasmania with remarks on their geographical distribution. Transactions of the Linnean Society of London, Series 2, Zoology, II: 61-92.
- Šrámek-Hušek, R., M. Straškraba & J. Brtek, 1962. Branchiopoda. Fauna ČSSR, Praha, Vol 16. 470 pp.
- Stebbing, T., 1902. Lynceus und Lynceidae. Zoologist, Series 4, 4: 101-106.
- Steuer, A., 1933. Die "Arten" der Cladocerenattung *Penilia* Dana. Mitteilungen aus der Zoologischen Sammlung des Museums für Naturkunde in Berlin 19: 80-83.
- Stingelin, T., 1895. Die Cladoceren der Umgebung von Basel. Revue Suisse de Zoologie 3: 161-274.
- 1906. Neue Beiträge zur Kenntnis der Cladocerenfauna der Schweiz. Revue Suisse de Zoologie 14: 317-387.
- Strauss, H.E., 1820. Mémoire sur les *Daphnia* de la classe des Crustacés (seconde partie). Mémoires du Musée Royale d'Histoire Naturelle de Belgique 6: 149-162.
- Tarling, D.H. & M.F. Tarling, 1971. Continental Drift. G. Bell & Sons, London. 112 pp.
- Thomasson, K., 1963. Araukarian lakes. Plankton studies in North Patagonia with notes on terrestrial vegetation. Acta Phytogeographica Suecica 47: 1-139.
- Timms, B.V., 1967. Ecological studies on the Entomostraca of a Queensland pond with special reference to *Boeckella minuta* Sars (Copepoda: Calanoida). Proceedings of the Royal Society of Queensland 79: 41-70.
- 1968. Comparative species composition of limnetic planktonic crustacean communities in South-East Queensland, Australia. Hydrobiologia 31: 474-480.
- 1969. A preliminary survey of the Wooli Lakes, New South Wales. Proceedings of the Linnean Society of New South Wales 94: 105-112.
- 1970a. Aspects of the limnology of five small reservoirs in New South Wales. Proceedings of the Linnean Society of New South Wales 95: 46-59.
- 1970b. Chemical and zooplankton studies of lentic habitats in North-Eastern New South Wales. Australian Journal of Marine and Freshwater Research 21: 11-33.
- 1972. The freshwater lagoon, Myall Lakes National

- Park. Hunter Natural History 4: 6-10.
- 1973. A comparative study of the limnology of three maar lakes in western Victoria. Ph.D. Thesis, Monash University, Melbourne.
- 1974. Aspects of the limnology of Lake Tarli Karng Victoria. Australian Journal of Marine and Freshwater Research 25: 273-279.
- 1977. A study of some coastal dune lakes in western Victoria. Proceedings of the Royal Society of Victoria 89: 167-172.
- 1978. The benthos of some lakes in north eastern Queensland. Proceedings of the Royal Society of Queensland 90: 57-64.
- S.H. Midgley, 1969. The limnology of Borumba Dam, Queensland. Proceedings of the Royal Society of Queensland 81: 27-42.
- Vavra, W., 1900. Süßwasser-Cladoceren. Hamburger Magalhaensische Sammelreise herausgegeben von Naturhistorischen Museum zu Hamburg 5: 1-25.
- Vidal, I.L., 1970. *Moina* sp. (Cladocera: Daphnidae) in a sewage plant, Wellington, New Zealand. New Zealand Journal of Marine and Freshwater Research 4: 203-209.
- Wagler, E., 1936. Die Systematik und geographische Verbreitung der genus *Daphnia* O.F. Müller mit besonderer Berücksichtigung der südafrikanischen Arten. Archiv für Hydrobiologie 30: 505-556.
- Wallace, A.R., 1880. Island Life. Macmillan, London.
- Wegener, A., 1925. Origin of continents and oceans. Moscow, Leningrad. (Russian translation of 3rd German edition).
- 1966. The origin of continents and oceans. Dover, New York. (Translated from 4th German edition).
- Whittaker, R.H. & C.W. Fairbanks, 1958. A study of plankton copepod communities in the Columbia Basin, Southeastern Washington. Ecology 39: 46-65.
- Williams, J.L., 1978. *Ilyocryptus gouldeni*, a new species of water flea, and the first American record of *I. agilis* Kurz (Crustacea: Cladocera: Macrothricidae). Proceedings of the Biological Society of Washington 91(3): 666-680.
- Williams, W.D., 1974. Freshwater Crustacea. In 'Biogeography and Ecology in Tasmania' (ed. W.D. Williams). Junk, The Hague.
- Zernov, S.A., 1908. *Penilia schmackeri* Richard (Cladocera) in the Black Sea. Yearbook of the Zoological Museum of the Academy of Sciences 13: 500-2. (In Russian.)
- Zonenshein, L.P., & A.M. Gorodnitskiy, 1976. Paleoceans and continental drift. Priroda (Moscow) 2: 74-83. (In Russian.)

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<i>M. micrura micrura</i>	86	<i>S. vetulus elisabethae</i>	98
<i>M. mongolica</i>	88	<i>S. vetulus gibbosus</i> n.comb.	102
<i>M. tenuicornis</i>	87	<i>S. victoriensis</i> n.sp.	105
MOINIDAE	84	<i>Streblocerus</i>	83
		<i>S. serricaudatus</i>	83