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Revision of the Australian Cyclopidae (Copepoda: Cyclopoida). I *Acanthocyclops* Kiefer, *Diacyclops* Kiefer and *Australocyclops*, gen. nov.

D. W. Morton

Department of Zoology, Monash University, Clayton, Vic. 3168.

Abstract

The Australian species of *Acanthocyclops* Kiefer, *Diacyclops* Kiefer and *Australocyclops*, gen. nov. are revised and the following species are recognized: *Acanthocyclops robustus* (Sars), *Diacyclops bisetosus* (Rehburg), *D. cryonastes*, sp. nov., *Australocyclops australis* (Sars), *A. palustrium*, sp. nov. and *A. similis*, sp. nov. All are described, figured and discussed and keys are provided for their identification.

Introduction

Despite the common occurrence of Cyclopidae in Australian inland waters, works relating to the taxonomy of this group have appeared only infrequently and are scattered throughout the literature. The first cyclopids recorded from Australia, *Cyclops macleayi* and *Cyclops australis*, were described by Dana (1847) and King (1855), respectively. The former of these species is now considered unrecognizable. The latter was redescribed by Sars (1896), who also recorded the presence of a further five species from the vicinity of Sydney. Subsequent authors (Sars 1908; Smith 1909; Breinl 1911; Henry 1919, 1922; Lindberg 1948; Brehm 1950, 1953; Chappuis 1951) described or recorded species from various parts of the continent, thereby raising the number of recorded nomina to 20. Lindberg (1953) briefly reviewed these and listed the 14 species that he considered valid, the others being either reduced in synonymy or else considered to be of uncertain taxonomic status. Since that time, only three further taxonomic papers pertaining to the Australian Cyclopidae have appeared (Kiefer 1967, 1969, 1981); these added a further six species, bringing the total of known, apparently valid, species to 20, which remained the total number until the commencement of the present study.

Considering the area of the Australian continent, and its diverse climatic and hydrological conditions, the low number of species known from the country would be remarkable, particularly when one considers that 47 species or subspecies are known from Great Britain alone (Gurney 1933). However, as Lindberg (1953) surmised, and as indicated in a preliminary way by Bayly and Morton (1978), this lack of species is more apparent than real, due mainly to the lack of collections from large parts of the continent and from a sufficient variety of habitats.

This paper is the first of a series that will deal comprehensively with the Australian Cyclopidae. A large number of collections from a greatly increased proportion of the continent (compared with the extent of previous sampling) has been examined. The cyclopids from these collections and from museum material where available are described,

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or redescribed, and discussed where appropriate. The Australian cyclopid fauna is now known to comprise at least 56 species, of which approximately 30 will be newly described in this series of papers.

Methods

Much of the material studied was collected by the author. Further material was loaned or given to the author by many people who are acknowledged in the lists of material examined—where the collector of the material is not named, the author was the collector. Type or museum material has also been examined where available. Except where otherwise indicated, all specimens listed under Material Examined are stored in the Department of Zoology, Monash University. Type specimens of newly described species have been lodged with the Museum of Victoria, Melbourne (MVM). All of these specimens have been studied under the microscope and most have been dissected and mounted in PVA–lactophenol mountant using the methods of Hamond (1969). All drawings were made using a *camera lucida* attachment on a Wild M20 microscope.

Total body length, defined as the distance from the anterior edge of the prosome to the end of the caudal rami, was measured mid-dorsally at 80× magnification and is given to the nearest 0·01 mm. No allowance for telescoping of body somites has been made but damaged specimens have been omitted. The lengths of various appendages were measured at 100×, 200× or, most commonly, 450× magnification. The caudal rami were measured ventrally: the length was measured from the point of insertion on the anal somite along the outer margin as far as the distalmost point; the width is the greatest width, no matter at what level. The length and width of the terminal segment of the fourth endopod are the greatest dimensions of this segment.

Synonymies given for most species are limited to the original description and subsequent comprehensive works. Accounts of the males are supplementary to those of the conspecific females; only some sexually dimorphic characters are considered.

Morphology and Terminology

The terminology adopted here to differentiate the major divisions of the cyclopid body is that of Sars (1901) as amended by Gooding (1957) who defined, *inter alia*, the following:

prosome: the anterior region of the body, limited posteriorly by the major articulation;

cephalothorax: the head region including, in addition to the maxillipedal somite, pedigerous somites in a fused complex;

metasome: those free pedigerous somites in front of the major articulation;

urosome: that part of the body behind the major articulation.

In the Cyclopidae, the major articulation occurs between the fifth and sixth thoracic somites. The prosome, therefore, comprises the cephalothorax [which bears the antennules (A1), antennae (A2), mandibles (Md), maxillules (Mx1), maxillae (Mx), maxillipedes (Mxp), and the first pair of swimming legs (P1)] and the metasome [comprising the third to fifth thoracic somites, each of which bears a pair of swimming legs (P2–4)].

The urosome consists of the sixth and seventh thoracic somites and the four abdominal somites. The sixth thoracic somite, henceforth referred to as the first urosomal somite to avoid confusion, bears the fifth leg (P5) ventrolaterally. In adult males, the seventh thoracic somite (or second urosomal somite) bears the sixth leg (P6) ventrolaterally. In adult females, the seventh thoracic and first abdominal somites are fused to form a single large genital somite, which bears the seminal receptacle and the genital opening. The urosome of the female, therefore, comprises one somite fewer than does that of the male. The terminal urosomal somite (the anal somite) bears, dorsally, the subterminal anus, which is overhung by the variously developed anal operculum and, terminally, a pair of unsegmented setiferous caudal rami (CR).

The four pairs of swimming legs (P1–4) are of similar construction. Each leg consists of two wide proximal segments (coxa and basis) and two rami: an exopodite (Re) and an endopodite (Ri). The coxae of each pair of legs are united by a hyaline membrane termed the intercoxal plate. The rami consist, at most, of three segments each, although fewer may be present. Where reference to these segments is required, they are numbered serially from the basal segment so that, for example, P4Ri3 refers to the third (or terminal) segment of the endopodite of P4.

A spine is always present on the outer margin of Re1 and Re2 of P1–4, whereas the outer margin of Ri1 and Ri2 of these legs is always bare. The remainder of the armature is described by means of the 'armature pattern' so that an abbreviation such as: P1 1.1.53 1.2.411, indicates that the P1 bears one seta on the inner margin of each of Re1 and Re2 and five setae on the inner margin and three spines on the outer margin of Re3; similarly, one inner seta is borne on Ri1, two on Ri2 and four inner setae, one

terminal spine and one outer seta on Ri3. The spine formula refers to the number of spines on the terminal segment of Re of P1–4. A spine formula of 3433 indicates that P1, P3 and P4 bear three spines on this segment while P2 bears four.

Taxonomy

Genus **Acanthocyclops** Kiefer

Cyclops (partim). Sars, 1918, pp. 40–6.
Cyclops (*Megacyclops*) Kiefer, 1927, p. 305; Kiefer, 1928*a*, p. 545; Kiefer, 1929, pp. 52–4; Yeatman, 1944, p. 3.
Cyclops (*Acanthocyclops*) Kiefer, 1927, pp. 305–6; Kiefer, 1928*a*, pp. 545–6; Kiefer, 1929, pp. 54–8; Yeatman, 1944, pp. 3–4.
Cyclops (*Acanthocyclops*) (partim). Gurney, 1933, pp. 182–218.
Megacyclops. Kiefer, 1937, p. 421.
Acanthocyclops. Kiefer, 1937, p. 421; Dussart, 1969, pp. 122–44.
Acanthocyclops (partim). Rylov, 1948, pp. 210–38.

A1 of female 11- to 17-segmented, without hyaline membrane or spinule row on distal segments. Rami of P1–4 3-segmented. P4Ri3 with 2 terminal spines. P5 2-segmented; proximal segment with seta at outer corner; distal segment with long apical outer seta and with short inner spine situated apically or subapically on inner edge and no longer than about $\frac{1}{2}$ length of segment.

Type species: *Cyclops vernalis* Fischer, 1853.

Only one species is known from Australia.

Acanthocyclops robustus (Sars)
(Figs 1*a*–1*e*)

Cyclops robustus Sars, 1862, p. 245; Lilljeborg, 1901, p. 19; Sars, 1918, p. 45.
Cyclops vernalis Fischer (partim). Schmeil, 1892, p. 88; Gurney, 1933, pp. 198–204.
Acanthocyclops robustus (Sars). Kiefer, 1929, p. 55; Kiefer, 1976, pp. 96–100.
Acanthocyclops vernalis var. *robustus* (Sars). Rylov, 1948, p. 226.

Description

Female

Length 1·23–1·70 mm. Prosome robust, ovate, slightly less than twice as long as wide and twice as long as urosome. Tergite of 4th prosomal somite conspicuously produced dorsolaterally, sharply pointed. lst urosomal somite much wider than genital somite, produced laterally into slightly recurved point. Genital somite about as long as greatest width, widest anteriorly; lateral outline not angulate but evenly curved. Distal margins of genital and 2 succeeding somites with small irregular denticles ventrally, smooth dorsally. Anal somite with row of spinules around base of each caudal ramus ventrally. Anal operculum undeveloped. Caudal rami (Fig. 1*b*) 3·3–3·6 times as long as greatest width and equal to, or slightly shorter than, combined lengths of last 3 abdominal somites; outer margin with small notch $\frac{1}{4}$ way along ramus; innermost terminal seta slender, 0·7–0·8 times length of ramus and 1·6–2·0 times as long as outermost terminal seta, bearing long, widely spaced setules along its whole length; outermost terminal seta strong, somewhat spiniform, 0·4–0·5 times length of ramus; dorsal seta no longer than outermost seta; of 2 median terminal setae, inner as long as urosome and 1·5 times as long as outer—both these setae naked proximally, inner

bearing in distal $\frac{3}{4}$ of its length long fine setules initially widely spaced but gradually becoming more closely spaced distally, outer bearing in distal $\frac{1}{2}$ short, very closely spaced setules.

A1 17-segmented, not reaching to end of cephalothorax; aesthete on segment 12 extending only to end of segment 14. A2 and mouthparts not remarkable. P1–4 with both rami 3-segmented. Medial lobe of basis of P1 with seta reaching to end of Ri2; those of P2–4 with pointed, triangular process near inner corner. Intercoxal plate of P4 (Fig. 1*c*) with free edge straight or slightly sinuate and with row of small spinules situated $\frac{1}{2}$ way along plate, 4–6 on each side. Ri2 of P1–4 with 2 setae; spine formula 3444; armature of swimming legs as follows:

P1	1.1.43	1.2.411,
P2	1.1.44	1.2.411,
P3	1.1.44	1.2.411,
P4	1.1.44	1.2.221.

Setae of swimming legs, particularly distalmost ones of both rami of P3 and P4, showing tendency toward modification into spines, transitional forms common. P4Ri1 (Fig. 1*a*)

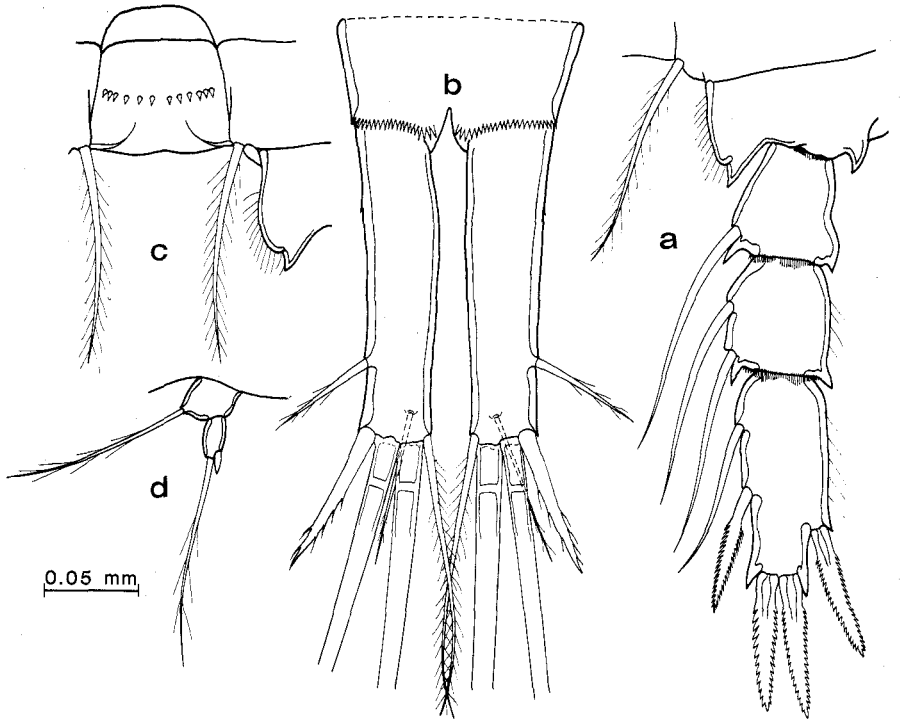

Fig. 1. *Acanthocyclops robustus* (Sars). Female: (*a*) P4Ri; (*b*) caudal rami; (*c*) intercoxal plate of P4; (*d*) P5.

with shallow notch or indentation on its outer edge. P4Ri3 (Fig. 1*a*) 2·0–2·2 times as long as greatest width; inner terminal spine 0·7–0·8 times length of segment and as long as, or very slightly shorter than, outer spine; setae of this segment do not reach to ends of terminal spines. P5 2-segmented (Fig. 1*d*); proximal segment 1·0–1·5 times as wide as long and about twice as wide at its base as distal segment, bearing distolaterally long, slender seta; distal segment longer than wide with long terminal seta and short, subterminal spine at most only $\frac{1}{2}$ length of segment.

Male

Length 0·99–1·10 mm. P6 with strong, well-developed inner spine up to twice as long as small median seta and $\frac{1}{2}$ as long as slender outer seta.

Discussion

A. robustus Sars has been regarded by some authors (Gurney 1933; Coker 1934; Rylov 1948) as no more than a junior synonym of *A. vernalis* Fischer although Kiefer (1929) considered them distinct and gave the spine formula (3444 in *robustus*, 2333 in *vernalis*) as the major, and almost the sole, distinction between the two. This was unfortunate since Sars (1918) himself remarked on the fact that the spine formula of *Cyclops lucidulus* Koch (=*A. vernalis*) could be either 2333 or 3444. Kiefer's action, therefore, gave unwarranted importance to the spine formula as a species-specific character and directed the attention of subsequent workers towards this character to the detriment of other, potentially more useful ones. As a result, the rearing experiments of Lowndes (1928), in which he showed that specimens having different spine formulae could freely interbreed, that forms having intermediate and asymmetric spine formulae existed and that individuals of one form could occur in broods of the other, were instrumental in fostering the view that only one variable species (*vernalis*) should be recognized and that the spine formula should not be considered taxonomically important.

Lowndes' studies, however, were essentially uncritical in that each of his experiments was conducted on the progeny of a single, isolated ovigerous female. These progeny were necessarily conspecific and therefore all that can be concluded from his results is that within the species that he studied (whichever it was) the spine formula was variable. He, in fact, produced no evidence to negate the possibility, which he apparently did not consider, that two or more species, some or all of which might be variable with respect to the spine formula, might be contained within the *A. vernalis–robustus* complex.

This possibility is supported by the work of Price (1958) who found seven reproductively isolated forms of the *A. vernalis–robustus* complex in Canada. Price showed that these isolates (which must be considered separate species) varied not only morphologically, but also ecologically, physiologically and in their propensity to become parasitized by the tapeworm *Triaenophorus crassus* Forel. All seven isolates exhibited intraspecific variability with respect to the spine formula, with over one-quarter of the individuals examined in some isolates having spine formulae other than 3444 or 2333.

Kiefer (1976) has recently reviewed and redescribed, from topotype material, both *A. robustus* and *A. vernalis*, giving a whole suite of characters by which the two may be distinguished and minimizing the importance of the spine formula. Petkovski (1975) has also discussed the taxonomic relationship between the two species and considers them to be clearly distinct on the basis of genital characters.

Nevertheless, the situation is still not clear. Price's (1958) work indicates that the *A. vernalis–robustus* complex comprises at least seven, and probably more, species, most of which are very difficult to separate morphologically. Price himself pointed out that one of his isolates is most probably referable to *Cyclops brevispinosus* Herrick but the others remain unnamed. Other names are available in the literature but it is unlikely that these can be assigned with certainty to any of his isolates.

Furthermore, conflicting conclusions on the group have recently been produced: Kiefer (1976) concluded that *A. americanus* (Marsh), another species in the complex, is neither an independent species nor a form, variety or subspecies of *A. vernalis* or

A. robustus but a synonym of both. Conversely, Monchenko and Tavolzhanova (1976) have shown that reciprocal crosses of *A. vernalis* and *A. americanus* in Russia produced negative results, pointing to the reproductive isolation of both species.

The subject is far from exhausted and a thorough revision of the whole group, on a world-wide basis, is needed. In the meantime, however, because the Australian specimens agree best with Kiefer's (1976) description of *A. robustus*, they are assigned to that species.

Material Examined

Victoria: roadside pool, Dixon's Creek, 2.iii.1973; roadside pool, Nyora, 15.iv.1973; roadside pool, 4·6 km west of Nyora, 24.v.1973; paddock pools, Cardinia, 26.iv.1973; roadside pool, 16 km east of Lower Tarwin, 9.v.1974; farm dam, between Tarwin and Lower Tarwin, 9.v.1974; farm dam, between Bayles and Cardinia, 10.v.1974; billabong, Alexandra, coll. R. J. Shiel, 17.v.1974; Acheron River, via Buxton, coll. L. MacMillan, 25.v.1975; Dandenong Creek, Rowville, coll. J. Ischia, October 1975; Werribee River, Werribee, coll. L. MacMillan, 10.i.1976; roadside ditch, 5 km south-west of Maffra, coll. K. Hortle, 2.vii.1978; roadside ditch, 1 km west of Nathalia, 16.x.1978. **New South Wales:** Burrinjuck Dam, via Yass, coll. R. J. Shiel, 15.xi.1977. **South Australia:** Torrens River, Gumeracha, coll. R. J. Shiel, 2.vii.1976.

Remarks

This is a not uncommon species in south-eastern Australia, particularly in running waters. Its distribution is shown in Fig. 7.

Genus **Diacyclops** Kiefer

Cyclops (partim). Sars, 1918, pp. 47–54.
Cyclops (*Diacyclops*) (partim) Kiefer, 1927, pp. 306–7; Kiefer, 1928*a*, pp. 546–7; Kiefer, 1929, pp. 58–66.
Cyclops (*Acanthocyclops*) (partim). Gurney, 1933, pp. 219–51.
Diacyclops. Kiefer, 1937, p. 421; Dusssart, 1969, pp. 144–66.
Cyclops (*Diacyclops*). Yeatman, 1944, p. 4.
Acanthocyclops (partim). Rylov, 1948, pp. 238–64.

A1 of female 10- to 17-segmented, without hyaline membrane or spinule row on distal segments. Rami of P1–4 3-segmented in most cases, sometimes with P1Ri, P2Ri and P1Re 2-segmented. P4Ri3 with 2 terminal spines. P5 usually 2-segmented, rarely with proximal segment partially fused with lst urosomal somite (complete fusion seen sometimes in *A. nanus* and *A. abyssicola* only); proximal segment with seta at outer corner; distal segment with long apical outer seta and shorter inner spine, latter usually situated apically and about as long (or at least as long) as segment.

Type-species: *Cyclops bicuspidatus* Claus, 1857.

Key to Females of Australian Species of *Diacyclops*

A1 17-segmented; innermost terminal seta of CR shorter than outermost ..... *bisetosus* (Rehberg)
A1 11-segmented; innermost terminal seta of CR 1½–2 times as long as outermost .....
..... *cryonastes*, sp. nov.

Key to Males of Australian Species of *Diacyclops*

Innermost terminal seta of CR shorter than outermost; CR more than 4 times as long as wide .....
..... *bisetosus* (Rehberg)
Innermost terminal seta of CR 1½–2 times as long as outermost; CR less than 3 times as long as wide ..
..... *cryonastes*, sp. nov.

Diacyclops bisetosus (Rehberg)
(Figs 2*a*–2*e*)

Cyclops bisetosus Rehberg, 1880, p. 543; Lilljeborg, 1901, p. 14; Sars, 1918, p. 48.
?*Cyclops crassicaudoides* Kiefer, 1928*b*, pp. 7–8; Kiefer, 1928*c*, pp. 169–70.
?*Cyclops* (*Diacyclops*) *crassicaudoides* Kiefer, 1929, p. 60.
Cyclops (*Diacyclops*) *bisetosus* Rehberg. Kiefer, 1929, p. 60; Yeatman, 1944, pp. 55–6.
Cyclops (*Acanthocyclops*) *bisetosus* Rehberg. Gurney, 1933, pp. 227–30.
Acanthocyclops bisetosus Rehberg. Rylov, 1948, pp. 242–3.
?*Diacyclops crassicaudoides* Kiefer. Brehm, 1953, p. 57.

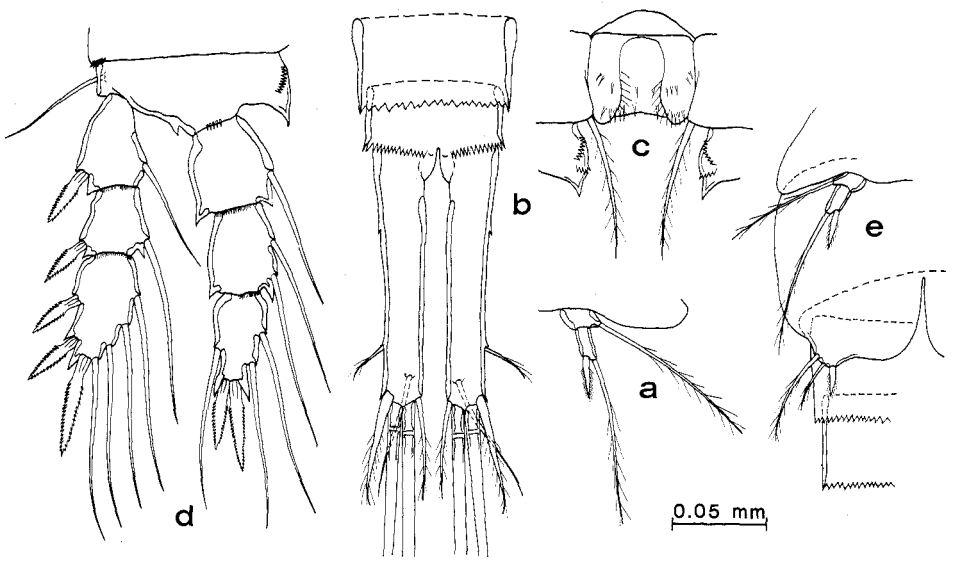

Fig. 2. *Diacyclops bisetosus* (Rehberg). Female: (*a*) P5; (*b*) caudal rami; (*c*) intercoxal plate of P4; (*d*) P4. Male: (*e*) P5 and P6.

Description

Female

Length 0·85–1·10 mm. Prosome slender, twice as long as greatest width and 1·6 times as long as urosome. 1st urosomal somite slightly produced laterally, equal to greatest width of genital somite. Genital somite about as long as broad, widest just anterior to middle and indented laterally at level of genital opening. Distal margin of genital and 2 succeeding somites denticulate dorsally and ventrally. Anal somite with row of spinules around bases of caudal rami dorsally and ventrally. Anal operculum well developed, truncated distally. Caudal rami (Fig. 2*b*) long and narrow, 4·6–5·8 times as long as greatest width and as long as last 3 abdominal somites combined; outer edge with small spinule $\frac{1}{3}$ way along ramus; outermost terminal seta strong, finely plumose, just less than $\frac{1}{2}$ length of ramus and slightly longer than slender, similarly plumose innermost seta; dorsal seta as long as, or slightly longer than, outermost seta; of 2 median terminal setae, outer about $\frac{3}{4}$ length of inner, inner about as long as the urosome—both these setae naked proximally and in distal $\frac{3}{5}$ of length bear long, fine, widely spaced setules.

A1 17-segmented, reaching no farther than end of cephalothorax; aesthete on segment 12 extends to more than $\frac{1}{2}$ way along segment 15. A2 and mouthparts not distinctive. P1–4 with both rami 3-segmented. Medial lobe of basis of P1 with seta reaching about to end of Ri2; that of P2–4 tapering to curved point, this most accentuated in P4. Intercoxal plate of P4 (Fig. 2*c*) with free edge straight or concave and with rounded prominence on each side and bearing row of setules on inner edge of each prominence, row of spinules just in from free edge and 2nd curved row of spinules near middle of plate. P1Ri2 with 1 seta, P2–4 with 2 setae on this segment; spine formula 2333; armature of swimming legs as follows:

P1	1.1.42	1.1.411,
P2	1.1.43	1.2.411,
P3	1.1.43	1.2.411,
P4	1.1.43	1.2.221.

P4Ri3 (Fig. 2*a*) 1·4–1·7 times as long as greatest width; inner terminal spine about same length as segment (0·9–1·1) and 1·3–1·5 times length of outer spine; setae of this segment extend well beyond ends of spines. P5 (Fig. 2*a*) 2-segmented; proximal segment twice as wide at its base as distal segment and bearing long seta at its outer distal corner; distal segment twice as long as wide and bearing terminally long, slender outer seta and, subterminally, spine slightly longer than segment.

Male

Length 0·75–0·88 mm. P6 (Fig. 2*e*) comprising very short inner spine, median seta about 1·5 times as long as spine, and slender outer seta up to 3 times as long as spine.

Discussion

Brehm (1953) recorded *D. crassicaudoides* from Launceston in Tasmania. This species, described by Kiefer (1928*b*, 1928*c*) from Lake Ellesmere in New Zealand, differs from *D. bisetosus* only in the structure of the seminal receptacle, which was observed by Kiefer (1928*c*) in only one specimen. This separation of the two taxa is of dubious validity, not only because it is often quite difficult to observe accurately the structure of the seminal receptacle but also because its possible variability has not been studied (Dumont *et al.* 1981).

Chapman and Lewis (1976, p. 124) queried the authenticity of *D. crassicaudoides* and stated that they have never found it in New Zealand. Kiefer himself recorded *D. crassicaudoides* from only one locality while *D. bisetosus* occurred commonly in the same region (Kiefer 1931). Similarly, where it has been possible to observe the seminal receptacle in Australian specimens, all have been of the configuration seen in *D. bisetosus*.

In view of the foregoing, therefore, it seems highly probable that Brehm's (1953) identification of his specimens as *D. crassicaudoides* was in error. It also appears likely that *D. crassicaudoides* is a junior synonym of *D. bisetosus*.

Material Examined

Victoria: roadside pool, Nyora, 15.iv.1973; roadside pools, Cranbourne, 24.v.1973; pools, Monash campus, Clayton, 24.v.1973, 23.vi.1973, 22.vii.1973, 25.viii.1973, 29.ix.1973; roadside pool, Catani, 26.vi.1973; paddock pool, Cardinia, 26.vi.1973; roadside pool, Clayton, 22.vii.1973; pool near Bunyip River, near crossing of South Gippsland Highway, 8.viii.1973; pool, Jock Marshall Reserve, Clayton, 10.viii.1973. **Tasmania:** roadside pool, 1·5 km north of Osterley, 20.viii.1974; permanent pond, 11 km east of Derwent Bridge, 20.viii.1974; roadside pool, Stonor, 22.viii.1974; roadside pool, 8 km east of Steppes, 22.viii.1974; farm dam, 1·5 km north of Richmond, 23.viii.1974; roadside pool, 19 km south of Perth, 25.viii.1974; roadside pool, 16 km south-east of Campbell Town, 25.viii.1974; farm dam, 3 km south of Conara Junction, 25.viii.1974.

Diacyclops cryonastes, sp. nov.
(Figs 3*a*–3*e*)

Acanthocyclops sp. Bayly, 1970, p. 25.
Acanthocyclops, sp. nov. Cowie, 1980, p. 25.

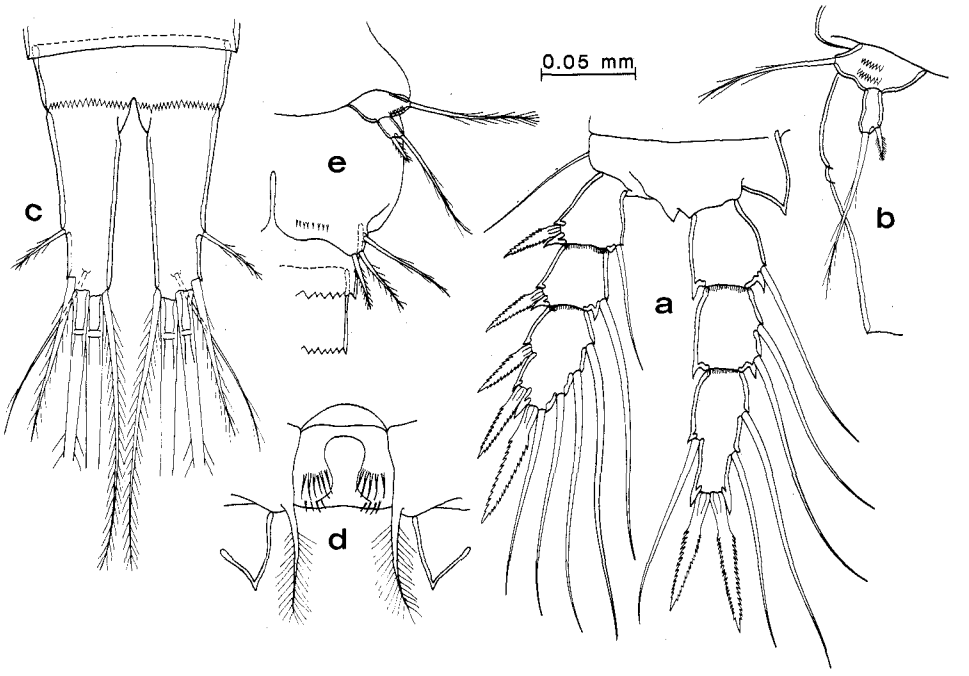

Fig. 3. *Diacyclops cryonastes*, sp. nov. Female: (*a*) P4; (*b*) P5; (*c*) caudal rami; (*d*) intercoxal plate of P4 (posterior view). Male: (*e*) P5 and P6.

Description

Female

Length 0·80–1·04 mm. Prosome oval, 1·6 times as long as wide and 1·6 times as long as urosome. 1st urosomal somite wider than genital somite. Genital somite as long as wide, widest anteriorly. Distal margins of genital and 2 succeeding somites unornamented dorsally and ventrally. Anal somite with row of spinules around base of caudal rami ventrally. Anal operculum weakly developed, slightly convex. Caudal rami (Fig. 3*c*) 2·5–3·5 times as long as greatest width and slightly longer than combined lengths of last 2 urosomal somites; innermost terminal seta slender, 1·6–1·9 times length of outermost seta and noticeably longer than ramus—both these setae bear fine setules along almost entire length; dorsal seta longer than outermost seta; of 2 median terminal setae, inner about as long as urosome and almost twice length of outer—both these setae naked proximally and in distal $\frac{3}{5}$ bear long fine setules.

A1 11-segmented, reaching almost to end of cephalothorax. A2 and mouthparts not distinctive. P1–4 with both rami 3-segmented. Medial lobe of basis of P1 with seta reaching past end of Ri2; that of P2–4 tapering to point, this most accentuated in P4. Intercoxal plate of P4 (Fig. 3*d*) with free edge slightly concave and bearing 2 rows of spinules on each side, 1 row situated near free edge and other, comprising longer spinules, about $\frac{1}{2}$ way along plate. P1Ri2 with 1 seta, P2–4 with 2 setae on this segment; spine

formula 2333; complete armature of P1–4 identical with that of *D. bisetosus*. P4Ri3 (Fig. 3*a*) 1·7–2·3 times as long as wide; inner terminal spine 0·9–1·2 times length of segment and 1·0–1·3 times length of outer spine; all setae of this segment extend beyond ends of terminal spines. P5 (Fig. 3*b*) 2-segmented; proximal segment 3–4 times wider at its base than distal segment, with 2 rows of spinules on its ventral surface and bearing long seta at its distolateral corner; distal segment approximately twice as long as wide and bearing long terminal outer seta and short inner subterminal spine as long as segment.

Male

Length 0·79–0·82 mm. Distal margins of 2nd, 3rd and 4th urosomal somites denticulate ventrally. P4Ri3 proportionately shorter than in female (length : width 1·6–1·7) and its inner terminal spine comparatively longer (length of spine : length of segment 1·3–1·4). P6 (Fig. 3*e*) comprising short inner spine, slightly longer median seta, and outer seta twice as long as median seta.

Etymology

The specific name, *cryonastes*, is derived from the Greek words *cryos* (= cold) and *nastes* (= an inhabitant), indicating that the species appears to favour cold conditions.

Type Material

Holotype ♀, allotype ♂ and 6 paratypes ♀, *Sphagnum* bog near summit of Mt Baw Baw, Victoria, coll. J. A. McAuley, 14.iv.1976 (MVM J7433–7435).

Discussion

This species belongs to a circum-Antarctic group of species that includes also *D. michaelseni* (Mrazek), *D. skottsbergi* (Lindberg) and *D. mirnyi* (Borutsky & Vinogradov). *D. michaelseni* is known from freshwater ponds and pools in Tierra del Fuego and the Falkland Islands and *D. skottsbergi* (described from a single damaged male) is recorded from the estuary of the Para River, South Patagonia (Lindberg 1949). *D. mirnyi* is a pelagic form from large, deep lakes in the Bunger and Vestfold oases in Antarctica (Borutsky and Vinogradov 1957).

According to Borutsky and Vinogradov (1957), the species of this group are characterized by an 11-segmented A1 in the female, three-segmented rami in all swimming legs, and segments of P4 that are 'longer than usual'. This last character is somewhat vague and cannot be considered definitive of the group as numerous other *Diacyclops* species possess comparatively elongate segments in P4. Moreover, an 11-segmented A1 in the female cannot yet be said to be absolutely diagnostic of the group as the female of *D. skottsbergi* is unknown, this species being included in the group on the basis of other features (structure of P5 and CR). Nevertheless, these species do seem to form a cohesive group, especially when their geographical distribution is considered.

D. cryonastes differs from the other species of the group primarily in that the basal segment of P5 of this species is not partially fused with the first urosomal somite in either sex as it is in the other species. Additionally, *D. cryonastes* may be readily distinguished from both *D. mirnyi* and *D. michaelseni* by its possession in both sexes of shorter caudal rami, longer dorsal and innermost terminal setae of the caudal rami, and different structures of the anal operculum, P4Ri3, and P6 of the male. Comparison

of *D. cryonastes* with *D. skottsbergi* is hampered by the fact that only the male of the latter is known. However, the two are easily distinguishable because, apart from the difference in P5 (see above), they differ in the appearance of the caudal rami (inner margins hairy in *D. skottsbergi*, bare in *D. cryonastes*) and the length of the dorsal seta of the caudal rami (shorter than the outer seta in *D. skottsbergi*, longer in *D. cryonastes*).

Material Examined

Victoria: *Sphagnum* bog, Mt Buffalo, coll. J. L. McAuley, 20.iii.1976; *Sphagnum* bog, Mt Baw Baw, coll. J. L. McAuley, 14.iv.1976, 27.v.1976, 14.vii.1976; Acheron River, 5 km east of Narbethong, coll. L. A. Barmuta, 19.xi.1980; burrow water of *Engaeus* sp., Sherbrooke Forest, Sherbrooke, coll. A. J. Boulton, 15.ix.1983. **New South Wales:** Lake Cootapatamba, Mt Kosciusko, coll. I. A. E. Bayly, 22.ii.1969. **Tasmania:** roadside pool, 19 km south-west of Smithton, 18.viii.1974; roadside pool, 5 km east of Marrawah, 18.viii.1974; roadside pool, Parrawe, 18.viii.1974; permanent (?) pond, 27 km north of Rosebery, 19.viii.1974; permanent (?) pond near Lake Echo, 20.viii.1974; roadside pool near Lake Echo, 20.viii.1974; pool near Lake Crescent, 20.viii.1974; bog at Darwin Creek, 19 km east of Queenstown, coll. P. S. Lake, 31.x.1976.

Remarks

In Tasmania this species has a wide altitudinal range, occurring in both temporary pools and permanent ponds in lowland coastal areas and also on the Central Plateau. On the mainland, however, it is known only from high alpine areas of the Great Dividing Range. The distribution is shown in Fig. 7.

Genus **Australocyclops**, gen. nov.

Notocyclops Powling, 1980, p. 336 (*nomen nudum*).

1st urosomal somite unornamented, not laterally produced but produced ventrolaterally on each side (= remnant of primitive basal segment of P5) and bearing seta laterally. 4 terminal caudal setae bear long, fine setules along entire, or almost entire, lengths. A1 of female 12-segmented. P1 with both rami 2-segmented; those of P2–4 3-segmented. Medial lobe of basis of P1 bearing strong seta; those of P2–4 bearing small pointed spur at, or slightly abaxial from, corner. P4Rel without inner seta; P4Ri3 with 2 terminal spines. Spine formula 3333; armature of swimming legs as follows:

P1	1.53	1.511,
P2	1.1.43	1.1.411,
P3	1.1.43	1.1.411,
P4	0.1.43	1.1.221.

P5 1-segmented, situated on ventrolateral expansion of 1st urosomal somite, tapering distally and bearing long, apical seta and, usually, non-articulated spinule (may be greatly reduced) on inner margin.

Type-species: *Cyclops australis* Sars, 1896.

Discussion

As thus defined, the genus is distinguished from the closely related genera *Acanthocyclops* and *Microcyclops* by the following combination of characters—P5 one-segmented, P1 with both rami two-segmented, those of P2–4 three-segmented, P4Re1 without an inner seta.

The only species of *Australocyclops* hitherto known, *A. australis* (Sars), has been assigned both to *Microcyclops* (Kiefer 1929) and to *Acanthocyclops* (Rylov 1948), thereby creating problems in both genera. Inclusion of *Australocyclops australis* in *Microcyclops* destroys the homogeneity of that genus, all other species of which have

two-segmented rami in all swimming legs. On the other hand, to place the species in *Acanthocyclops* is equally objectionable because of the one-segmented nature of P5 in *Australocyclops australis*. Moreover, the articulation pattern of the swimming legs of *A. australis* is not found in any species of *Acanthocyclops*.

It may be argued that the single segment of P5 in *Australocyclops australis* is very similar to the distal segment of P5 in some species of *Acanthocyclops*, thus suggesting an intimate relationship between this species and that genus (assuming that P5 in *Australocyclops* is the result of fusion of the proximal segment with the first urosomal somite). However, the structure of the corresponding segment in the two new species included in *Australocyclops* is of the type found in *Microcyclops varicans* and related species, a structure not otherwise seen in *Acanthocyclops*. In any case, the permanent loss of a segment of a leg, particularly a leg of such taxonomic importance as P5, is a reduction so profound that it must be considered of generic importance.

Gurney's (1933) definition of *Acanthocyclops* is very broad and easily includes the three species here assigned to *Australocyclops* even though they are included more by means of his exceptions to the criteria he proposed than by the criteria themselves. These species, however, are considered sufficiently distinct, although morphologically homogeneous amongst themselves, to warrant the erection of the new genus.

Key to Females of *Australocyclops*, gen. nov.

1. CR with setules along inner edges; P5 with inner spine reaching past end of segment ..... *australis* (Sars)
   Inner edges of CR without setules; inner spine of P5, when present, greatly reduced and never reaching past end of segment 2
2. Innermost terminal seta of CR at least twice as long as ramus; CR less than 3 times as long as wide ..... *palustrium*, sp. nov.
   Innermost terminal seta of CR at most only slightly longer than ramus; CR more than 3 times as long as wide ..... *similis*, sp. nov.

Australocyclops australis (Sars)
(Figs 4*a*–4*e*)

?*Cyclops australis* King, 1855, p. 74 (*nomen nudum*).
Cyclops australis King. Sars, 1896, pp. 74–5; Sars, 1908, pp. 15–16; Henry, 1922, p. 562.
Cyclops sydneyensis Schmeil, 1898, pp. 154–5.
Cyclops (*Microcyclops*) *australis* King. Kiefer, 1929, p. 69.
Cyclops restrictus Lindberg, 1948, pp. 73–6.
Acanthocyclops australis (King). Rylov, 1948, p. 211.
Microcyclops australis (Sars). Bayly, 1967, p. 12.
Microcyclops sydneyensis (Schmeil). Timms, 1970, p. 22.

Discussion of Synonymy

King (1855) gave neither description nor figures of the species he named *Cyclops australis*, which thus becomes a *nomen nudum* and is accordingly unavailable under Article 12 of the International Code of Zoological Nomenclature. Sars (1896) briefly described a species that he took to be *Cyclops australis* King simply because it was the only species found by him, in collections from near Sydney, that could not be identified with a well-known European species. Sars was thus the first actually to describe the species and must therefore be considered its author, a fact alluded to by him in a later paper (Sars 1908). The law of homonymy (Article 53, International Code of Zoological Nomenclature) is not applicable here as King's name is unavailable.

Schmeil (1898) proposed the name *Cyclops sydneyensis* as a replacement for *C. australis* King, which he, quite correctly, considered unavailable. However, Sars' paper clearly predates that of Schmeil and his (Sars') name must take precedence.

The figures and description provided by Lindberg (1948) for his species *Cyclops restrictus* show this to be, without doubt, a junior synonym of the present species. This is confirmed by the same author in a later paper (Lindberg 1953).

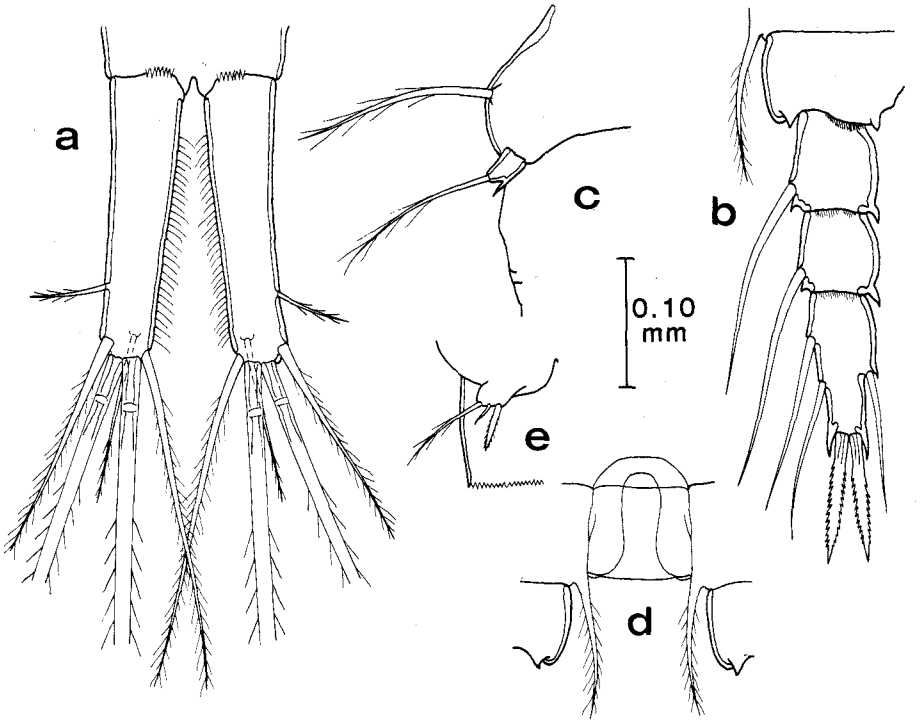

Fig. 4. *Australocyclops australis* (Sars). Female: (*a*) caudal rami; (*b*) P4Ri; (*c*) P5; (*d*) intercoxal plate of P4. Male: (*e*) P5 and P6.

Description

Female

Length 1·30–2·00 mm. Prosome robust, elliptical, 1·8 times as long as greatest width and 1·3 times as long as urosome. Genital somite slightly longer than wide, widest anteriorly; posterior margin of this and 2 succeeding somites denticulate ventrally and dorsally. Anal somite unornamented dorsally, bearing ventrally group of 10–12 spinules of varying size situated slightly medial of centre of base of each caudal ramus. Anal operculum weakly convex. Caudal rami (Fig. 4*a*) 4·3–8·1 times as long as wide and about as long as, or slightly longer than, last 3 urosomal somites combined; continuous row of setules present along whole of inner margin; innermost terminal seta long, slender, 0·8–1·1 times length of ramus and 1·3–1·6 times length of outermost terminal seta; dorsal seta very thin, shorter than outermost terminal seta; of 2 median terminal setae, inner about 0·8 times length of urosome and about 1·3 times length of outer.

A1 reaching about to end of cephalothorax. A2 and mouthparts (except Mx) not distinctive. Mx with strong seta at base of beak-like process of basis with 7–8 spinules along its proximal edge. Spines of P1 bearing setules rather than denticles marginally.

Intercoxal plate of P4 (Fig. 4*d*) unornamented, with free edge straight or slightly sinuate and with very small, rounded prominences laterally. P4Ri3 (Fig. 4*b*) 1·8–2·2 times as long as wide; inner terminal spine 0·8–1·0 times length of segment and 1·0–1·2 times as long as outer; setae of this segment do not reach quite to ends of terminal spines. P5 (Fig. 4*c*): segment slightly longer than greatest (=basal) width and bearing large sharply pointed spinule arising $\frac{2}{3}$ way along inner edge and extending past end of segment.

Male

Length to 1·20 mm. Anal somite ornamented distally with continuous row of spinules around base of each caudal ramus ventrally and dorsally. Lateral and outermost terminal setae of caudal ramus with small group of spinules immediately anterior to their points of insertion.

P4Ri3 slightly more slender than in female (2·2–2·5 times as long as wide) with comparatively longer inner spine (1·0–1·4 times length of segment); setae of this segment all reach to end of terminal spines. P6 (Fig. 4*e*): outer seta reaches nearly to end of 3rd urosomal somite; median seta short, $\frac{1}{3}$ length of outer seta; inner spine strong, twice length of median seta.

Material Examined

Victoria: Lake Catani, Mt Buffalo, coll. I. A. E. Bayly, February 1969; farm dam, Wulgulmerang Junction, coll. I. A. E. Bayly, February 1969; Lake Omeo, via Benambra, coll. B. V. Timms, 1.xi.1970; Lake King, via Benambra, coll. B. V. Timms, 1.xi.1970; Swan Lake, via Nelson, coll. B. V. Timms, 17.xi.1970; pools in paddock, Yarra Glen, 9.ii.1973; roadside pool, Catani, 26.vi.1973; roadside pool, Traralgon, 17.vii.1973; pool, 11 km east of Rosedale, 19.vii.1973; pools, Monash Campus, Clayton, 10.viii.1973; pools, Cavendish, 18.viii.1973; Hattah Lake, Hattah Lakes National Park, coll. B. V. Timms, 10.xii.1973; Moonee Ponds Creek, coll. J. M. Bayly, April 1974; pool, near Lake Cundare, Cundare, 20.v.1974; pool, 9·6 km east of Cobden, 20.v.1974; permanent pond, 22 km south of Harrow, 21.v.1974; roadside pool, 3·2 km south of Glenormiston North, 21.v.1974; roadside pool, Dopewara, coll. N. A. Robinson, 22.v.1974; waterhole, 27·2 km south of Kaniva, 23.v.1974; pool, 21 km east of Horsham, 24.v.1974; artificial pond, South Yarra, coll. R. Hamond, 24.vi.1975; farm dam, Devon Meadows, coll. R. Tait, 30.vi.1976; Eildon Reservoir, via Alexandra, coll. R. J. Sheil, 14.x.1977; Pink Lake, via Nhill, coll. R. J. Shiel, 27.v.1978; billabong, Seymour, coll. R. J. Sheil, 22.viii.1978; billabong, Wodonga, coll. R. J. Shiel, 5.ix.1978; roadside pools, 33 km north-east of Edenhope, 18.x.1978; roadside ditch, 9 km north-east of Edenhope, 18.x.1978; roadside ditch, 11 km south-east of Carimut, 19.x.1978; roadside ditch, 7 km west of Edenhope, 19.x.1978; roadside ditch, 12 km north of Rokewood, 20.x.1978; roadside ditch, 2 km north-west of Gisborne, 20.x.1978; paddock pools, 5 km south of Portland, coll. C. Yule, 10.vii.1979. **Tasmania:** farm dam, 6·4 km east of Tasman Bridge, coll. I. A. E. Bayly, August 1965; pool, 37 km east of Smithton, 17.viii.1974; swamp, 13 km east of Marrawah, 18.viii.1974; roadside pools, 9·6 km north of Steppes, 22.viii.1974; farm dam, 3·2 km north of Rhyndaston, 22.viii.1974; farm dam, 1·6 km north of Richmond, 23.viii.1974; paddock pool, 19 km south of Perth, 25.viii.1974; paddock pool, opposite Devonport Airport, 27.viii.1974. **South Australia:** roadside pools, 16 km south of Bordertown, 23.v.1974; farm dam, 40 km west of Murray Bridge, 13.vii.1974; roadside pool, Lochiel, 14.vii.1974; farm dam, 6·4 km west of Quorn, 14.vii.1974; small lake, Quorn Caravan Park, 14.vii.1974; Aroona Dam, 22·5 km south of Leigh Creek, 17.vii.1974; paddock pools, 16 km east of Peterborough, 19.vii.1974; waterhole, 11 km south-east of Cockburn, 19.vii.1974; Lake Alexandrina, coll. M. C. Geddes, 18.v.1977; Murray River, Mannum, coll. R. J. Shiel, 30.xi.1977. **New South Wales:** treehole, Moree, coll. A. Dyce, 17.xii.1963; Lake Jindabyne, coll. I. A. E. Bayly, 22.xi.1969; Steven's Creek Reservoir, via Broken Hill, coll. B. V. Timms, 10.xii.1973; farm dam, Murrumbo, via Denman, coll. B. V. Timms, 14.xii.1973; roadside pool, 107 km south of Broken Hill, 20.vii.1974; stock dam, Lightning Ridge, coll. B. V. Timms, 22.vii.1974; farm dams, 10 km north of Holbrook, coll. R. Hamond, 9.iv.1975; unnamed lake south of Boundary Lake, via Nimmitabel, coll. B. V. Timms, 14.v.1975. **Queensland:** roadside pool, Barcaldine, coll. B. V. Timms, 18.vii.1974; dam, 60 km east of Cunnamulla, coll. R. J. Shiel, 23.v.1978. **Western Australia:** unnamed lake, south of Yarloop, coll. I. A. E. Bayly, 12.vi.1977; roadside pool, 2·3 km south of Northcliffe, coll. I. A. E. Bayly, 17.vi.1977; granite rock pool, Yowerda Soak, 22.viii.1978; roadside pool, 17 km north of Gibson, 25.viii.1978.

Remarks

A. australis is widespread and common over most of Australia; records are lacking only for the far north of the continent (Fig. 7). This is an opportunistic, possibly fugitive, early colonizer of new habitats, i.e. temporary pools, farm dams and large man-made reservoirs, where it can be found living a truly planktonic existence (Bayly 1970).

This species attains the largest size of all Australian freshwater cyclopoids.

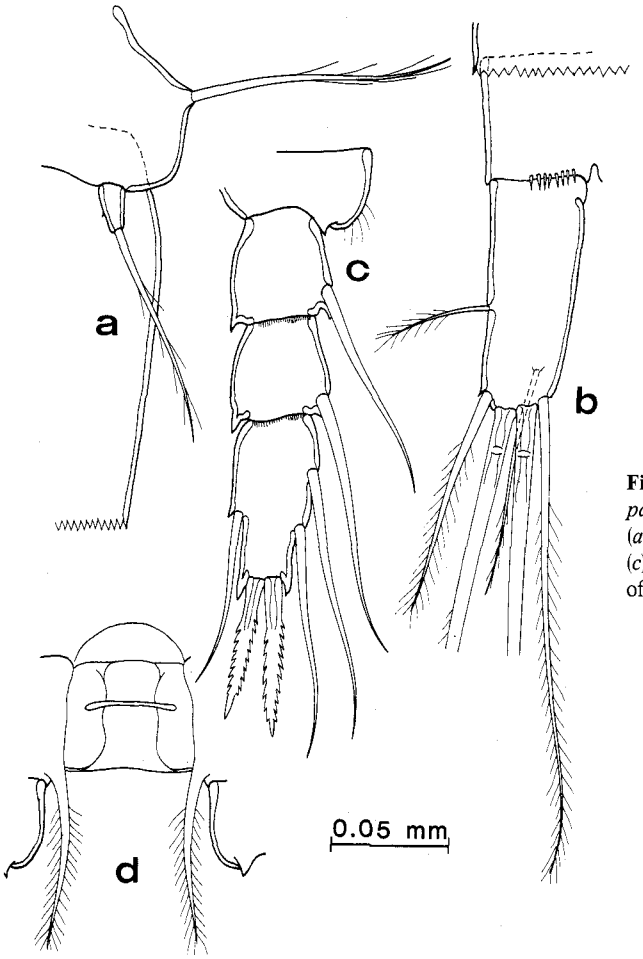

Fig. 5. *Australocyclops palustrium*, sp. nov. Female: (*a*) P5; (*b*) caudal ramus; (*c*) P4Ri; (*d*) intercoxal plate of P4.

Australocyclops palustrium, sp. nov.
(Figs 5*a*–5*d*)

Description

Female

Length 1·15–1·20 mm. Prosome elliptical, 1·5 times as long as greatest width and 1·3 times length of urosome. Genital somite slightly wider than long, widest $\frac{1}{2}$ way along length; posterior margin of this and 2 succeeding somites denticulate ventrally and dorsally. Anal somite unornamented dorsally, bearing ventrally group of about 7–10 spinules situated a little adaxial of centre of base of each caudal ramus. Anal operculum

moderately developed, convex. Caudal rami (Fig. 5*b*) 2·3–2·9 times as long as greatest width and about as long as, or slightly longer than, last 2 urosomal somites combined; inner margins without setules, innermost terminal seta 2·2–2·4 times as long as ramus and 1·9–2·4 times length of outermost terminal seta; dorsal seta shorter than outermost seta; of 2 median terminal setae, outer about as long as urosome and about $\frac{2}{3}$ length of inner.

A1 reaching about to end of cephalothorax. A2 and mouthparts (except Mx) not distinctive. Mx with strong seta at base of beak-like process of basis with 3–4 spinules along its proximal edge. Seta on medial lobe of basis of P1 borne on small distally directed prominence. Intercoxal plate of P4 (Fig. 5*d*) unornamented, with free edge sinuate or slightly concave, lateral prominences very small or absent. P4Ri3 (Fig. 5*c*) 2·0–2·4 times as long as greatest width; inner terminal spine as long as, or slightly shorter than (0·9–1·0), length of segment and 1·1–1·3 times length of outer spine; setae of this segment reach, at most, to end of inner terminal spine. P5 (Fig. 5*a*): segment twice as long as greatest (= basal) width and either with inner edge bare or, occasionally, with minute spinule $\frac{2}{3}$ way along inner edge.

Male

Unknown.

Etymology

The specific name, *palustrium* (Latin, of swampy places), alludes to the localities, especially the type locality, where the species has been found.

Type Material

Holotype ♀ and 6 paratypes ♀, swamps in Botanical Gardens Annexe, Cranbourne, Victoria, 7.vii.1976 (MVM J7436 and J7437).

Material Examined

Victoria: swamps in Botanical Gardens Annexe, Cranbourne, 7.vii.1976; roadside pool, 10 km east of Terang, coll. P. S. Lake, 26.x.1976. **South Australia:** flooded ditch, 6·4 km north of Beachport, 12.vii.1974. **Tasmania:** extensive temporary water, 3·2 km south of Conara Junction, 25.viii.1974.

Remarks

This species is apparently widespread in south-eastern Australia (Fig. 7) but is not common. It has been collected only from temporary waters.

Australocyclops similis, sp. nov.
(Figs 6*a*–6*d*)

Description

Female

Length 0·89–1·13 mm. Prosome slender, elliptical, 1·6 times as long as greatest width and 1·4 times length of urosome. Genital somite about as wide as long, widest anteriorly; posterior margin of this and 2 succeeding somites either unornamented or weakly denticulate dorsally and ventrally. Anal somite ornamented distally with row of spinules around base of each caudal ramus ventrally and dorsally. Anal operculum

rather well developed, distal edge straight. Caudal ramus (Fig. 6*c*) 3·1–4·1 times as long as wide and about as long as last 3 urosomal somites combined; inner margins without setules; innermost terminal seta slender, 0·8–1·2 times length of ramus and 1·2–1·8 times as long as outermost terminal seta; of 2 median terminal setae, outer about $\frac{3}{4}$ length of inner, inner slightly shorter than urosome.

A1 reaching about to end of cephalothorax. A2 and mouthparts (except Mx) not distinctive. Mx with strong seta at base of beak-like process of basis without strong spinules along proximal edge but with 1–2 small spinules on proximal or both edges. Intercoxal plate of P4 (Fig. 6*b*) unornamented, with free edge sinuate and reduced lateral prominences. P4Ri3 (Fig. 6*d*) 1·6–2·0 times as long as greatest width; inner terminal spine 0·8–1·1 times length of segment and 1·1–1·3 times as long as outer spine; all setae of this segment reach at least to end of terminal spines. P5 (Fig. 6*a*): segment about 1·5 times as long as greatest (= basal) width and bearing, just past midway along inner edge, very small spinule not reaching to end of segment.

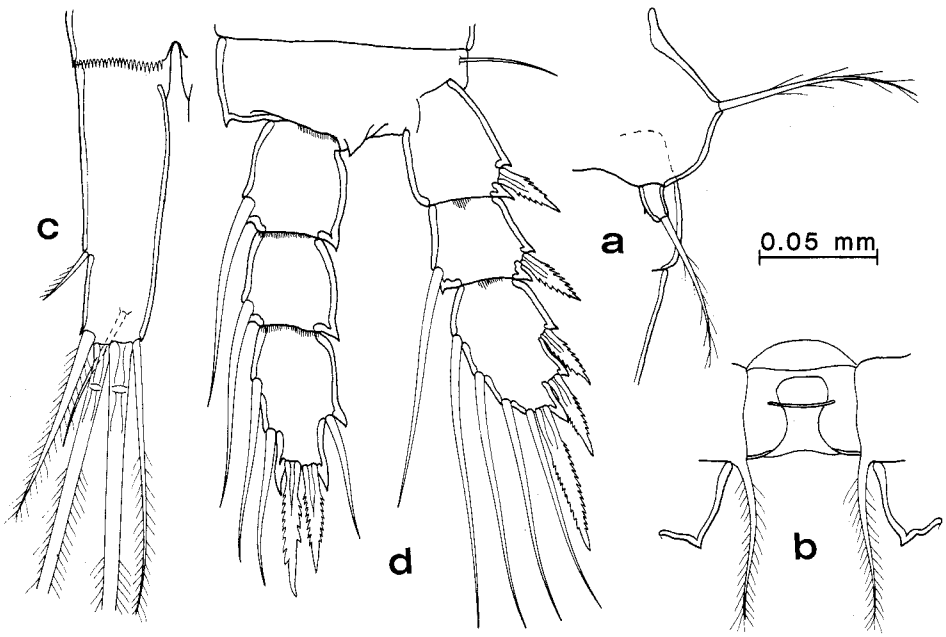

Fig. 6. *Australocyclops similis*, sp. nov. Female: (*a*) P5; (*b*) intercoxal plate of P4; (*c*) caudal ramus; (*d*) P4.

Male

Unknown.

Etymology

The specific name, *similis* (Latin, similar), refers to the similarity between this species and others of the genus.

Type Material

Holotype ♀ and 6 paratypes ♀, temporary roadside pools, Fernbank, Victoria (37°52′15″S.,147°19′30″E.), 17.vii.1973 (MVM J7438 and J7439).

Material Examined

Victoria: roadside pools, Fernbank, 17.vii.1973; roadside pool, 8 km west of Bairnsdale, 17.vii.1973; roadside pool, 10 km east of Stratford, 18.vii.1973; Showler's Swamp, Karnak, coll. N. Robinson, 22.v.1974; permanent pond, Gordon, coll. R. Hamond, 23.x.1976; roadside ditch, 7 km west of Edenhope, 19.x.1978; paddock

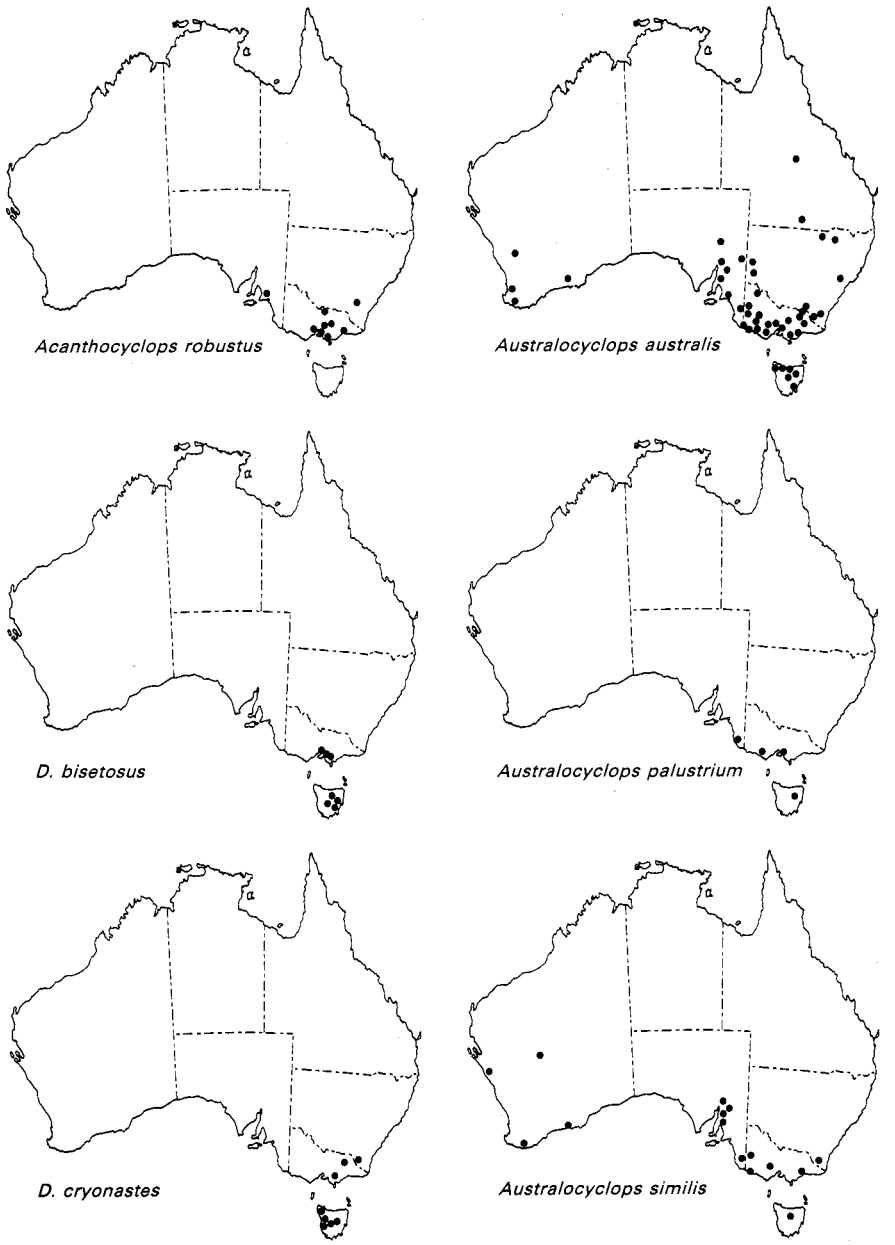

Fig. 7. Distribution of the Australian species of *Acanthocyclops*, *Diacyclops* and *Australocyclops*.

pools, 5 km south of Portland, coll. C. Yule, 10.vii.1979. **New South Wales:** unnamed lake south of Boundary Lake, via Nimmitabel, coll. B. V. Timms, 14.v.1975. **South Australia:** pool, 16 km south of Bordertown, 23.v.1974; pool, 25·6 km north of Snowtown, 14.vii.1974; Broughton River, 4·8 km south of Crystal Brook, 14.vii.1974; farm dam, 4·8 km north of Crystal Brook, 14.vii.1974; roadside pool, 6·4 km west of Quorn,

14.vii.1974; farm dam, Orroroo, 18.vii.1974; roadside pool, 22 km north of Orroroo, 18.vii.1974. **Tasmania:** roadside pool, 9·6 km north of Steppes, 28.viii.1974. **Western Australia:** roadside pool, 144 km north of Geraldton, coll. I. A. E. Bayly, 19.viii.1973; paddock pool, 6·5 km east of Kenderup, coll. I. A. E. Bayly, 24.v.1977; roadside ditch, Stirling National Park, coll. I. A. E. Bayly, 24.v.1977; roadside ditch, 37 km west of Esperance, coll. I. A. E. Bayly, May 1977; roadside ditch, north of Scadda, coll. I. A. E. Bayly, 5.vii.1977; pool in weedbed, south of Wiluna, 19.viii.1978.

Remarks

A. similis is not uncommon. It is known from both permanent and temporary waters across much of the southern half of the continent (Fig. 7).

Acknowledgments

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