CSIRO Publishing

Invertebrate Taxonomy

An international journal of biodiversity and systematics

Volume 15, 2001

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Invertebrate Taxonomy, 2001, **15**, 893–908

Meridiecyclops, gen. nov., a new cyclopid genus (Crustacea : Copepoda : Cyclopidae) from southern Australia

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Abstract. Some 60 years after the initial description by Sars (1908) of *Metacyclops arnaudi* found in a swamp in Victoria, Kiefer (1967) reported this species again from the same region, and described a subspecies *M. arnaudi platypus* from a locality in South Australia. Re-examination of the specimens studied by Kiefer revealed several important differences between them and Sars' original description. Moreover certain unique features of both taxa, as displayed in the morphology of the fourth leg, the female genital field and, not least, in the remarkable dimorphism of the maxilla in the male, justify the erection of a separate genus, *Meridiecyclops*, gen. nov. Two species, *M. baylyi*, sp. nov. (for Kiefer's *Metacyclops arnaudi s. str.*) and *M. platypus*, new rank (for Kiefer's *M. arnaudi platypus*), are assigned to the genus, the former being designated as type species.

Introduction

Although freshwater copepod research in Australia dates back to the middle of the 19th century, information on species richness has remained fragmentary. Until about 1985 only 20 cyclopid species were reported from this immense continent (Morton 1985 and references therein). In recent decades, however, renewed interest in the Australian continental cyclopid fauna (Dumont and Maas 1985; Morton 1985, 1990; Dussart and Fernando 1988; Pesce and De Laurentiis 1996; Pesce *et al.* 1996*a*, 1996*b*; De Laurentiis *et al.* 1997, 1999) resulted in a further addition of several species, mostly new to science.

In several contributions Bayly (1964) and Bayly and Williams (1964, 1966*a*, 1966*b*) have described the limnological characteristics of many Australian inland waters. Identification of the invertebrates encountered in their studies was often entrusted to specialists in Australia and abroad. Cyclopid copepods were sent for identification to Friedrich Kiefer in Germany who reported (Kiefer 1967) on three different cyclopid species (*Halicyclops ambiguus* Kiefer, 1967; *Metacyclops arnaudi* (Sars, 1908); *Apocyclops dengizicus* (Lepeschkin, 1900)) and one subspecies (*M. arnaudi platypus* Kiefer, 1967) found in eight samples obtained in Victoria, South Australia and Queensland. From the Australian continent one other species of the genus *Metacyclops* is known, *M. mortoni* Pesce *et al.* 1996*a*, recently described from the Cape Range Peninsula in Western Australia. An unnamed and as yet undescribed species of *Metacyclops* was reported by Timms and Morton (1988).

Within the framework of a study on the speciose and cosmopolitan genus *Metacyclops* Kiefer, 1927, the specimens attributed by Kiefer (1967) to *M. arnaudi* were re-examined. This revealed some quite important differences with respect to the original description of this species. Unfortunately, the type material of the latter is no longer available (Hamond 1987), hence only the original description of Sars (1908) with its fine illustrations can be used for comparison. The aims of the present paper are to redescribe the specimens attributed by Kiefer (1967) to *M. arnaudi* in detail, and to define a separate cyclopid genus, *Meridiecyclops*, gen. nov. to accommodate *M. baylyi*, sp. nov. and *M. platypus*, new rank. This forms part of the ongoing work towards a phylogenetic analysis of *Metacyclops* and related genera.

Material and methods

The material studied herein forms part of the Friederich Kiefer Copepod Collection (referred to as FKCC) lodged in the Staatliches Museum für Naturkunde in Karlsruhe (Germany). Dissected animals are mounted in glycerine, while preserved specimens are stored in a drop of glycerine. Observations were made with a Leitz Diaplan light microscope equipped with phase contrast, at magnifications of 625× and 1250×. Abbreviations used throughout the text are: Aesth, aesthetasc; Exo, exopodite; End, endopodite.

Metacyclops arnaudi: a comparison between the two available descriptions

When Sars (1908) described *Cyclops arnaudi* from a swamp at St Arnaud, located in northern Victoria, his sample contained only two adult females. The species was never

 10.1071/IT01003 0818-0164/01/06893

reported again until Kiefer (1967) attributed specimens found in samples from Victoria to this species. Kiefer (1967) pointed out several differences between the new material and the original description and illustrations, but considered them insignificant. In the following paragraphs, the main differences between Sars' description and Kiefer's are commented upon.

The specimens of *Metacyclops arnaudi* originally studied by Sars measured 950 µm and had a furcal index (length/width ratio) of more than 7 (measured from the illustration: Pl. IV: 8). The specimens observed by Kiefer measured 1630 µm, and had a furcal index between 4.8 and 5. Kiefer assumed that these differences were a result of the saline characteristics of the lakes whence his specimens came. Body length and the length/width ratio of the caudal rami may show considerable variability in certain cyclopid species, however, differences as large as those mentioned here are well beyond the range of natural variability.

Sars' illustration of the caudal ramus (Pl. IV: 8) shows clearly that the principal terminal setae have a breaking plane (for definition, see Von Vaupel Klein 1986) near their base. In contrast, the specimens studied by Kiefer lack any indication of such a feature. Personal observations on a wide variety of species from most cyclopid genera revealed that the absence of breaking planes in the terminal setae ('*helle Stelle*' *sensu* Kiefer 1967) may turn out to be an important generic characteristic.

The first leg, as depicted by Sars (Pl. IV: 4), possesses a medial spine on the basis that barely reaches the middle of the second endopodal segment. The specimens studied by Kiefer, however, have a medial spine that is clearly as long as the entire endopodite. Secondly, whereas the terminal spine on the second endopodal segment is depicted as a slender element in Sars' illustration, Kiefer's illustration shows a robust serrate element.

Sars' detailed illustration of the fourth leg (Pl. IV: 6) shows the medial edge of the basis with long hairs and with a distinct triangular process near the articulation of the endopodite. The specimens Kiefer observed also posses a rounded medial edge (with some short hairy elements on the surface) but lack the triangular structure near the insertion of the endopodite.

Finally, the differences between the two descriptions of the (female) fifth leg are quite noticeable. Although both have the same basic morphology (i.e. basal segment incorporated within fifth leg-bearing somite and distal segment differentiated, bearing a spine and a seta) the shape of the free segment and the relative lengths of the elements are distinctly different. Sars' illustration of this leg (Pl. IV: 7) shows a slender ovate segment with a narrow articulation. The medial spine length equals the length of the segment, whereas the outer seta is at least three times as long as the spine. Kiefer's specimens have a much more robust distal segment in the fifth leg, articulating with a wide arthrodial membrane. The medial spine is distinctly longer than the segment, while the length of the outer seta is less than twice the length of the spine.

The position of the distal segment of the fifth leg of *M. arnaudi* also differs significantly from those specimens examined by Kiefer. In the former, this segment is held laterally and is clearly visible when the animals are observed dorsally. In contrast, the distal segment of the fifth leg in Kiefer's specimens is positioned on the ventral side of the somite, and is as such rather difficult to see when the animal is observed in dorsal view.

In conclusion, the differences here observed between the original description of *Metacyclops arnaudi* and the redescription provided by Kiefer (1967) cannot be disregarded. The specimens that were collected by I. A. E. Bayly in the southern region of Australia and studied by Kiefer must not be considered conspecific with *Metacyclops arnaudi*. They represent a previously unknown species. In addition, the subspecies *Metacyclops arnaudi platypus* is considered on several grounds (see description below) to constitute a separate new species.

Systematics

Order **CYCLOPOIDA** Burmeister, 1835

Family **CYCLOPIDAE** Dana, 1853

Subfamily **CYCLOPINAE** Kiefer, 1927

Genus ***Meridiecyclops***, gen. nov.

Cyclops (partim): Sars, 1908; *Metacyclops* (partim): auctorum.
Type species: *Meridiecyclops baylyi*, sp. nov., here designated.
Other species: *Meridiecyclops platypus* (Kiefer, 1967), new rank.

Diagnosis

Large species with slender appearance. Genital double-somite with deep invagination in lateral margin of ancestral 3rd urosomite. Seminal receptacle expanded anteriorly and posteriorly. Copulatory pore flanked by two sclerotised external parallel crests. Caudal rami long, with smooth surface, bearing six elements. Principal terminal setae without breaking plane. Anal operculum not produced. Female antennule 11-segmented with complement from segments 1 to 11: 7–6–2–2–2–3–2+Aesth–2–2+Aesth–7+Aesth. Male antennule 17-segmented with three aesthetascs on segment 1, and one on segments IV, X, XIV and XVII. Setae unmodified. Antenna with exopodal seta, nine setae on second endopodal segment. Mandible with three setae. Maxillule with complete palp, maxilliped with full armament (3;2;1;3). Maxilla in female with common cyclopid morphology; in male considerably modified. Medial coxal seta on legs 1–4 present. Legs 1–4 with 2-segmented rami. Exopodal spine formula: 3333, setal formula: 5555 (complete setal complement in Table 1). Terminal endopodal segment of leg 4 with single distal spine. Medial margin of basis and first endopodal segment in leg 4 expanded in females; unmodified in males. Leg 5 with proximal segment fused to somite. Distal segment free, bearing two apical elements. Leg 6 vestige in female large, bearing three elements. Leg 6 vestige in male with three setiform elements.

Discussion

Traditionally, the generic assignation of cyclopid species is mainly based on the morphology and armature of the fifth leg (Kiefer 1927; Dussart and Defaye 1995) and far less on the morphology of other appendages. However, in recent years several authors have questioned the taxonomic value of the fifth leg in cyclopid systematics (see Pesce 1996 for review). Unfortunately, we are left with too many inadequate species descriptions that hamper a consistent re-analysis of the systematics of the group.

On the basis of traditional criteria, the characteristics of the species described here conform to the diagnosis of the genus *Metacyclops*: (*1*) leg 5 basal segment incorporated in somite; (*2*) distal segment of leg 5 distinct, bearing two terminal elements, the medial one spiniform; and (*3*) rami of the swimming legs 2-segmented. Besides these features however, both species here attributed to the new genus *Meridiecyclops* display a combination of characteristics that are not known to occur either in the other species presently unified in *Metacyclops* or in other genera and species of the Cyclopidae.

Females of *Meridiecyclops* possess a remarkable medial margin of the basis of leg 4, and have a peculiarly transformed first endopodal segment in this leg. The medial margin of the basis is laterally enlarged forming a rounded crest (*M. baylyi*) or spatula-shaped plate (*M. platypus*) that extends beyond the normal crescent medial margin. The basic shape of this margin in cyclopids is rounded and might be furnished with hairs and/or accompanied with a triangular processus (see discussion of *Metacyclops arnaudi* above), but in none is this margin produced into such a noticeable lamellar extension. Although some highly specialised genera (*Hesperocyclops* Herbst, 1984 and several species of *Bryocyclops* Kiefer, 1927, personal observation) have an enlarged medial corner (essentially triangular) of the fourth leg, it appears that these modifications are not comparable with the extension in the female fourth leg of *Meridiecyclops*. This novel structure seems to be related to the remarkable modification of the first endopodal segment of the fourth leg. In both species the frontal surface of the segment is expanded, forming a distinct groove or platform along the medial side. At least in *M. platypus*, where the medial extension of the basis fits into this cavity, we may assume that there is a functional relationship between both modifications.

The genital double-somite in cyclopids is the largest urosomal somite and generally has a fairly wide anterior part (ancestral 2nd urosomite) and a more slender posterior half (ancestral 3rd urosomite). The transition zone may be less noticeable or absent in several highly specialised genera (e.g. *Bryocyclops*, *Haplocyclops* Kiefer, 1952). In those genera with a typical constriction, the separation between halves is commonly well marked, but this area never shows signs of additional invaginations or depressions. In contrast, in *Meridiecyclops* the transition zone is very conspicuous as it is accentuated by the presence of a deep invagination, delimited by heavily sclerotised integument, on either side of the somite.

The genital double-somite typically has a flat ventral surface devoid of integumental structures in Cyclopidae, although some (i.e. *Mesocyclops* species) may show a partially or entirely marbled integument. The genital double-somite of *Meridiecyclops* is unique among the Cyclopidae in having its copulatory pore flanked on both sides by a crescent rim, arranged parallel to the median axis of the somite, as such forming a semi-enclosed cavity.

Males of *Meridiecyclops* differ from females in several aspects. They lack the modifications of the basis and endopodite of the fourth leg and have considerably longer terminal spines on the rami of legs 2–4 (equalling the segmental length in leg 4 or being longer as in legs 2–3). However, the most striking difference is noted in the maxilla, especially in the shape of the claw on the basis, it is either a bifid, ventrally recurved process (*M. baylyi*) or a short, medially directed, conical extension (*M. platypus*). In both species, the male maxilla is much more sclerotised than its female homologue. In addition, the proximal and distal syncoxal endites, as well as the endopodal setae have undergone severe modifications in *M. baylyi*.

Among the Cyclopidae, sexual dimorphism is, in general, confined only to the antennula, the fifth and sixth legs and the urosomal tagmosis. This is also the case in *Meridiecyclops*. Only a few examples of other dimorphic features were previously known (e.g. *Diacyclops crassicaudis* Sars, 1863, several species in the genus *Bryocyclops*). However, with the modern emphasis upon the specific value of microstructures, more cases of dimorphism in cyclopid appendages have become known. Probably the most common dimorphic feature is the different lengths of the endopodal setae and spines (Dahms and Fernando 1998). Differences in setal ornamentation of endopodal setae of one or several legs have been documented for members of the Halicyclopinae by Rocha (1991), by Fiers *et al.* (1996) for *Diacyclops chakan* Fiers & Reid, 1996, and by Karaytug and Boxshall (1998) for members of *Paracyclops* Claus, 1893. Setal modifications are also present in *Diacyclops uruguayensis* Kiefer, 1935 and related species (Fiers *et al.* 2000). Different segmentation of the legs, primarily the fourth leg, has been documented for several species belonging to different genera (Reid and Strayer 1994; Pesce 1996) and is considered an important generic characteristic for the genus *Rheocyclops* Reid & Strayer, 1999 (in Reid *et al.* 1999). Dimorphism in the post-antennular head appendages seems far less common than modifications of the post-maxillipedal appendages and, to my knowledge, has only been observed for the caudal spinule pattern on the antennal basipodite of some *Paracyclops* Claus, 1893, where an additional row appears near the distal abexopodal corner in the males (Karaytug and Boxshall 1998).

The modification of the male maxilla in *Meridiecyclops* is a novel acquisition within the Cyclopidae and is clearly a derived condition. Moreover, the modifications of the female genital double-somite and the female fourth leg, in combination with the dimorphic maxillae in the male lead us to suppose that these derived conditions play an important role either in mate recognition or during copulation when the male firmly holds the female.

Besides these derived features, *Meridiecyclops* combines several characteristics that conform to the basic cyclopid morphology: antennal chaetotaxy with exopodal seta and nine setae on the second endopodal segment; mandible with three setae; maxilla with fully developed palp; 2-segmented endopodites in maxilla and maxilliped; and chaetotaxy of the legs with an inner seta on the proximal segments of the exopodite of legs 1–3 and the endopodites of legs 1–4, a possible indication that *Meridiecyclops* evolved early in the history of Cyclopinae. The absence of an inner seta on the first segment of the leg 4 exopodite is derived, but is not unique as this reduction occurs in several species from different genera.

The shape and degree of incorporation of the basal segment of the fifth leg could be an indication that *Meridiecyclops* evolved independently from *Metacyclops*. In the latter, the seta representing the vestigial basal segment of the leg arises from the lateral margin of the pediger. However, in *Meridiecyclops*, the ventrolateral corner of the first urosomite is represented as a posteriorly directed integumental flap, on which the setal homologue arises. Moreover, in some specimens (see Fig. 1*D*) a discrete integumental fold is present on the dorsal side of the somite marking the limits between the somite and the integumental flap. Thus, whereas the basal segment of the fifth leg is absent in *Metacyclops* because it is altered during development (copepodids III–VI), the basal segment in *Meridiecyclops* seems to be present but is confluent with the somite because of the absence of the arthrodial membrane between somite and segment.

Without drastically enlarging the generic diagnosis of *Metacyclops* Kiefer, 1927 *char. amend*. Lindberg, 1942, the species described here cannot be included within this taxon or any other genus with the basal segment of leg 5 incorporated in the somite and possessing a well-defined distal segment with two terminal elements.

Having justified in the previous paragraphs the separate systematic position of *Meridiecyclops*, the assignation of *Metacyclops arnaudi* remains to be established. As the male of *M. arnaudi* has never been described, we are unaware of possible modifications in the maxilla, the most distinctive generic feature of *Meridiecyclops*. As far as can be judged from the original illustrations, females of this species do not display any modification on the medial margin of the basis and the first endopodal segment of the fourth leg. Secondly, the female genital double-somite gently tapers posteriorly, in dorsal view. In *Meridiecyclops*, the anterior and posterior half are quite distinct because of the marked constriction and invagination of the lateral margins. *Metacylops arnaudi* should therefore be kept in the genus *Metacyclops*. Hence, *M. arnaudi* and *M. mortoni* remain the sole representatives of the genus known for this continent thus far.

Etymology

The generic name is a conjunction of the Latin word, *meridies* (meaning south) prefixed to the generic name *Cyclops*. The gender is masculine.

Meridiecyclops baylyi, sp. nov.

(Figs 1–5)

Not *Cyclops arnaudi* Sars, 1908.
Microcyclops (*Metacyclops*) *arnaudi* (Sars). – Bayly & Williams, 1966*a*: 217, tab. 14, 15.
Metacyclops arnaudi (Sars). – Kiefer, 1967.

Material examined

Holotype. ♂ dissected on 4 slides; Victoria: shallow saline lake near Meerlieu (c. 38°00′S 147°22′E), 24.v.1962, coll. I. A. E. Bayly, (FKCC).

Paratypes. 2 ♀ partially dissected (slides 7727–7728); 2 mounted, undissected ♂ (slide 7688); some 30 specimens (♂ and ♀) stored in glycerine (vial 3614). Same data as holotype.

Other material examined. **Victoria:** Lake Beeac, 1 ♂ copepodid V and about 50 ♀ copepodids IV, preserved in glycerine (vial 3621), 7.iv.1965, coll. I. A. E. Bayly (FKCC).

Description

Female

Habitus (Fig. 1A). Length 1585–1615 µm (n = 5) with prosome half as long as entire body length. Leg-bearing somites 2–4 without particular expansions laterally. Anal operculum undulate. Integument of somites sparsely marbled dorsally. Hyaline fringes of prosomites narrow and smooth, of urosomites narrow and undulate. Posterior margin of anal somite lacking spinules (Fig. 1*E*) or with 3–4 minute spinules dorsally.

Genital double-somite (Figs 1B–C). Slightly longer than wide (L/W: 1.1/1); with marked constriction in posterior half and rigid longitudinal rims defining a deep invagination on either side. Seminal receptacle field with slender anterior and slightly extended posterior. Lateral arms nearly straight, curved medially. Copulatory pore minute, flanked on either side with ovate, rigidly sclerotised, crest

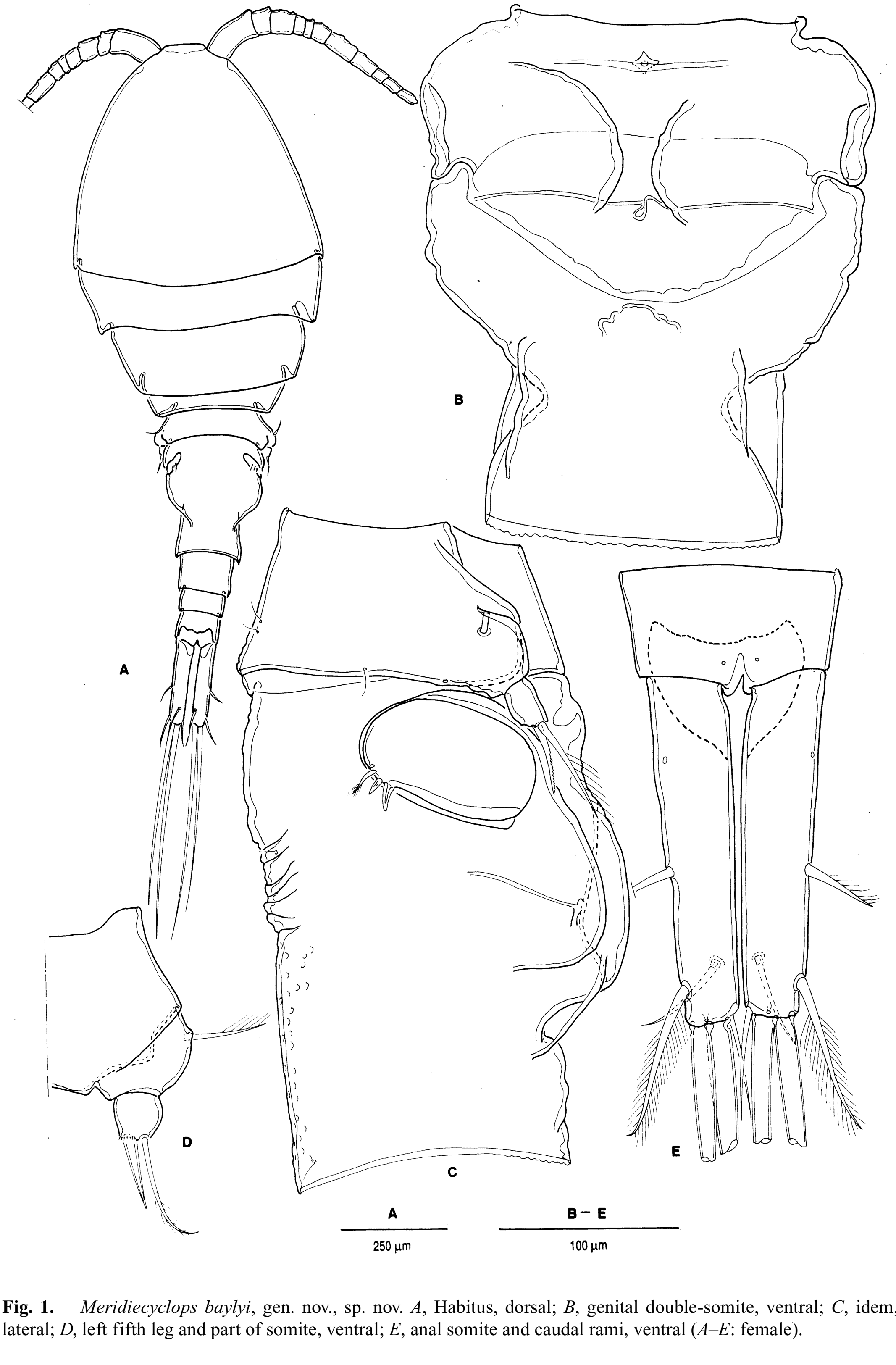

Fig. 1. *Meridiecyclops baylyi*, gen. nov., sp. nov. *A*, Habitus, dorsal; *B*, genital double-somite, ventral; *C*, idem, lateral; *D*, left fifth leg and part of somite, ventral; *E*, anal somite and caudal rami, ventral (*A–E*: female).

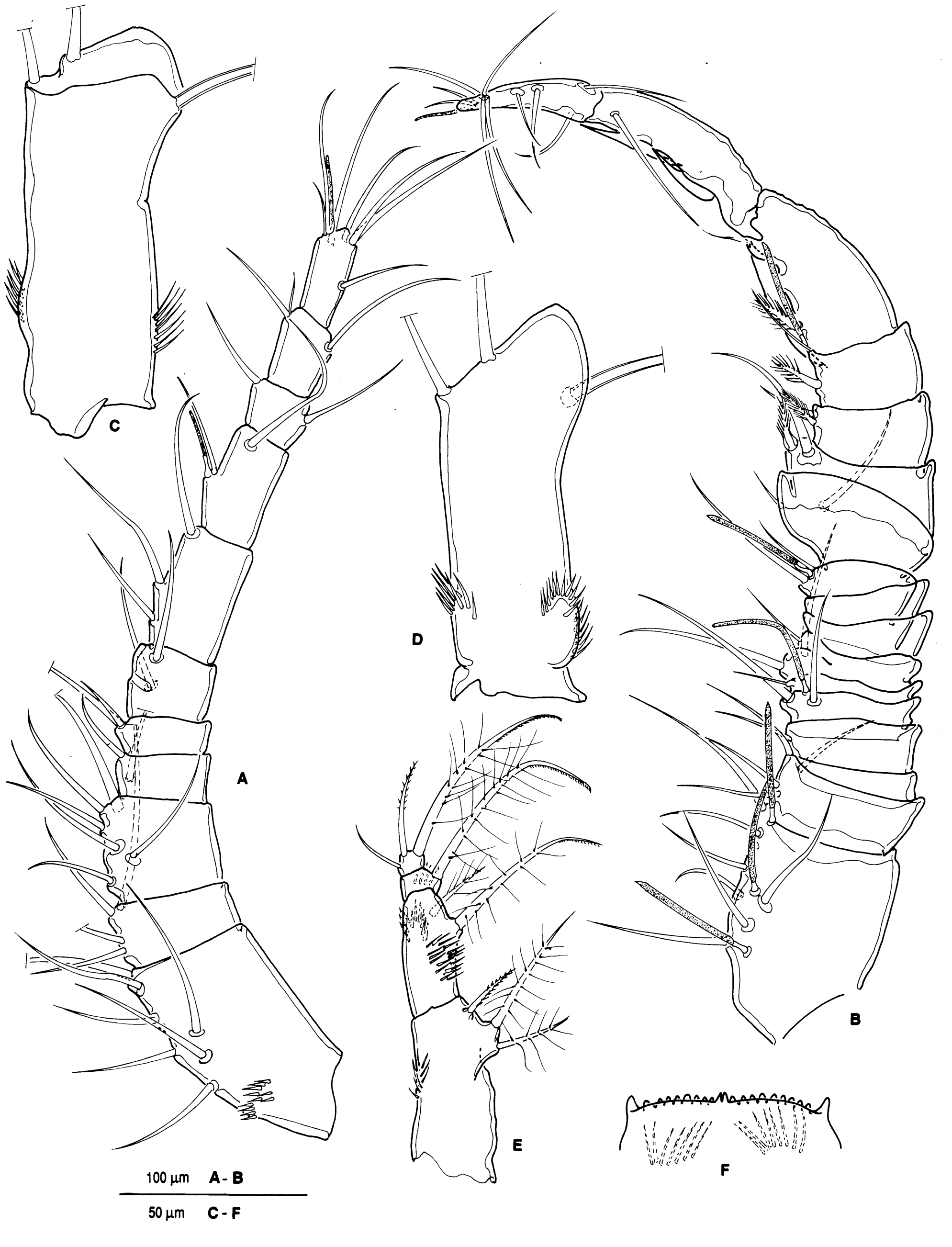

Fig. 2. *Meridiecyclops baylyi*, gen. nov., sp. nov. *A*, Female antennule; *B*, male antennule; *C*, antennal basipodite, frontal; *D*, idem, caudal; *E*, maxilliped; *F*, labrum (*A*, *C–F*: female; *B*, male holotype).

arising perpendicular to surface of somite. Ovipores covered with large ovate sixth leg, bearing three elements: medial and middle elements conical and smooth, outer element setiform and plumose. Integument of genital double-somite marbled dorsally.

Caudal rami (Fig. 1E). Length/width ratio: 4.8–5.0/1. Ventrodistal margin nearly straight with median pore orifice. Proximal lateral seta (45 µm) arising at distal end of median third. Distal lateral seta (90 µm) pinnate, setiform. Dorsal seta articulating on basal part, 55 µm. Medial seta (60 µm) smooth. Outer (495 µm) and inner (580 µm) principal setae without breaking plane, plumose. Integument of rami smooth.

Antennule (Fig. 2A). Eleven-segmented with following complement (Roman numerals for segment number, Arabic numerals for setal number): I(7)–II(4)–

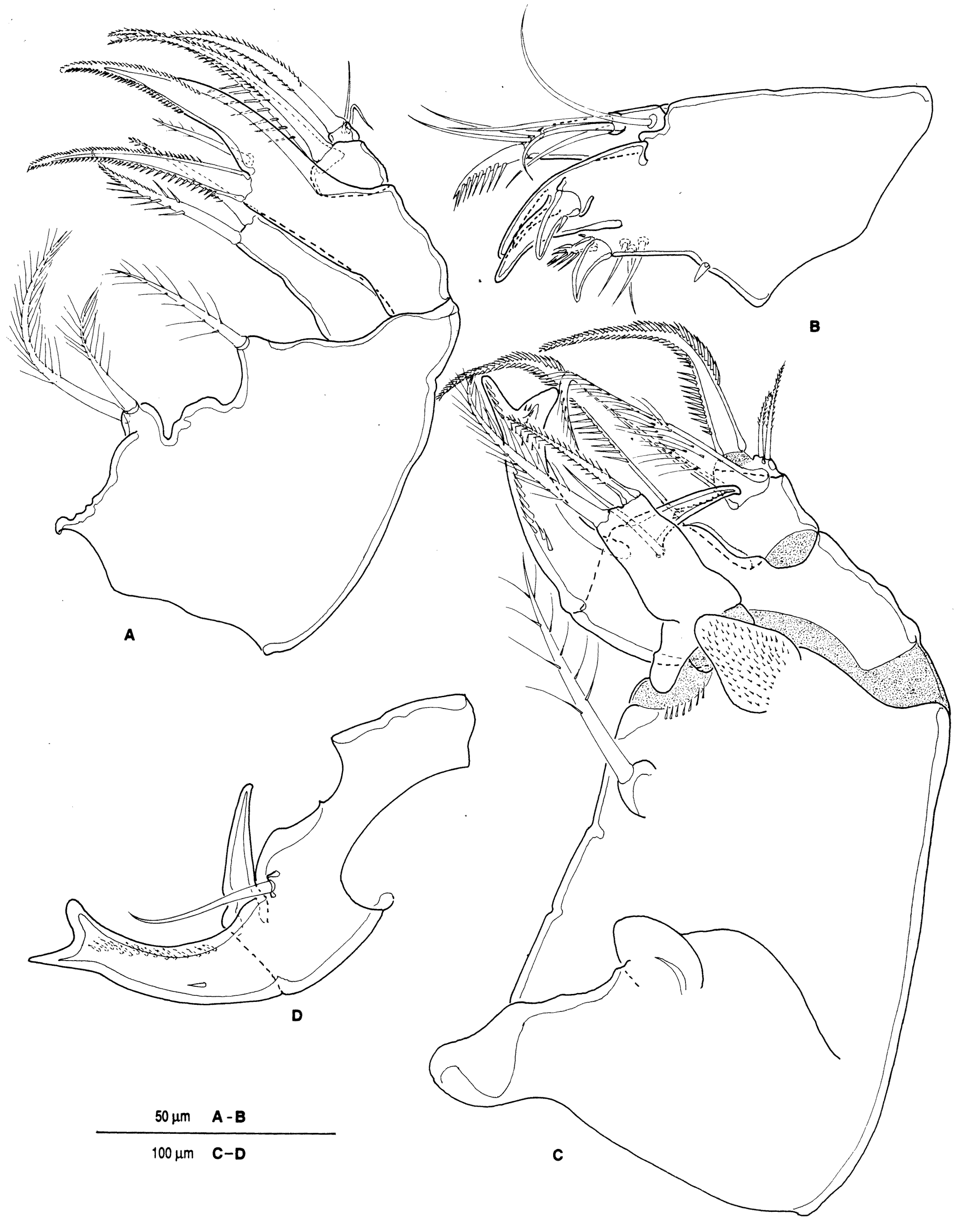

Fig. 3. *Meridiecyclops baylyi*, gen. nov., sp. nov. *A*, Female maxilla, frontal; *B*, maxillule; *C*, male maxilla, frontal; *D*, basis of male maxilla, caudal (*A–B*: female; *C–D*: male holotype).

III(6)–IV(2)–V(2)–VI(2)–VII(3)–VIII(2+Aesth)–IX(2)–X(2 +Aesth)–XI(7+Aesth). Aesthetasc on segment VIII linguiform, on segment X filiform and on segment XI tubuliform. First segment with comb of spinules in proximal half, all other segments with smooth integument.

Antenna (Figs 2C–D). Basipodite with long (200 µm) bipinnate exopodal seta and two abexopodal terminal setae. Endopodal segments with one, nine and seven setae respectively. Frontal surface of basipodite smooth except for row of slender spinules in proximal half of outer margin, arranged parallel with margin. Caudal surface with two clusters of slender spinules in proximal half, one near inner margin, one near outer margin.

Mandible. Cutting edge with typical armament: three complex teeth, four conical teeth and one serrate element. Dorsal surface with row of minute spinules near and parallel

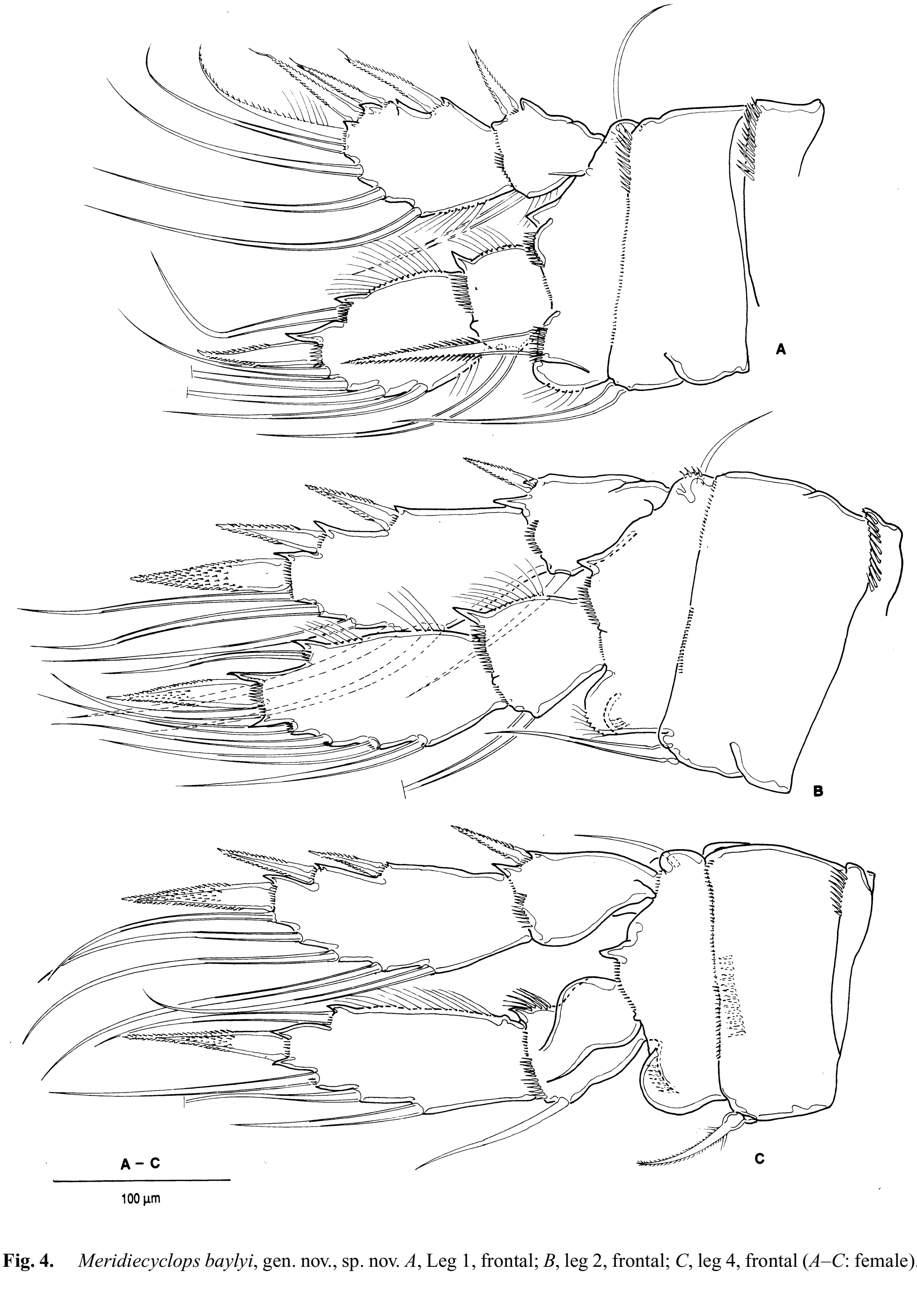

Fig. 4. *Meridiecyclops baylyi*, gen. nov., sp. nov. *A*, Leg 1, frontal; *B*, leg 2, frontal; *C*, leg 4, frontal (*A–C*: female).

to cutting edge. Ventral surface without ornamentation. Palp small but distinct with normal complement: two long finely plumed setae (broken in dissected specimens) and one short (30 µm) smooth element.

Labrum (Fig. 2F). Cutting edge nearly straight, with two triangular structures in middle. Seventeen blunt teeth between produced and rounded lateral corners. Ventral surface with two rows of long setules, dorsal surface entirely covered with minute spinules. Paragnath with three elements at base, setulose distally.

Maxillule (Fig. 3B). Arthrite with 10 elements. Medial-most ones strong, hook-shaped, smooth, blunt, jointed with

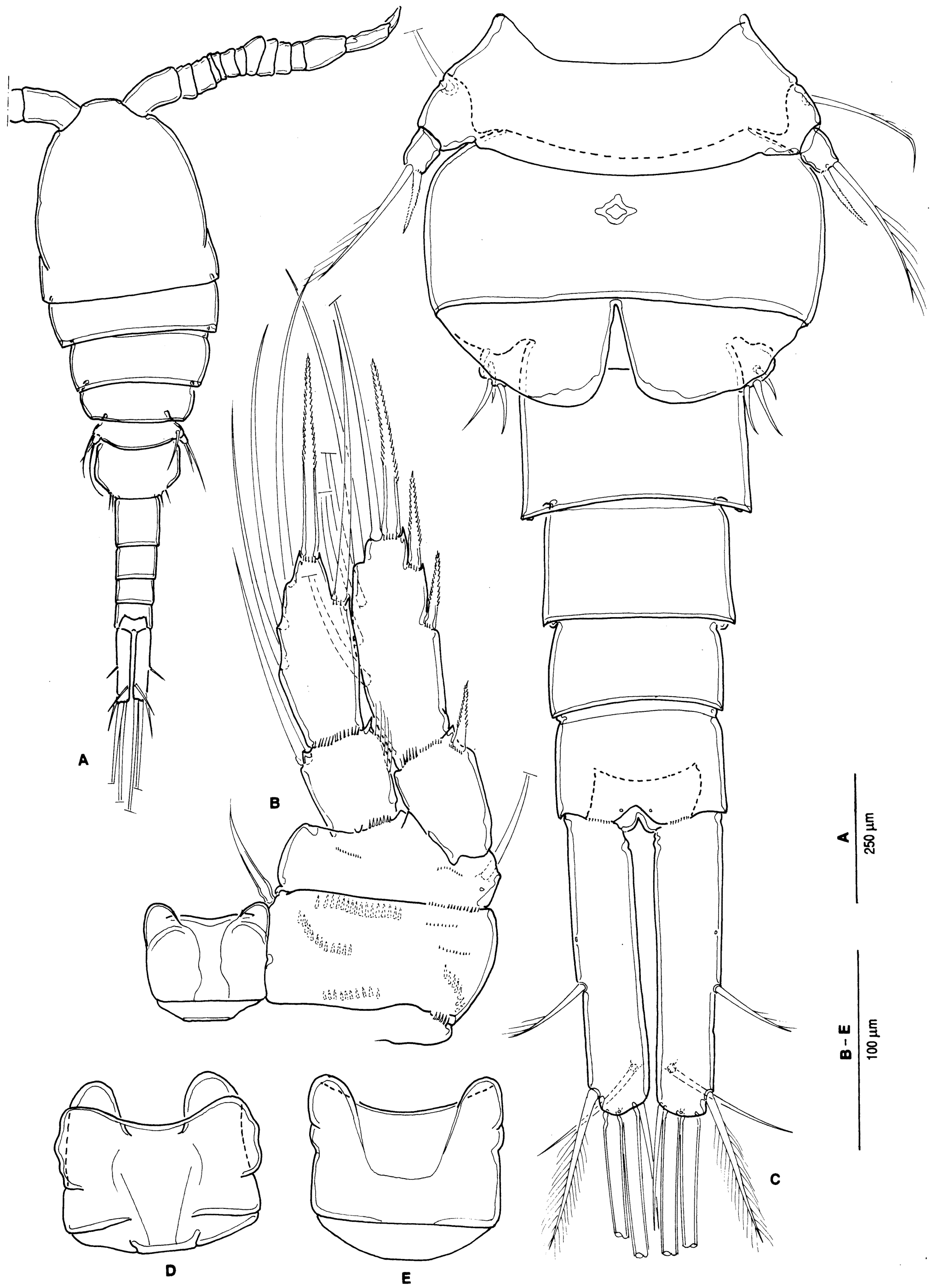

Fig. 5. *Meridiecyclops baylyi*, gen. nov., sp. nov. *A*, Male habitus; *B*, urosome, ventral; *C*, leg 4, frontal; *D*, intercoxal sclerite of leg 1, caudal; *E*, intercoxal sclerite of leg 2, frontal (*A–C*: male holotype; *D–E*: female)

robust blunt element, furnished with single tooth. Six marginal elements (from inner to outermost): one serrate; one blunt, smooth; three slender, smooth; one minute, blunt. Palp with exopodal seta and three endopodal setae, latter arising from small basal part. Distal edge with two slender elements and one uniserrate robust spine.

Maxilla (Fig. 3A). Syncoxal surface without ornamentation. Proximal endite globulous, bearing two pinnate setae. Median endite slightly produced, with one pinnate seta. Distal endite large and rather robust, with two serrate apical elements. Basis characteristically produced as a long claw with robust proximal seta, both with serrate margins. Frontal seta short, pinnate. Endopodite 2-segmented: proximal segment with two robust, serrate elements; distal segment with one robust, two short smooth apical setae.

Maxilliped (Fig. 2E). Four-segmented with typical appearance, bearing three, two, one and three elements on syncoxa, basis and endopodal segments respectively. Coxal, basal and endopodal setae with broadly spaced rigid plumes, apical-most setae on second endopodal segment and distal third of inner endopodal serrate. Syncoxa with cluster of slender spinules in middle of outer margin. Group of spinules on caudal and frontal surface of basis, on frontal surface of first endopodal segment.

Legs 1–4 (Figs 4A–C). Frontal surface of praecoxa with spinule row near outer distal frontal corner. Coxa with robust medial seta, reaching halfway along second endopodal segment in leg 1, just beyond first endopodal segment in legs 2 and 3, just beyond basis in leg 4. Medial seta pinnate in legs 1–3, serrate in leg 4. Distal margin of coxa with spinules frontally. Coxa of legs 1–3 with a crescent spinule row near outer margin on caudal surface. Caudal surface of leg 4 coxa with continuous mediodistal and medioproximal row of spinules, a short row of spinules near outer margin, an oblique row of spinules in medial half (see Fig. 5*B* of the male fourth leg). Intercoxal sclerite of each leg with smooth posterior surface. Lateral edges produced and crescent (Figs 5*D–E*). Basis with triangular mediodistal process, spinules near articulation with endopodite. Medial margin crescent, hairy in legs 1–3, smooth in leg 4. Medial spine of leg 1 robust, reaching almost to distal end of second endopodal segment. Rami 2-segmented, chaetotaxy shown in Table 1. Outer spines of leg 1 exopodite flagellate. Terminal spines of legs 2–4 quite robust and ornamented with dense pattern of spinules. All terminal spines distinctly shorter than segment (65% of segment length). First endopodal segment of leg 4 with anterior surface produced into a heavily sclerotised globulous process.

Leg 5 (Fig. 1D). Basal segment fused with somite, with remnant of ancestral separation visible in dorsal view. Outer seta pinnate, 50 µm long. Distal segment as long as wide, with minute spinules near insertion of medial spine. Outer seta 70 µm long, pinnate, less than twice length of medial spine (50 µm). Lateral spinules of medial spine hardly visible.

Table 1. Chaetotaxy of legs 1–4 in *Meridiecyclops*, gen. nov.

	Exopodite	Endopodite
Leg 1	1,I – 3,2,III	1,0 – 3,1I1
Leg 2–3	1,I – 4,1I,II	1,0 – 4,1I,1
Leg 4	0.I – 4,1I,II	1,0 – 3,I,1

Male

Habitus (Fig. 5A). Body length: 1035 µm (1028–1042, n = 3). Prosome half total body length. Urosomites 3–6 rather narrow. Integument of head and somites marbled dorsally and laterally (not illustrated). Anal somite with a short row of minute spinules along ventrodistal margin. Hyaline fringes entire. Anal operculum slightly crescent. Caudal rami 4.15 times as long as wide (Fig. 5*C*).

Antennule (Fig. 2B). 17-segmented with following complement: I(7+3 Aesth)–II(4)–III(1)–IV(2+Aesth)–V(1)–VI(2)–VII(1)–VIII(0)–IX(0)–X(2+Aesth)–XI(2)–XII(2)–XIII(2)–XIV(2+Aesth)–XV(3)–XVI(3)–XVII(10+Aesth). Aesthetascs linguiform, except for tubuliform aesthetasc on segment XVII. Segment 1 without spinule pattern. Elements on segments XIV and XV typically transformed as long T-shaped plates.

Antenna, labrum, mandible, maxillule and maxilliped as in female.

Maxilla (Figs 3C–D). Syncoxa without proximal endite, two globulous processes on frontal surface, one in proximal half (smooth) and one near distal margin (serrate). Median endite slightly produced, bearing a single pinnate seta. Distal endite robust and heavily sclerotised, bearing, a pinnate and a serrate element terminally. Basis heavily sclerotised, with strong bifid serrate curved claw. Accessory element short, conical and directed perpendicular to bifid claw. Endopodite 2-segmented. Proximal segment with two rigid elements: medial element serrate, distal element pinnate. Distal endopodal segment with one rigid and serrate element and two short terminal setae. Arthrodial membranes between syncoxa and basis, and between basis and endopodite remarkably wide.

Legs 1–3. As in female, except for longer terminal spines on the endopodites and exopodites, 0.95 times as long as segment.

Leg 4 (Fig. 5B). Spinule pattern on coxa as in female. Medial margin of basis not expanded, smooth. Terminal spine of exopodite 0.90 times as long as segment: terminal spine of endopodite longer than segment (1:1.19).

Leg 5 (Fig. 5C). As in female but with longer elements: medial spine (*c.* 40 µm) twice as long as segment, and outer seta 4.5 times as long as segment (*c.* 100 µm).

Leg 6 vestiges (Fig. 5C). Without ornamentation on surface, bearing three setiform elements.

Etymology

The specific name is dedicated to Dr I. A. E. Bayly, in honour of his scientific contributions to copepod systematics and limnology.

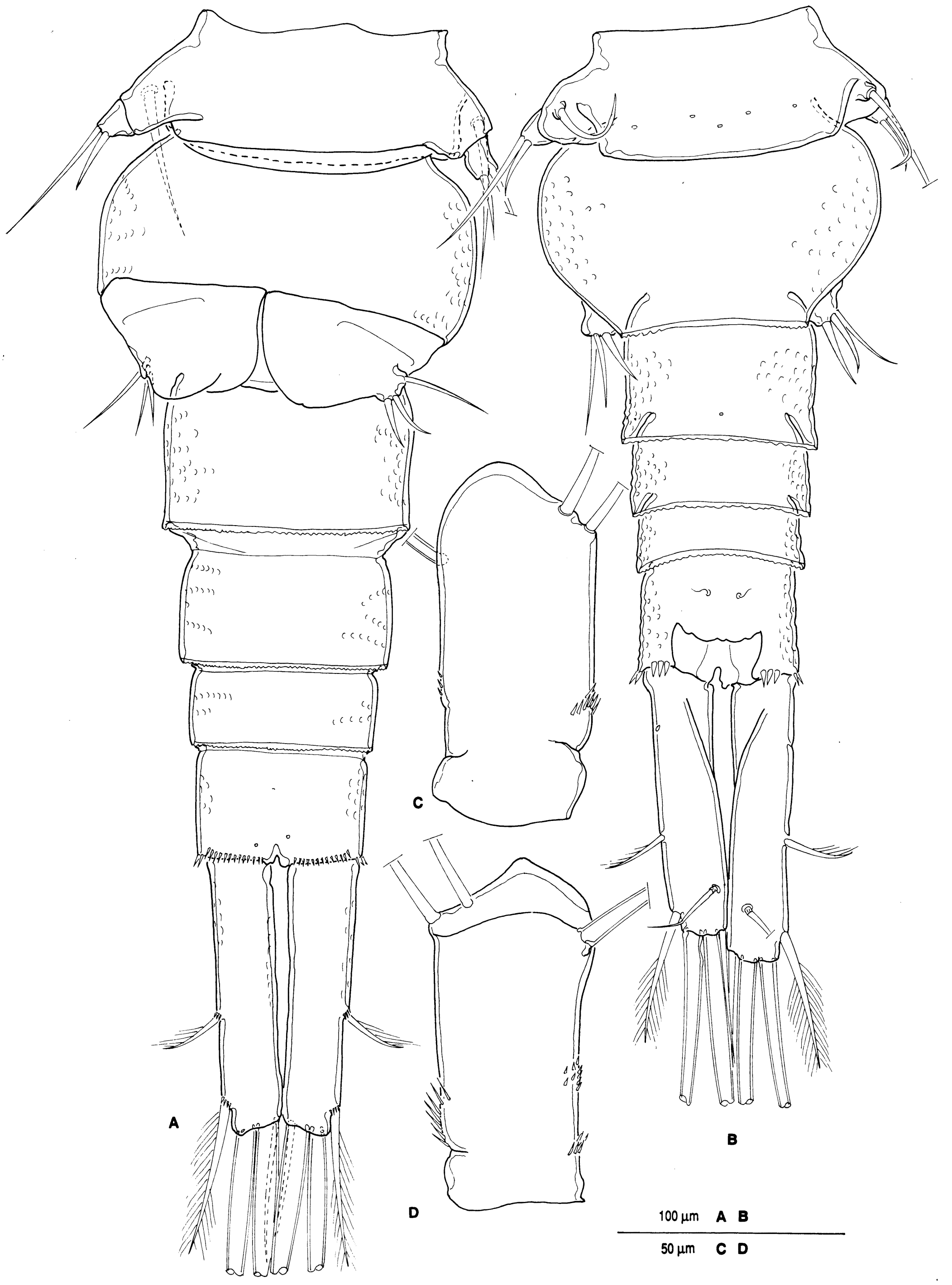

Fig. 6. *Meridiecyclops platypus* (Kiefer, 1967). *A*, Urosome, dorsal; *B*, urosome, ventral; *C*, intercoxal sclerite of leg 2, frontal; *D*, idem of leg 3, frontal (*A–D*: female).

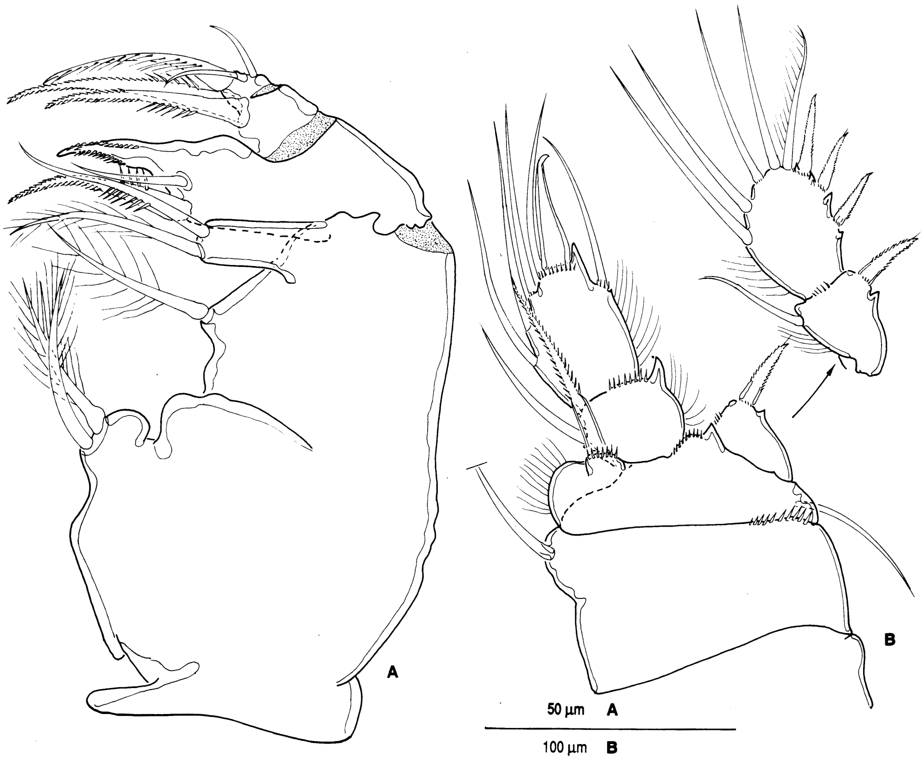

Fig. 7. *Meridiecyclops platypus* (Kiefer, 1967). *A*, maxilla; *B*, leg 1, frontal (*A*: male; *B*: female).

Meridiecyclops platypus (Kiefer), comb. nov.
(Figs 6–9)

Metacyclops arnaudi platypus Kiefer, 1967: 298–300, figs 17–20.

Material examined

Syntypes. **South Australia:** salt lake near Penong (*c*. 31°52′S 133°02′E), 5.v.1964, coll. I. A. E. Bayly: 6 dissected ♀ (FKCC 7719–7724); 2 dissected ♂ (FKCC 7725–7726); and 5 ♀ (1 ovigerous) and 2 ♂ preserved in glycerine (vial 3620) (FKCC).

Description

Female

Habitus. Length: 1210–1234 µm (*n* = 4) with prosome half as long as entire body length. Pedigerous somites without posterolateral expansions. Integument sparsely marbled. Hyaline fringes of prosomites and urosomites narrow and smooth. Pediger 5 laterally expanded as result of fusion of basal segment of fifth leg. Dorsal surface of somite with distinct transverse ridge closely parallel to posterior margin. Anal sinus partially spinulose. Posterodorsal margin of anal somite with 3–4 spines. Posteroventral margin smooth. Anal operculum ovate.

Genital double-somite (Figs 6A–B). Slender, as long as wide, with anterior part only weakly expanded laterally. Proximal half with two small, distinct lateral invaginations. Copulatory pore (not observed, covered with two spermatophores) flanked with large crescent flap on either side, a transverse ridge close to anterior origin of longitudinal flaps. Ovipores covered with large plate, each bearing three small elements: outermost setiform, median and medial elements conical.

Caudal rami (Figs 6A–B). Convergent, with length/ width ratio: 1/4.0 –1/4.5. Lateral seta (33 µm) arising at distal end of median third. Distal outer element (76 µm) pinnate, longer than medial one (48 µm). Dorsal seta (51 µm) articulating on minute basal part. Principal terminal setae without breaking plane, plumose. Lateral and outer distal setae without spinules near insertion.

Antennula and antenna. As in *M. baylyi*. Antenna with comparable spinule pattern to that of *M. baylyi* on caudal (Fig. 9*C*) and frontal (Fig. 9*D*) surface: spinules, shorter. Post-antennal buccal appendages as in *M. baylyi*.

Legs 1–4 (Figs 7B, 8A–B). Caudal spinule pattern on coxa not observed. Frontal surface of coxa smooth except for short spinule row near distal outer edge. Intercoxal sclerites with smooth anterior and posterior surface. Distal edges weakly produced, rounded (Figs 6*C–D*, 8*B*). Medial coxal seta of legs 1–4 reaching beyond distal margin of proximal endopodal segment. Medial margin of basis in legs 1–3

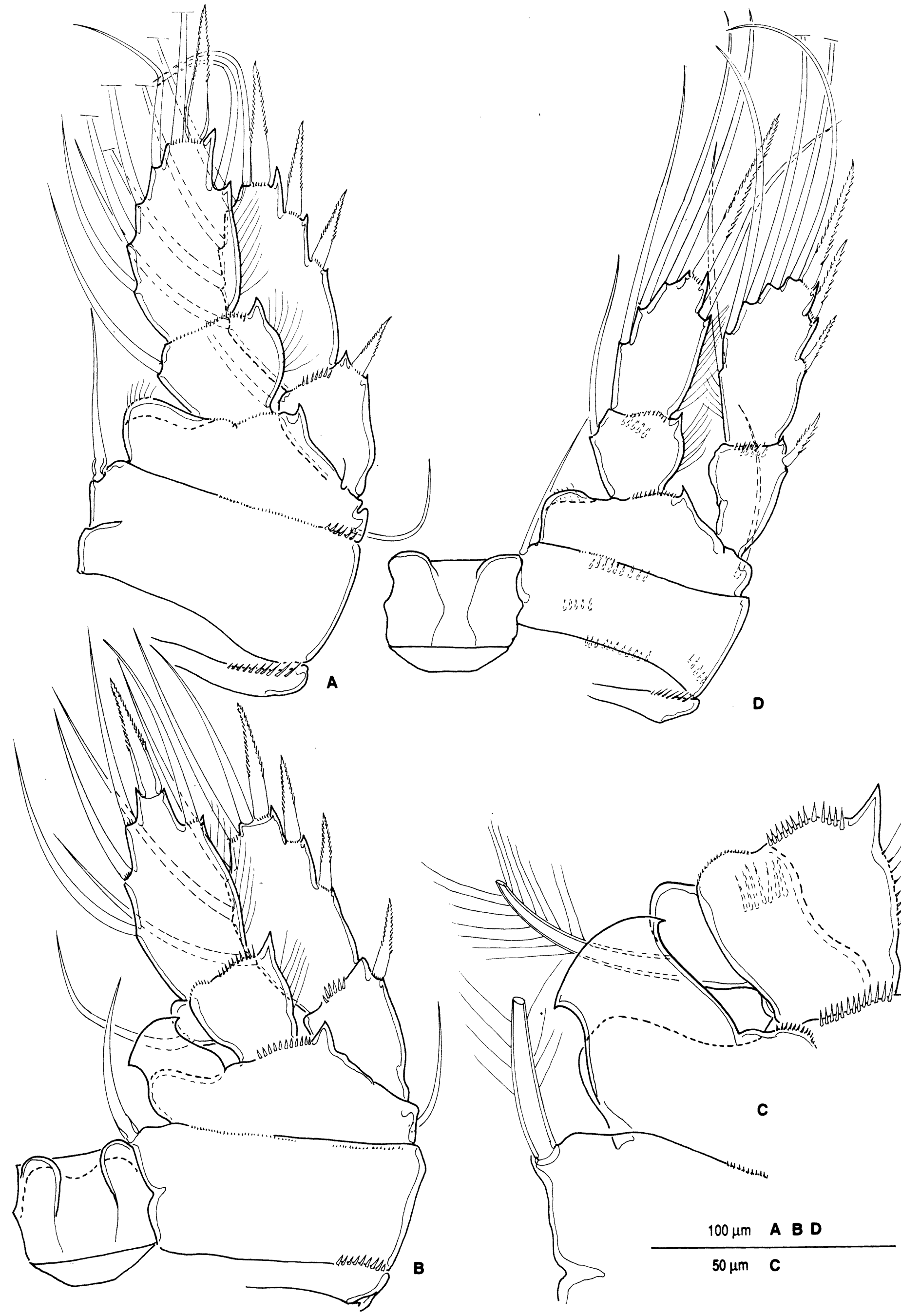

Fig. 8. *Meridiecyclops platypus* (Kiefer, 1967). *A*, Leg 3, frontal; *B*, leg 4, frontal; *C*, medial part of coxa and basis, and first endopodal segment of leg 4; *D*, leg 4, frontal (*A–C*: female; *D*, male).

crescent and hairy, in leg 4 (Fig. 8*C*) produced as large flat axe-shaped plate. Each leg with triangular mediodistal process on basis. Medial spine on basis of leg 1 serrate, reaching to the distal-most margin of endopodite. First endopodal segment of leg 4 expanded posteriorly and medially, forming distinct flat platform along inner margin of segment (Fig. 8*C*). Setal complement of rami as in *M. baylyi*. Terminal spine on leg 1 endopodite smooth, as long as segment. Terminal spine of endopodite in legs 2–4 spinulose, shorter than segment (70–75% of segment length).

Leg 5 (Figs 6A–B). Basal segment fused to somite but still distinct. Lateral seta 63 µm. Distal segment square, with two terminal elements. Medial spine twice as long as

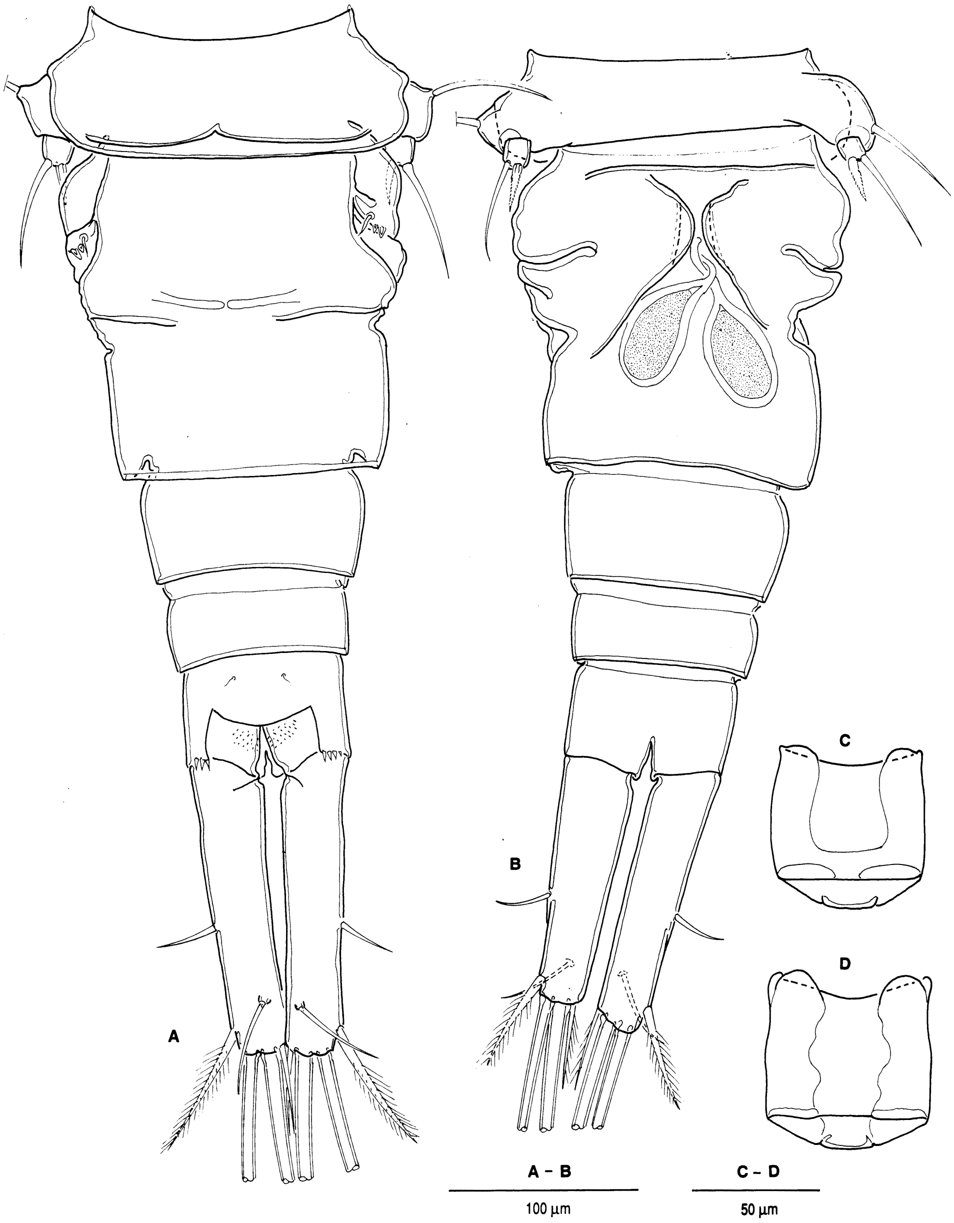

Fig. 9. *Meridiecyclops platypus* (Kiefer, 1967). *A*, Male urosome, ventral; *B*, idem, dorsal; *C*, antennal basipodite, caudal; *D*, idem, frontal (*A–B*: male; *C–D*: female).

segment, finely serrate. Outer seta smooth, twice as long as medial element.

Male

Habitus. Length 985–990 µm (n = 2) with urosome slightly longer than half body length (Figs 9*A–B*). Pediger 5 laterally expanded with distal segment of fifth leg, perpendicular to body axis. Sixth leg-bearing somite expanded laterally, barrel-shaped. Anal somite with undulate operculum. Posterodorsal margin with cluster of three large spinules, posteroventral margin with continuous comb of minute spinules. Integument of urosomites marbled laterally, hyaline fringe weakly undulate.

Caudal rami. Convergent, length/width ratio: 1/4.55 (Fig. 9*A*), in some specimens length unequal (Fig. 9*B*). Lateral seta (33 µm) arising in median third. Pinnate medial and smooth outer distal elements equal in length (70 µm). Dorsal seta short (37 µm), articulating on minute basal part.

Principal terminal setae without breaking plane. Integument weakly marbled. Spinules near insertion of lateral and outer distal setae.

Antennule. As in *M. baylyi*.

Antenna and post-antennal buccal appendages. As in female, except for maxilla.

Maxilla (Fig. 7A). Syncoxa as in female with three endites. Integument somewhat more sclerotised. Basis with short, straight conical medial extension, armed with spinules along both margins. Endopodite 2-segmented with two and three elements on proximal and distal segment respectively. Elements on proximal segment serrate, largest element on distal segment pinnate.

Legs 1–3. As in female, except for distal spine on endopodite, as long as supporting segment.

Leg 4 (Fig. 8D). Basis with crescent medial margin. First endopodal segment not modified. Terminal endopodal spine serrate, 1.28 times as long as supporting segment.

Leg 5 (Figs 9A–B). Lateral seta (66 µm long) of basal segment arising on small pedestal. Distal segment wide proximally, tapering distally. Medial spine (30 µm long) smooth, twice as long as segment. Outer seta (65 µm long) slightly more than than twice length of spine.

Leg 6 (Fig. 9A). Valve with smooth surface. Outermost seta longer than median. Medial elements shorter than outermost element.

Remarks

Apparently relying exclusively on the morphology of the protopodites of the female fourth legs and the relative lengths of the fifth leg armature, Kiefer (1967) considered that the differences between the specimens he attributed to *Metacyclops arnaudi* and those found in a sample from South Australia did not warrant distinction at the species level; he therefore created the subspecific taxon *M. a. platypus* for the 'deviating form'.

However, *Meridiecyclops platypus* (= *Metacyclops arnaudi platypus*) differs in several aspects from *Meridiecyclops baylyi* (= *Metacyclops arnaudi sensu* Kiefer, 1967). The most obvious differences concern the female fourth leg with, in the former species, the pronounced axe-shaped medial expansion of the basis. The medial margin of the fourth leg in *M. baylyi* is crescent shaped and far less expanded than in the females of its congener.

Males from both species differ from each other in their remarkable transformation of the medial claw of the maxillular basis. *Meridiecyclops baylyi* has a very elaborate maxilla with a forked and curved maxillular claw in combination with transformations of the endites whereas the maxillular claw of *M. platypus* is straight and conical and lacks additional transformations of the endites.

Other discriminating differences between both species are their body lengths (females: 1600 µm in *M. baylyi*, 1250 µm in *M. platypus*), the ornamentation of the terminal endopodal spine in legs 3 and 4 (entirely covered with spinules in *M. baylyi*, only serrate along the margins in *M. platypus*), and the wide (*M. baylyi*) or narrow (*M. platypus*) shape of the anterior half of the female genital double-somite.

Acknowledgments

I would like to express my thanks to Dr H.W. Mittmann, Staatliches Museum für Naturkunde, Karlsruhe, for his hospitality and help during my stay at his Institute, to Dr. M. Bergmans for his critical reading and valuable comments on an earlier draft of the paper, and to the two anonymous reviewers.

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Manuscript received 8 January 2001; revised and accepted 27 June 2001.