

# Rare cyclopoid copepods (Crustacea) from Mediterranean littoral caves

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**SYNOPSIS.** Three cyclopoid copepods are reported from anchihaline cave habitats on Mallorca. Both sexes of *Cyclopina esilis* Brian are redescribed. Sexual dimorphism in the mandibular exopod, as discovered in *C. esilis*, has not previously been reported for any cyclopinid. The male of the primitive marine cyclopid *Neocyclops (Protoneocyclops) mediterraneus* (Kiefer) is described in detail for the first time and the characters distinguishing this species are discussed. Both sexes of *Euryte longicauda* Philippi are redescribed. The genus *Euryte* Philippi is briefly reviewed and the characters used to differentiate species are critically reevaluated. It is concluded that all three genera, the cyclopinid genus *Cyclopina* Claus and the primitive cyclopid *Neocyclops* Gurney and *Euryte*, are in urgent need of revision, but that this process will be hampered by the inadequacy of published descriptions and the lack of available type material.

## INTRODUCTION

Anchihaline cave habitats are rich sources of interesting and unusual crustaceans. Copepods of immense phylogenetic significance have been discovered in such caves in the last decade, including the platycopiid *Antrisocopia* Fosshagen, the misophrioid *Speleophriopsis* Jaume & Boxshall, and the calanoid *Erebonectes* Fosshagen (Fosshagen & Iliffe, 1985; Jaume & Boxshall, 1996). There have been few reports of cyclopoid copepods in anchihaline caves. Recently, however, Rocha & Iliffe (1991, 1994) described a new family of cyclopid, the Speleothonidae, and the primitive cyclopid *Troglocyclops*, from caves on the Bahamas Islands. During our studies of the copepod fauna of Mallorcan caves we discovered numerous cyclopid, including the three rare species described in this account. All three species were originally described from the Mediterranean Basin. All have been the subject of considerable taxonomic confusion because their original descriptions were inadequate and we have attempted to clear up some of this confusion at the same time as presenting full redescriptions.

## THE CAVES

The copepods were collected from four caves located on the East coast of Mallorca, less than 20 m inland. These caves occur in two different types of substratum. Cova 'C' de Cala Varques and Es Secret des Moix are in Tortonian (10 Myr BP), coral reef-derived, porous calcarenites and mixing-zone corrosion processes seem to have played an important role in their development. Cova de na Barxa and Cova de na Mitjana are in Triassic, fissured limestones. All these caves have subaerial entrances; the difficulty of access can be deduced from their topographies, published elsewhere (see below). The water conditions varied from cave to cave: In Es Secret des Moix, the sampled lake (that located closest to the entrance) was completely marine (i.e., in water salinity, a detectable swell, the nature of the accompanying fauna), as was the lake in Cova de na Mitjana. Cova 'C' de Cala Varques and Cova de na Barxa are typical anchihaline caves (in the sense of Stock *et al.*, 1986), with a thin layer of fresh water on the top of the deeper saline waters of the lakes.

Sampling was undertaken using meat-baited traps placed at different depths in the cave lakes and left for several days, and by using a hand-held plankton net with an extensible handle. The terminology used in the descriptions follows Huys & Boxshall (1991).

## SYSTEMATICS

Order **CYCLOPOIDA** Burmeister, 1834  
 Family **CYCLOPINIDAE** Sars, 1913  
 Subfamily **CYCLOPININAE** Kiefer, 1927  
 Genus *Cyclopina* Claus, 1863

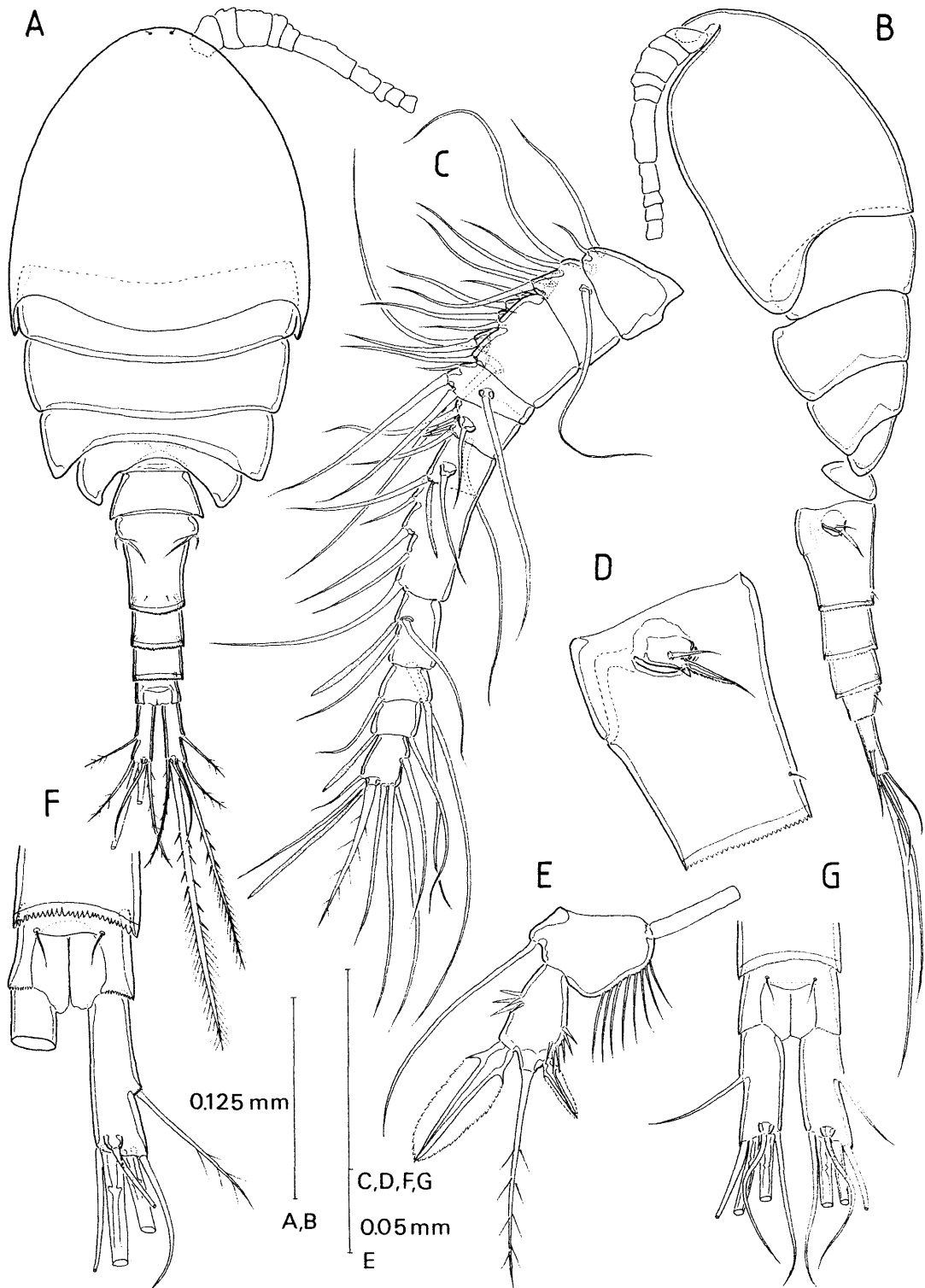
### *Cyclopina esilis* Brian, 1938

(Figs 1–4)

*Cyclopina* cf. *kieferi*: Herbst (1953; 1962)

**MATERIAL EXAMINED.** Cova de na Mitjana (Capdepera). UTM coordinates: 539.10; 4390.95. Topography published by Ginés *et al.* (1975): 96 individuals, both sexes (BMNH 1995. 1331–1340). Collected by D. Jaume, 17 July 1994.

**ADULT FEMALE.** Body (Figs 1A, B) cyclopiniform, up to 0.37 mm long. Prosome 5-segmented, about 1.7 times longer than urosome. Rostrum developed, oval. Posterolateral margins of cephalosome vaulted. First pedigerous somite free, partially concealed by dorsal and posterolateral extensions of cephalosome. Second to fourth pedigerous somites with evenly rounded posterolateral angles. Urosome 5-segmented, with genital and first abdominal somites completely fused to form genital double-somite. Serrate hyaline fringe adorning posterodorsal margin of fifth pedigerous somite, posterior margins of genital double-somite and abdominal somites 2 and 3, and posterolateral margins of anal somite; degree of serration varying directly with body size. Genital double-somite (Fig. 1D) symmetrical, 1.6 times longer than wide, expanded anteriorly. Single copulatory pore opening mid-ventrally at about two-fifths of distance along double-somite. Paired gonopores located laterally, each covered by operculum armed with short spinous process, 1

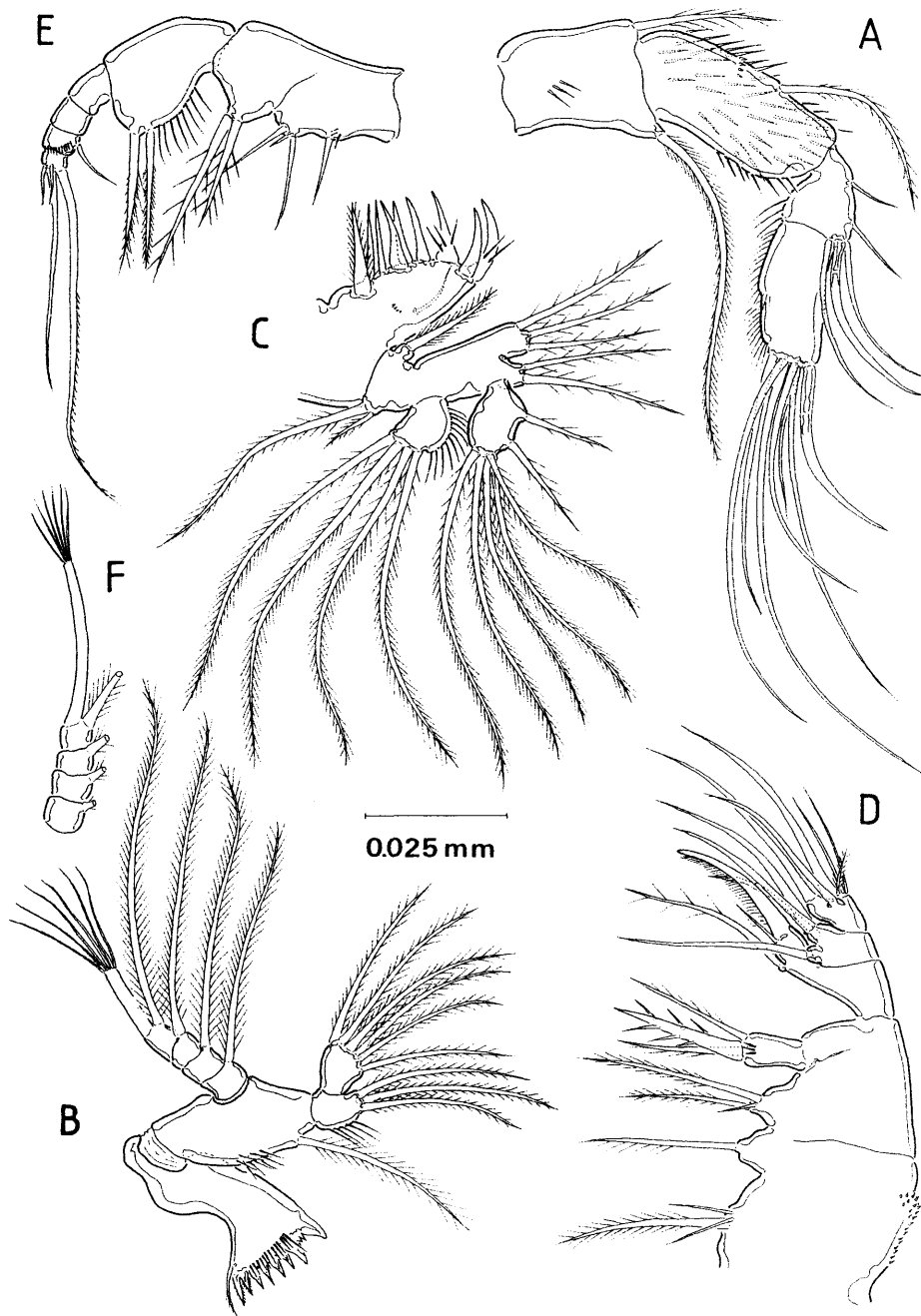


**Fig. 1.** *Cyclopina esilis* Brian, 1938, adult female. A, body, dorsal view; B, lateral; C, antennule; D, genital double-somite, lateral; E, fifth leg; F-G, dorsal view of anal somite and caudal rami, showing variation with body size in the position of the lateral seta of the caudal ramus.

seta, and 1 long flanged spine (Fig. 1D). Anal somite (Figs 1F, G) bearing smooth operculum. Caudal rami longer than anal somite, about 2.6 to 3.3 times longer than wide; proportional length related to body size. Armature consisting of 6 setae; position of seta II

variable, ranging from two-fifths (Fig. 1G) to three-fifths of distance along distal margin (Fig. 1F).

Antennules (Fig. 1C) symmetrical, 10-segmented, shorter than prosome (Fig. 1B). Segmental fusion pattern and armature as fol-



**Fig. 2.** *Cyclopina esilis* Brian, 1938, A and C–F, adult female, B, adult male. A, antenna; B, mandible; C, maxillule; D, maxilla; E, maxilliped; F, mandibular exopod.

lows: segment 1 (corresponding to fused ancestral segments I and II), 3 setae; segment 2 (corresponding to fused ancestral segments III to V), 5 setae; segment 3 (fused segments VI to IX), 8 setae; segment 4 (fused segments X and XI), 4 setae; segment 5 (fused segments XII to XIV), 6 setae; segment 6 (fused segments XV to XX, partial suture present between segments XVI and XVII), 6 setae + aesthetasc; segment 7 (fused segments XXI to XXIII), 3 + aesthetasc; segment 8 (XXIV), 2 setae; segment 9 (XXV), 1 + aesthetasc; segment 10 (fused segments XXVI to XXVIII), 7 + aesthetasc.

Antenna (Fig. 2A) 4-segmented. Fused coxa and basis short, about 1.5 times longer than wide, armed with 1 inner basal seta distally and 1 long seta (representing exopod) on outer margin.

Endopod 3-segmented. Proximal segment with 1 seta at about two-thirds of distance along inner margin; segment covered by long spinules on anterior surface. Second segment with 2 lateral and 3 distal setae (one of them claw-like) along inner margin. Distal segment with 7 distal setae, one of them claw-like. Secondary ornamentation on segments as figured.

Mandible (Figs 2B, F) with gnathobase armed with 10 unequal, sharp teeth plus 1 dorsal seta; row of 13 spinules located subdistally. Palp well developed; basis elongate, with patch of setules and 1 subdistal seta along inner margin. Exopod (Fig. 2F) inserted at about midway of distance along outer margin of basis; 4-segmented; setal formula 1,1,1,2; distal, brush-like seta somewhat shorter and thicker

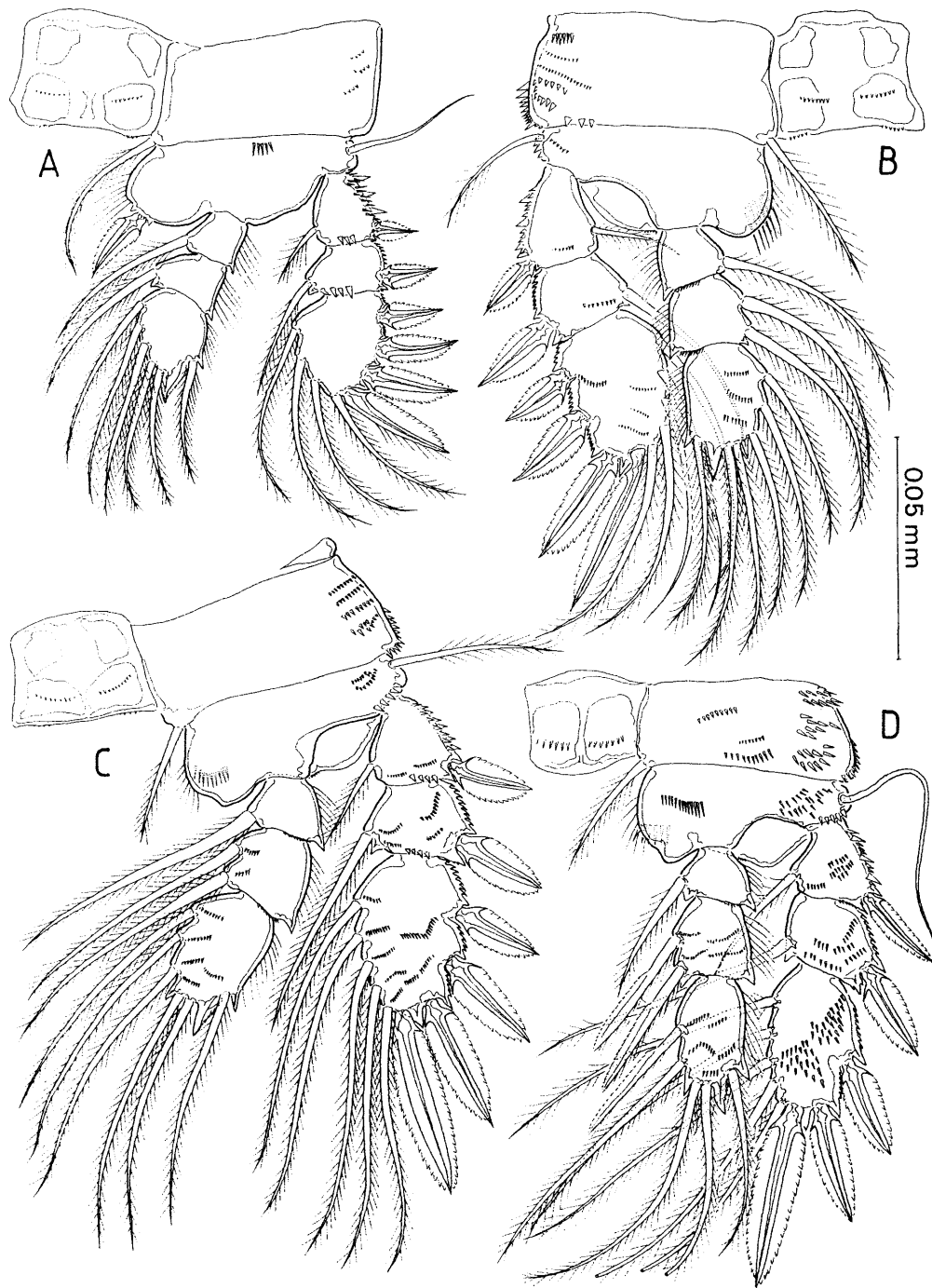


Fig. 3. *Cyclopina esilis* Brian, 1938, adult female swimming legs, posterior view. A, leg 1; B, leg 2; C, leg 3; D, leg 4.

than others, with brush of 6 setules on tip. Endopod 2-segmented, shorter than exopod, setal formula 3,6.

Maxillule (Fig. 2C) with well developed praecoxal arthrite, armed with 9 thick, unequal spines around distal margin plus isolated seta on posterior surface. Coxa and basis fused: coxal epipodite represented by 2 unequal setae; coxal endite represented by small cylindrical knob armed with 1 seta. Proximal and distal endites of basis discrete, bearing 3 and 2 setae respectively. Endopod 1-segmented, bearing 7 setae. Exopod 1-segmented, armed with 4 distal setae and marginal row of long setules.

Maxilla (Fig. 2D) well developed, 4-segmented. Praecoxa and coxa partially fused, endites with setal formula 3,1,3,3. Basis with large endite bearing claw-like spine plus 2 unequal setae. Endopod 2-segmented; proximal segment representing fused first and second ancestral endopodal segments; distal representing fused third and fourth ancestral segments; endopod setation formula (2+2),(2+4).

Maxilliped (Fig. 2E) slender, 6-segmented. Praecoxa and coxa fused forming syncoxa, bearing 3 (coxal) endites with setal formula 1,3,2. Basis with medial margin swollen, ornamented with marginal row of long setules; 2 setae implanted subdistally on medial margin.

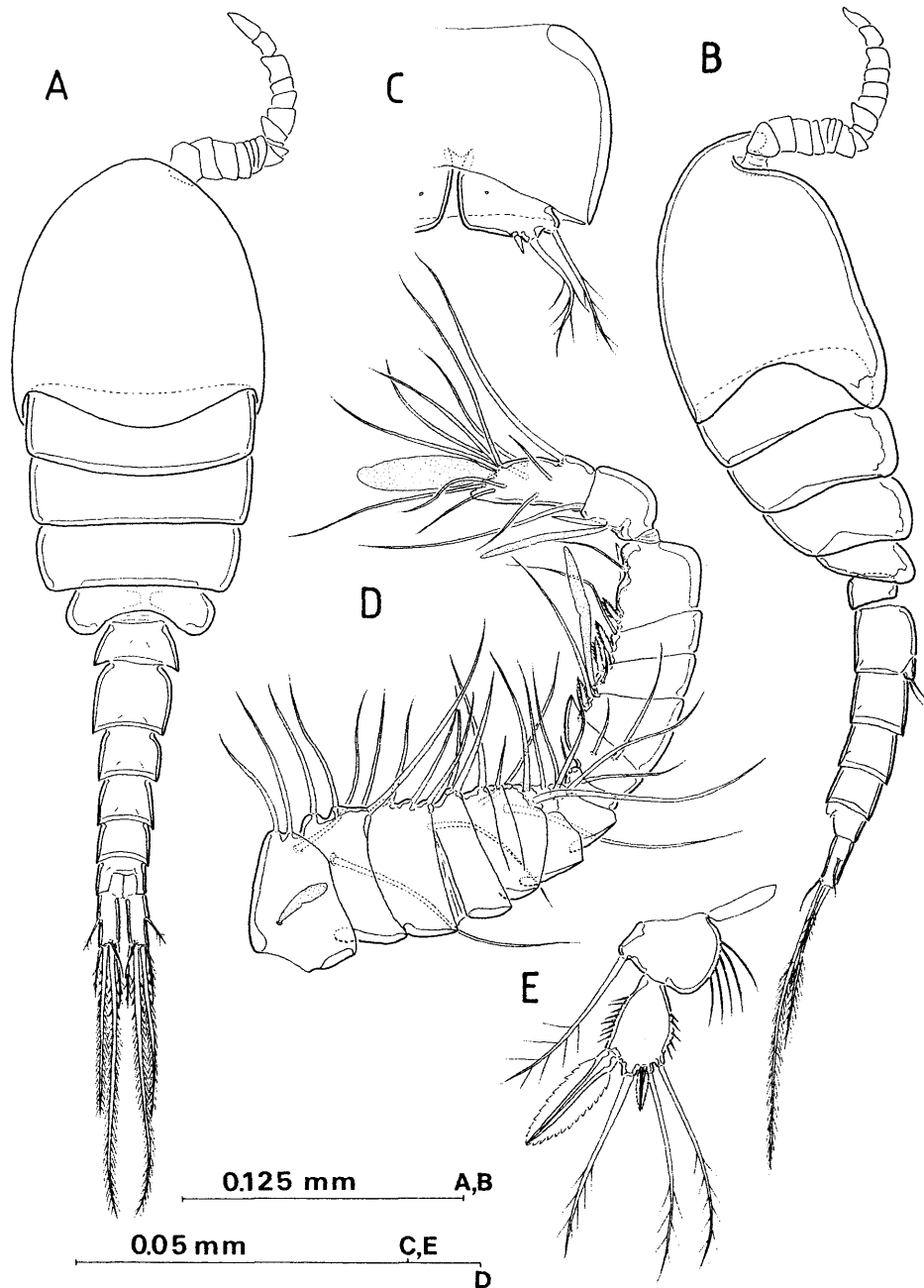


Fig. 4. *Cyclopina esilis* Brian, 1938, adult male. A, body, dorsal; B, lateral; C, genital somite, ventral; D, antennule; E, fifth leg.

Endopod 4-segmented, setal formula 0,0,1,4; transverse row of setules on segment 3.

Swimming legs 1 to 4 (Fig. 3) biramous, both rami 3-segmented. Legs subequal in size except first, somewhat reduced. All legs richly ornamented with denticles, as figured; anterior surface of coxae covered by small denticles, omitted from figures. Spines on exopodal segments flanged with serrate hyaline frill; distal spine on third exopodal segment of legs 1 and 2, and spines on endopod of leg 4 flanged only on one side. Armature as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1	0-1	1-I	I-1;I-1;III,I,4	0-1;0-1;1,2,3
Leg 2	0-1	1-0	I-1;I-1;III,I,5	0-1;0-2;1,2,3
Leg 3	0-1	1-0	I-1;I-1;III,I,5	0-1;0-2;1,2,3
Leg 4	0-1	1-0	I-1;I-1;II,I,5	0-1;0-II;1,2,1+1

Fifth legs (Fig. 1E) uniramous, 2-segmented, joined by naked intercoxal sclerite. Coxa and basis fused forming trapezoidal protopodal segment; inner margin with row of long setules; outer margin with long, smooth seta subdistally. Distal segment (exopod) about 1.6 times as long as wide, produced distally into median