

ROTIFERA FROM AUSTRALIAN INLAND WATERS. VII. NOTOMMATIDAE (ROTIFERA: MONOGONONTA)

by W. KOSTE* & R. J. SHIEL†

Summary

KOSTE, W. & SHIEL, R. J. (1991) Rotifera from Australian inland waters VII. Notommatidae (Rotifera: Monogononta). *Trans. R. Soc. S. Aust.* 115(3), 111-159, 29 November, 1991.

Keys are given to 14 genera and 70 species of the Rotifera: Monogononta in the family Notommatidae presently recorded from Australian inland waters. Available distribution data and ecological information are given for *Cephalodella* (26 species), *Dorystoma* (1), *Eosphara* (5), *Eothinia* (1), *Itura* (3), *Monommata* (11), *Notommata* (14), *Pleurotrocha* (1), *Resticula* (3), *Scaridium* (1), *Taphrocampa* (2) and *Tetrastrophon* (1). *Drilophaga* is recorded here for the first time. A record of *Rousseletia* is *incertae sedis*. The genera *Metadiaschiza*, *Pseudoharringia*, *Pleurotrochopsis*, *Sphyrias* and *Tylatrocha* are not recorded from the continent.

KEY WORDS: Rotifera, Australia, taxonomic revision, Notommatidae, *Cephalodella*, *Dorystoma*, *Drilophaga*, *Eosphara*, *Eothinia*, *Itura*, *Monommata*, *Notommata*, *Pleurotrocha*, *Resticula*, *Rousseletia*, *Scaridium*, *Taphrocampa*, *Tetrastrophon*

Introduction

The purpose of our series of papers has been to document the rotifers recorded from Australia, primarily to provide usable keys to them. We have demonstrated the existence of a diverse Australian rotifer fauna distinct from that of Europe or North America, with >50% of recorded species in some genera endemic. Also, there is marked latitudinal and longitudinal variation in species assemblages. Taxonomic resolution of this component of aquatic systems permits more informed understanding of community ecology in inland waters and, thereby, better interpretation of environmental impacts on water quality.

The taxonomy of the rotifer families we have reviewed to date (see Koste & Shiel 1990b) has been reasonably straightforward. The Notommatidae, in contrast, appears to be the repository of everything not readily placed elsewhere. In their revision of the Wisconsin notommatids, Harring & Myers (1924) noted of the family that "there has been a steady accretion of new species and a periodic shifting of the old ones, until it has become a veritable Serbonian bog, carefully avoided by everybody or, at least, trespassed upon only under compulsion". It seems that time has only compounded the confusion. In the ensuing years some efforts were made to resolve loosely affiliated taxa by erection of new families, e.g. Lindiidae, Dicranophoridae, particularly by Remane (1933). Notwithstanding, the Notommatidae still contains 21 genera in two

subfamilies (Koste 1978), with one-third of the genera monospecific, and an extraordinary profusion of 'species' in others [>200 in *Cephalodella* (Ruttner-Kolisko 1974)]. A systematic revision of the family is needed urgently. Given recent technological advances, particularly scanning electron microscopy (SEM) (cf. Koste & Shiel 1990a), resolution of the group is feasible.

Notommatid rotifers are predominantly littoral (epiphytic or epibenthic) in habit, collected in and around vegetation in shallow waters of lake or river margins, in billabongs, and in the roots or scales of floating macrophyte mats. Most are grazers, feeding on detritus, bacteria and epiphytic algae, particularly diatoms. Some taxa are omnivores, taking protozoans and other rotifers, and several species are parasitic on worms or leeches (Pourriot 1965; Koste 1978).

General problems associated with rotifer systematics are more pronounced in the Notommatidae, especially those arising from study of preserved material, sometimes long after collection (cf. Berzins 1982). Animals may be strongly contracted in preservatives, artefacts are produced by distortion, colours of organelles may fade, etc., leading to erroneous observations, incorrect measurements and misidentifications. For these reasons we consider that some of the notommatid taxa reported from Australia probably do not occur here. They may be good endemic species named for the European taxa they most closely resemble, or a known species wrongly identified.

To minimise erroneous identifications, we suggest that live material be examined wherever possible, followed by critical examination of mastax

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morphology, particularly the species-specific sclerotised *trophi* (Fig. 2). Extensive use of trophi morphology has been made in European revisions. General trophi structure was reviewed in Koste & Shiel (1987a), but in view of the difficulty of working with these small structures (some less than 20 μm), we attempted in earlier parts to produce keys to species based on morphometry, e.g. body v. toe length, claw:toe ratios, etc. Unlike most metazoans, rotifers are eutelic (cell numbers constant between generations) with little intraspecific morphological variation, hence comparative measurements of body parts can be used diagnostically. In the Notommatidae, close examination of the trophi is necessary to prevent confusion of closely allied taxa or juveniles of large species with adults of smaller forms.

In this review the format of earlier parts is followed; for convenience, genera and species are treated alphabetically. Keys to rotifer families are included in Koste & Shiel (1987a), which also contains brief descriptions of general morphology. Known distribution and ecological information are given for the species we have encountered. Available type locality and holotype information is included. Where type locality is not known, probable place of origin is given in parentheses; some early authors did not specify origin of material, however we consider it likely that in the late 18th–early 19th century their collections derived from proximal localities.

Methods

Live animals can be collected with floating or submerged macrophytes from most standing waters. Stems of *Vallisneria*, *Eleocharis*, *Myriophyllum*, and other submergents provide rich rotifer assemblages. The floating liverwort, *Ricciocarpus*, or the fern, *Azolla*, usually have diverse rotifer faunas associated with their submerged parts.



Fig. 1. Low vacuum system for mounting rotifers and clearing trophi onto a Nuclepore filter.

Whole plants or segments can be examined under LP microscopy and resident rotifers removed by fine pipette onto glass slides for HP microscopy. Animals can be restrained by light pressure of a coverslip (supported on plasticine "feet" or coverslip fragments), or in a purpose-built compression chamber (Martin 1986); all measurements of body morphology can be made on uncontracted individuals. If live material is not available, recently-preserved is preferable to long-preserved.

When all body measurements are taken, preparation of trophi for light microscopy should be made by clearing the animal(s) in sodium hypochlorite; at least several preparations should be made to permit interpretation of the orientation of the minute components. A drop of bleach solution placed beside the coverslip is drawn underneath it by carefully touching lens tissue to the opposite side. The clearing animal should be in view during the process because rapid flow of the bleach may move it or the trophi, and the preparation will be lost. A microscope-mounted video camera is a useful accessory for recording both whole-animal and trophi morphology during this procedure.

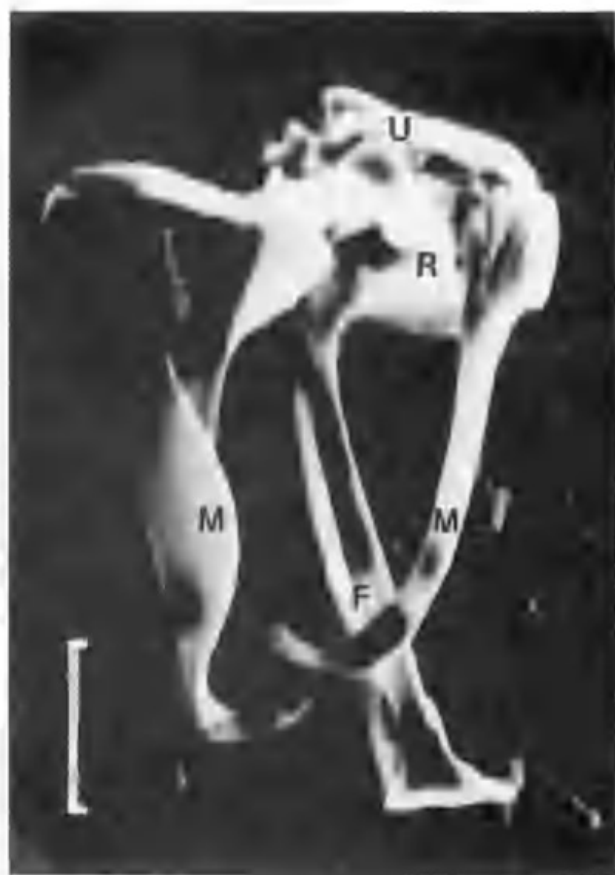


Fig. 2. Trophi of *Notommata copeus* from R. Murray waters, Barmah Forest. F = fulcrum, M. = manubrium, R = Ramus, U = uncus. Cambridge S600 Stereoscan. Scale line 20 μm .

Treatment of trophi for SEM will depend on their robustness; some larger trophi can simply be extracted from cleared animals by micropipette, rinsed through a graded ethanol series and pipetted from the final 100% ethanol or acetone onto a SEM stub (cf. Fig. 1). For more delicate trophi, the system shown in Fig. 2 was adapted from Markevitch & Koreneva (1981). Rotifers removed from field collections are rinsed through filtered water,

pipetted in a small drop of water onto a Nuclepore membrane and treated with sodium hypochlorite for 5-10 min. Low vacuum is then applied to remove the hypochlorite solution, the cleared trophi are rinsed gently with distilled water, and the filter is removed and dried over silica gel. Critical point drying is not necessary. If sufficient numbers of animals are used, standard sputter coating with gold/palladium and examination under SEM

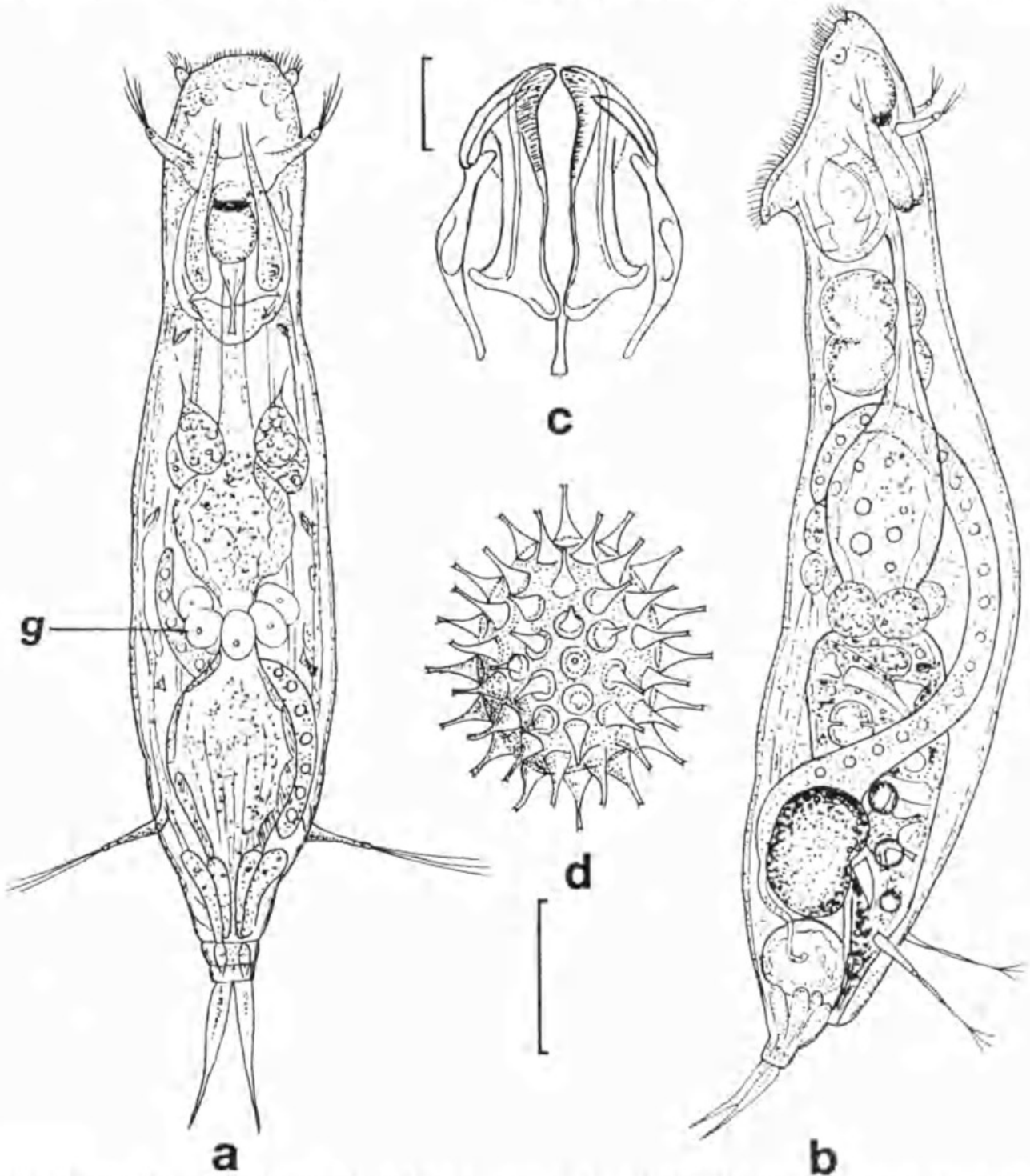


Fig. 3. *Tetrasiphon hydrocora* Ehrenberg: (a) dorsal, swimming (g = glands); (b) lateral, swimming; (c) trophi; (d) resting egg. Scale lines: a, b, d 100 μm; c 20 μm. After Koste (1978).

enables detailed resolution of trophi in different orientations. An alternative method detailed by Kleinow *et al.* (1990) permitted high-resolution micrographs of undistorted trophi preparations of a brachionid species, *Brachionus plicatilis*, but has not yet been used for rotifers with more complex trophi. Further details of trophi ultrastructure are given by Markevitch & Kutikova (1989).

SYSTEMATICS

Family Notommatidae Remane

The characteristics of the family were described by, *inter alia*, Haring & Myers (1924), Remane (1933) and Koste (1978). It is a diverse assemblage of illoricate or partly loricate taxa comprising two subfamilies: Tetrastrophinae (two genera) and Notommatinae (19 genera) separated on the basis of presence (Tetrastrophinae) or absence (Notommatinae) of a whorl of bulbous glands between the stomach and intestine.

Subfamily Tetrastrophinae

Of two described genera, *Repaulina* and *Tetrastrophon*, only *Tetrastrophon* is known from Australia.

Genus *Tetrastrophon* Ehrenberg

Tetrastrophon Ehrenberg, 1840, p. 219. Monotypic genus.

Type: *Tetrastrophon hydrocora* Ehrenberg, 1840 p. 219.

Tetrastrophon hydrocora Ehrenberg

FIGS 3, 4

Syn.: ?*Repaulina dicerea* Berzins, 1960, pp. 1-3.

Type locality: Berlin.

Holotype: Not designated.

Description: Body illoricate, cylindrical to fusiform; no annular ring separating head and trunk, cuticle somewhat stiff; abdomen ends in short stumpy projection over cloaca; foot short, bi-segmented, with two acutely pointed, elongated toes; corona oblique, extended ventrally to elongated 'chin'; tentaculate dorsal paired lateral antennae; lateral antennae towards posterior end of abdomen similarly elongate, with exceptionally long sensory setae; single cerebral eye; trophi with single toothed unci; manubria with complex projections (Fig. 3c); rami long, lyrate, curved dorsally, with pointed alulae; large hypopharynx muscle inserted in mastax wall; adult animal commonly in yellowish gelatinous sheath.

Length 450-1000 μm , toes 60-80 μm ; subitaneous



Fig. 4. *Tetrastrophon hydrocora* grazing on *Pleurotaenium*. Tallandoon billabong, Mitta Mitta River, Vic. Kodak T-max, 1/30 sec.

egg 140-154x110-115 μm , with curved spinules 45-65 μm long; resting egg 200 x 155 μm ; male to 300 μm ; male egg 102-126 x 88-92 μm .

Ecology: In *Sphagnum* pools, acid waters in Europe, N. and S. America; billabongs of upper Murray tributaries, N.S.W., Vic.; dune lakes in Tasmania. Specialist grazer on large desmids, e.g. *Cosmarium*, *Micrasterias*, *Pleurotaenium* (Fig. 4), *Staurastrum*. During filmed feeding experiments, an individual from a billabong on the Mitta Mitta River at Tallandoon, Vic., ingested 10 *Staurastrum* in 30 min. As the cells passed along the gut they gradually lost colour, the semicell branches were fractured by muscular action, and the fragments were egested.

Literature: Pourriot 1965; Koste 1968, 1978.

Subfamily Notommatinae

The subfamily has 19 named genera, 13 of which are known from Australia. *Metadiaschiza* Fadeev (Fig. 5:1), *Pleurotrochopsis* Berzins (Fig. 5:2), *Pseudoharringia* Fadeev (Fig. 5:3), *Sphyrias* Haring (Fig. 5:4) and *Tylotrocha* Haring & Myers (Fig. 5:5) are not presently recorded here. For further information on them, see Koste (1978). *Drilophaga* is a new record, reported here for the first time. A single report of *Rousseletia* is considered *incertae sedis*.

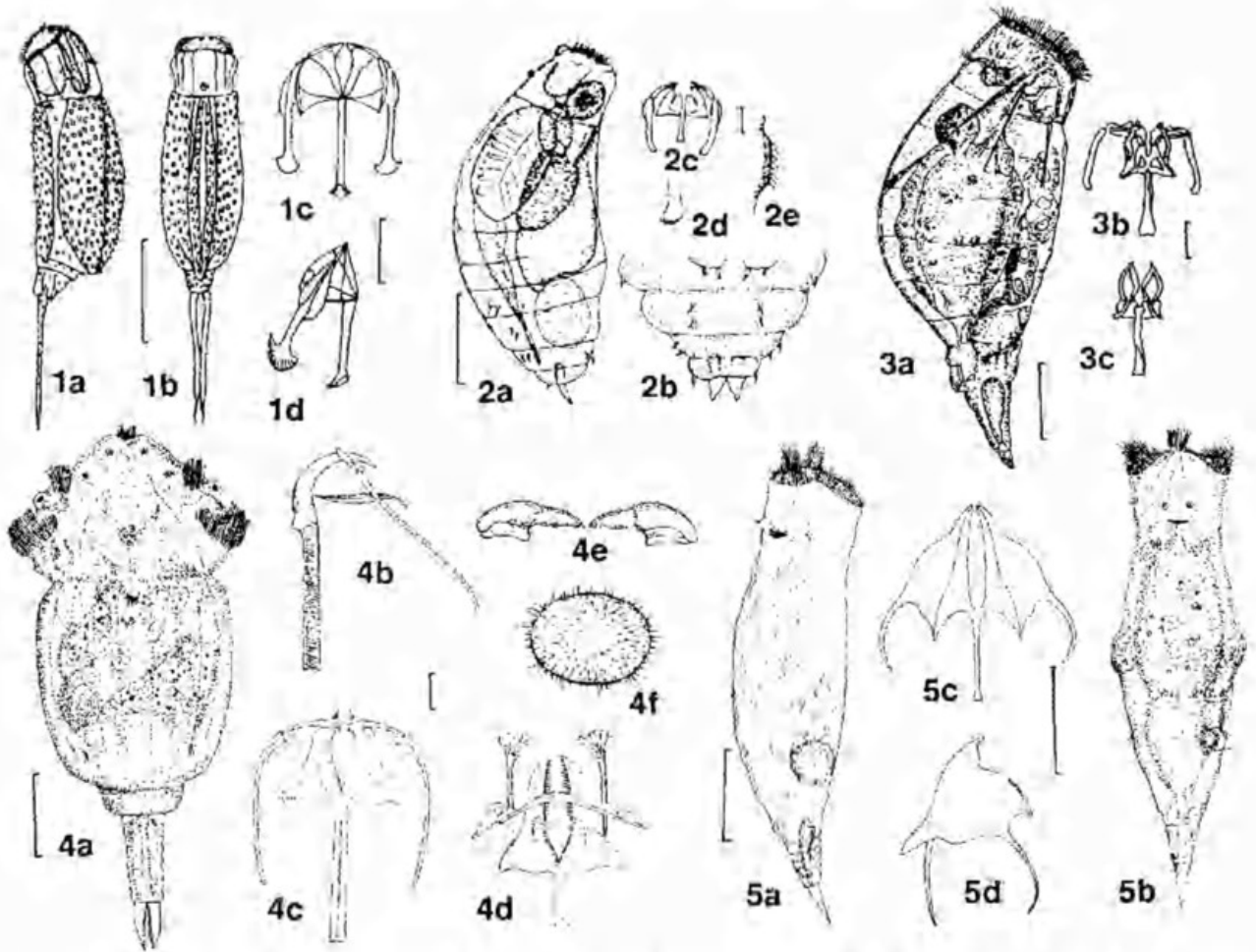


Fig. 5. 1, *Metadiaschiza* Fadeev: (a) lateral; (b) dorsal; (c) trophi ventral; (d) trophi, lateral. 2, *Pleurotrochopsis* Berzins: (a) lateral; (b) posterior abdomen and toes, dorsal; (c) trophi, ventral; (d) distal end of fulcrum; (e) ventral cuticular 'lamella' with hooks. 3, *Pseudoharringia* Fadeev: (a) lateral; (b) trophi, ventral; (c) fulcrum and rami. 4, *Sphyras* Haring: (a) dorsal; (b) trophi, lateral; (c) trophi ventral; (d) trophi, apical; (e) unci, lateral; (f) resting egg. 5, *Tylotrocha* Haring & Myers: (a) lateral; (b) dorsal; (c) trophi, ventral; (d) trophi, lateral. 1 after Wulfert (1937), 2 after Berzins (1973), 3 after Kutikova (1970), 4 after Koste (1978), 5 after Haring & Myers (1922). Scale lines: adults 50 μ m, trophi 10 μ m.

Key to genera of the subfamily Notommatinae

1. Corona on cylindrical extrusion/evagination, with circumapical ciliation (Fig. 14a); annular adhesive organ present; no lateral ciliary auricles; mouth deeply invaginated. . . . *Drilophaga* Vejdovsky (Fig. 14)
- Corona not extruded, may be frontal, oblique or extending ventrally; no adhesive organ; ciliary auricles may be present; mouth not deeply invaginated. . . . 2
- 2(1). Vitellarium band- or ribbon-shaped. . . . 3
- Vitellarium oval or kidney-shaped. . . . 5
- 3(2). Nuclei arranged linearly. . . . 4
- Nuclei irregularly distributed. . . . *Enteropleu* Ehrenberg (Fig. 15:2)
- 4(3). Eyeless; foot two to three-segmented. . . .
- *Pseudoharringia* Fadeev (Fig. 15:3)
- Two frontal eyes on papillae; foot one-segmented with annuli. . . . *Sphyras* Haring (Fig. 5:4)
- 5(2). Foot and toes longer than body. . . . 6
- Foot and toes shorter than body. . . . 7
- 6(5). Toes of dissimilar length; foot short, mostly 2-, rarely three-segmented. . . *Monommata* Bartsch (Figs 19, 20)
- Toes of similar length; foot 3-segmented and very long. . . . *Scaridium* Ehrenberg (Fig. 28:1)
- 7(5). Foot with single toe. . . *Tylotrocha* Haring & Myers (Fig. 5:5)
- Foot with two toes. . . . 8
- 8(7). Rump or last foot segment with spine. . . . 9
- Rump or last foot segment without spine. . . 10
- 9(8). Rump with curved spine. . . .
- . . . *Dorystoma* Haring & Myers (Fig. 15:1)
- Foot-end with short spine. . . . *Rousseletia* Haring (Fig. 29)
- 10(8). Trunk loricate with 3-5 species-specific cuticular plates. . . . 11
- Trunk illoricate. . . . 12

- 11(10). 2 dorsolateral plates; 1 granulated ventral plate *Cephalodella*
Bory de St Vincent (Figs 7:13)
2 dorsoventral, 2 (or 5) ventrolateral plates, also
3 smooth trunk plates present.
..... *Metadiaschiza* Fadeev (Fig. 5:1)
12(10). Cuticle with rows of tiny hooks.
..... *Pleurotrochopsis* Berzins (Fig. 5:2)
Cuticle lacking hooks. 13
13(12). Trunk with conspicuous annuli. *Taphrocampa*
Gosse (Fig. 28:2, 3)
Annuli absent. 14
14(13). One cerebral eye and two widely-separated frontal
eyes. 15
Cerebral eye absent (or if present, no frontal eyes
as above). 17
15(14). Stomach with blind sacs. *Itura*
Harring & Myers (Fig. 18)
Stomach without blind sacs. 16
16(15). Mastax with single salivary gland. *Eathina*
Harring & Myers (Fig. 17:2)
Mastax with paired salivary glands. *Eosphora*
Ehrenberg (Figs 16, 17:1)
17(14). Corona displaced ventrally; ciliary auricles
generally present. *Notommata*
Ehrenberg (Figs 21-25)
Corona anterior, no auricles present. 18
18(17). Salivary glands symmetrical. *Pleurotrocha*
Berzins (Fig. 26:1)
Salivary glands asymmetrical or rudimentary.
..... *Resnicula* Harring & Myers (Figs 27:2-4)

Genus *Cephalodella* Bory de St Vincent

Cephalodella Bory de St Vincent, 1826, p. 43.

Type: *Cercaria catellina* Müller, 1786, p. 130. =
Cephalodella catellina (Müller).

Type locality: Copenhagen.

Fusiform notommatid rotifers of various shapes, from elongate to short and stumpy; occasionally illaricate, but mostly with one or more lorica plates, position of which varies according to species; slight constriction between head and trunk, none between trunk and short foot, which bears two toes; in loricate taxa, dorsal and lateral sulci distinct between plates; corona frontal, oblique, with long marginal cilia and two lateral tufts of long swimming cilia; buccal field lightly ciliated; mastax virgate, with long straight fulcrum, poorly developed rami; retrocerebral organ rudimentary or absent; eyespot cervical, single or paired frontal, or absent.

Of >200 *Cephalodella* species worldwide, Koste (1978) described 132 taxa from Europe. Twenty-four of these, and two endemics, are known from Australia. Other taxa (especially *nomina dubia*) are given by Harring & Myers (1924), who also discuss the confused generic nomenclature.

Trophi morphology: In the descriptive section

below, we recognize the six trophi types described by Wulfert (1937). In descriptions of trophi structures, we use 'proximal' to refer to the head or anterior end and 'distal' to the tail or posterior end. 'Basal' as used by Wulfert implies proximal.

Type A (Fig. 6:1): fulcrum spatulate distally; rami single, without teeth on inner margin; manubria slender, rodlike, curving inwards in top view, from straight shaft, no basal lamellae or distal dilation of manubria, which form characteristic crescentic shape when closed.

Type B (Fig. 6:2): fulcrum as Type A; inner margin of rami toothed or striated, at times with alulae; manubria with single or bilateral basal lamellae, distally T-shaped (termed 'double-crooked' by Wulfert, referring to a curved shepherd's 'crook'. This implement, and the term, no longer seem to be in common usage). Several species (e.g. *C. eva*) have a spatulate dilation of the manubria ends rather than a free-standing T, but in all other features conform to Type B trophi.

Type C (Fig. 6:3): features distinctive ringlike fenestrations at distal ends of manubria, considered by Wulfert to be derived from double-crooked Type B trophi.

Type D (Fig. 6:4): is most complex, with trophi parts not found in other types. Fulcrum short, dilated distally (also in lateral view), narrower in middle; rami from above widely separated, with comblike teeth on forcipate tips (absent in *stenroosi*); manubria proximally with wide bilateral lamellae, distally with single abrupt inward curve or crook; behind basal expansions, branched structures (subunci) occur; unci single, often with dorsal plate. In some species (*forficula*, *gigantea*, *tenuiseta*), a large delicate frontal plate with denticulate margin occurs above rami.

Type E (Fig. 6:5): known only in *C. megaloccephala*. Fulcrum not dilated; rami right-angled dorsally (visible in lateral view), closed distally (at fulcrum) and separating proximally; basal lamellae of thin, S-shaped manubria apparently separate.

Type F (Fig. 6:6): recorded only in *C. mira*, which is not known from Australia. This trophus is comprised entirely of delicate rods.

Key to species of *Cephalodella* recorded from Australian inland waters

1. Ratio total length/toe length <3 2
Ratio total length/toe length >3 5
- 2(1). With single or double cerebral eye. 3
Eyeless. 4
- 3(2). Toes curved dorsally, distinctly segmented, ...
..... *C. lantilloides* Hauer (Fig. 13:1)

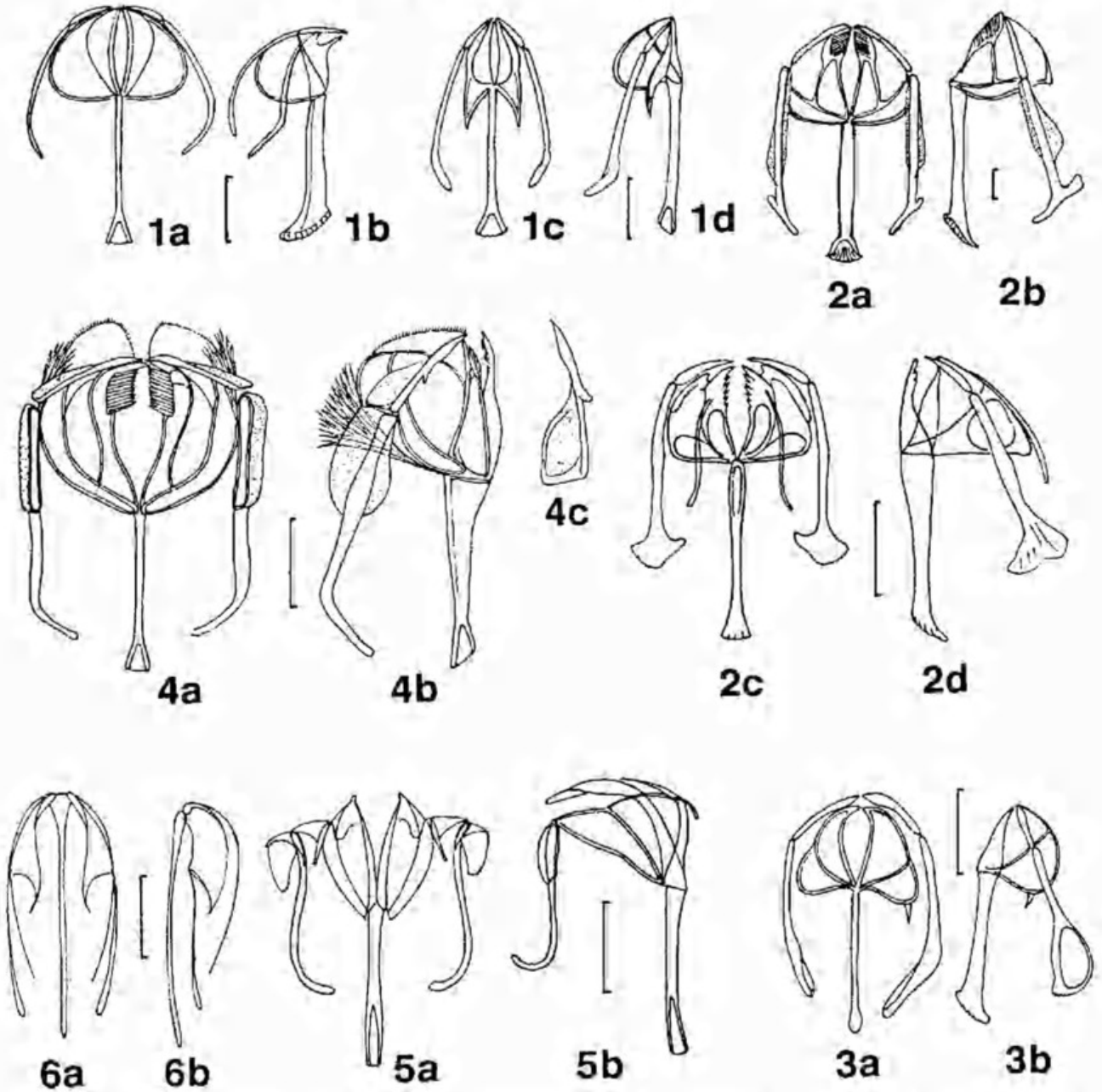


Fig. 6. Trophi types recognized in *Cephalodella* species. 1, Type A: (a) ventral; (b) lateral; (c, d) variant. 2, Type B: (a) ventral; (b) lateral; (c, d) variant. 3, Type C: (a) ventral; (b) lateral. 4, Type D: (a) ventral; (b) lateral, (c) uncus, lateral. 5, Type E: (a) ventral; (b) lateral. 6, Type F: (a) ventral; (b) lateral. After Wulfert (1937). Scale lines 10 μ m.

- | | | |
|---|--------|--|
| Toes sigmoid in lateral view, not segmented... | 7(6). | Body >300 μ m.....18 |
| <i>C. nana</i> Myers (Fig. 12:1) | | Body <300 μ m.....8 |
| 4(2). Abdomen with hooked caudal projection..... | 8(7). | Body >90 μ m, toes >20 μ m.....9 |
| <i>C. mucronata</i> Myers (Fig. 11:4) | | Body <90 μ m, toes $\leq$ 20 μ m..... <i>C. gisleni</i> |
| Without hooked caudal projection..... | | Berzins (Fig. 10:2) |
| <i>C. biungulata</i> Wulfert (Fig. 7:3) | 9(8). | Toes (straight or curved) taper evenly from base to tip.....11 |
| 5.(1). Ratio total length/toe length 3-5.....6 | | Toes with recurved bristle-like tip or obvious segmentation.....10 |
| Ratio total length/toe length >5.....21 | 10(9). | Tips of toes sickle-shaped, recurved..... |
| 6(2). Toe tips with longitudinal denticle row (2-4) on functionally ventral side..... <i>C. lindamaya</i> | | <i>C. apocolea</i> Myers (Fig. 7:1) |
| Koste & Shiel (Fig. 11:1) | | |
| Toe tips without ventral denticles, but may have median dorsal denticles.....7 | | |

- Distal 1/4 of toes demarcated by transverse septum into segmented tip *C. intuta* Myers (Fig. 10:5)
- 11(9). Toes >60 μm 12
Toes <60 μm 13
- 12(11). Trophi >70 μm *C. gibba* (Ehrenberg) (Fig. 9:6)
Trophi ca. 30 μm *C. tinca* Wulfert (Fig. 13:3)
- 13(11). Toes 30–60 μm 15
Toes <30 μm 14
- 14(13). Body <125 μm ; toes 20–26 μm ; trophi <30 μm *C. exigua* (Gosse) (Fig. 9:3)
Body >125 μm ; toes 25–28 μm ; trophi 30–34 μm *C. ventripes* Dixon-Nuttall (Fig. 13:4)
- 15(13). Trophi <30 μm 16
Trophi >30 μm 17
- 16(15). Paired eyespots with crystalline lens; toes > 1/3 body length; *C. misgurnus* Wulfert (Fig. 11:3)
No eyespots; toes < 1/3 body length *C. forficata* (Ehrenberg) (Fig. 9:4)
- 17(15). Single eyespot at posterior end of ganglion; corona with prominent lips; manubria not crooked *C. hoodi* (Gosse) (Fig. 10:4)
Paired frontal eyespots in single capsule; corona without prominent lips; manubria crooked *C. sterea* (Gosse) (Fig. 12:4)
- 18(7). Toes >100 μm 19
Toes <100 μm 20
- 19(18). Toes ca. 1/3 body length; trophi >70 μm *C. gibba* (Ehrenberg) (Fig. 10:1)
Toes 1/6 body length; trophi <70 μm *C. panarista* Myers (Fig. 12:2)
- 20(18). Distinct eyespot; toes 1/5 body length *C. forficula* (Ehrenberg) (Fig. 9:5)
No eyespot, toes 1/2 body length *C. tenuisetia* (Burn) (Fig. 13:2)
- 21(2). Toes >20 μm 22
Toes <20 μm *C. caellina* (Müller) (Figs 7:4, 8)
- 22(21). Body >190 μm 23
Body <190 μm 24
(NB: Occasionally individuals of *C. parasitica* may exceed 190 μm ; see species determination.)
- 23(22). Toes >50 μm (at least 1/3 body length) *C. eya* (Gosse) (Fig. 9:2)
Toes <50 μm , 1/6 body length *C. megaloccephala* (Glasscott) (Fig. 11:2)
- 24(22). Eyespot(s) visible, coloured or colourless 25
No eyespot *C. parasitica* (Jennings) (Fig. 12:3)
- 25(24). Two cerebral eyespots; lorica keeled in dorsal 1/3 *C. euderhyi* Wulfert (Fig. 9:1)
Single eyespot, colourless or coloured; no dorsal keel on posterior lorica 26
- 26(25). Eyespot reddish; trophi >30 μm *C. auriculata* (Müller) (Fig. 7:2)
Eyespot colourless; trophi <30 μm *C. gracilis* (Ehrenberg) (Fig. 10:3)

Cephalodella apocolca Harring & Myers

FIG. 7:1

Cephalodella apocolca Harring & Myers, 1924, p. 509, Figs 33:1, 2.

Type locality: Not specified. "... common in weedy ponds and bogs." Vilas and Oneida Counties, Wisconsin, are first localities mentioned by Harring and Myers.

Holotype: Not designated, ? Myers Collection, American Museum of Natural History (AMNH), New York.

Description: Body transparent, elongate, slightly compressed laterally; plates obvious, with distinct lateral sulci; foot large, robust, with small protruding tail; foot glands large, pyriform; toes set wide apart, straight, ending in recurved, sickle-shaped tips (toes may be crossed in swimming animal); corona oblique, convex, without protruding lips; trophi modified type A, slender, with delicate, curved manubria; fulcrum with slight terminal bend; eyespot absent.

Total length 125–185 μm ; trophi 29–33 μm (fulcrum 12–20 μm , manubria 20 μm); toes 32–58 μm .

Ecology: In acid-neutral waters on submerged plants, in periphyton, where it feeds on diatoms and unicellular algae. Europe, N. America, New Zealand. pH tolerant. Single record: Magela Creek, N.T. (billabong not named, possibly Mine Valley).

Literature: Koste 1981.

Cephalodella auriculata (Müller)

FIG. 7:2

Vorticella auriculata Müller, 1773, p. 111.*Cephalodella auriculata*: Harring & Myers, 1924, p. 479, Fig. 28:6.

For extensive synonymy see Rutikova (1970: 240), Koste (1978: 366).

Type locality: Copenhagen.

Holotype: Not designated.

Description: Body short, stout; head conspicuously wider than trunk, with small rostrum; lorica rigid, plates distinct; foot very short, toes short (<1/5 length); caudal antennae setae long; mastax large with two round, clear salivary glands; trophi type A, with small, thin mallei, slender recurved manubria, fulcrum long, expanded distally. Resembles *C. ventripes*, but has single red cervical eyespot.

Total length 120–160 μm ; trophi 36 μm ; toes 22–28 μm ; male 95 μm .

Ecology: Cosmopolitan in beach sand, in littoral of still and flowing waters, where its main food is phytoflagellates and detritus. Qld, N.T., Tas., Vic., common in R. Murray billabongs. 16.0–22°C, pH 6.4–7.3, 57.3–274 $\mu\text{S cm}^{-1}$.

Literature: Colledge 1914; Koste 1981; Berzins 1982; Koste *et al.* 1988.

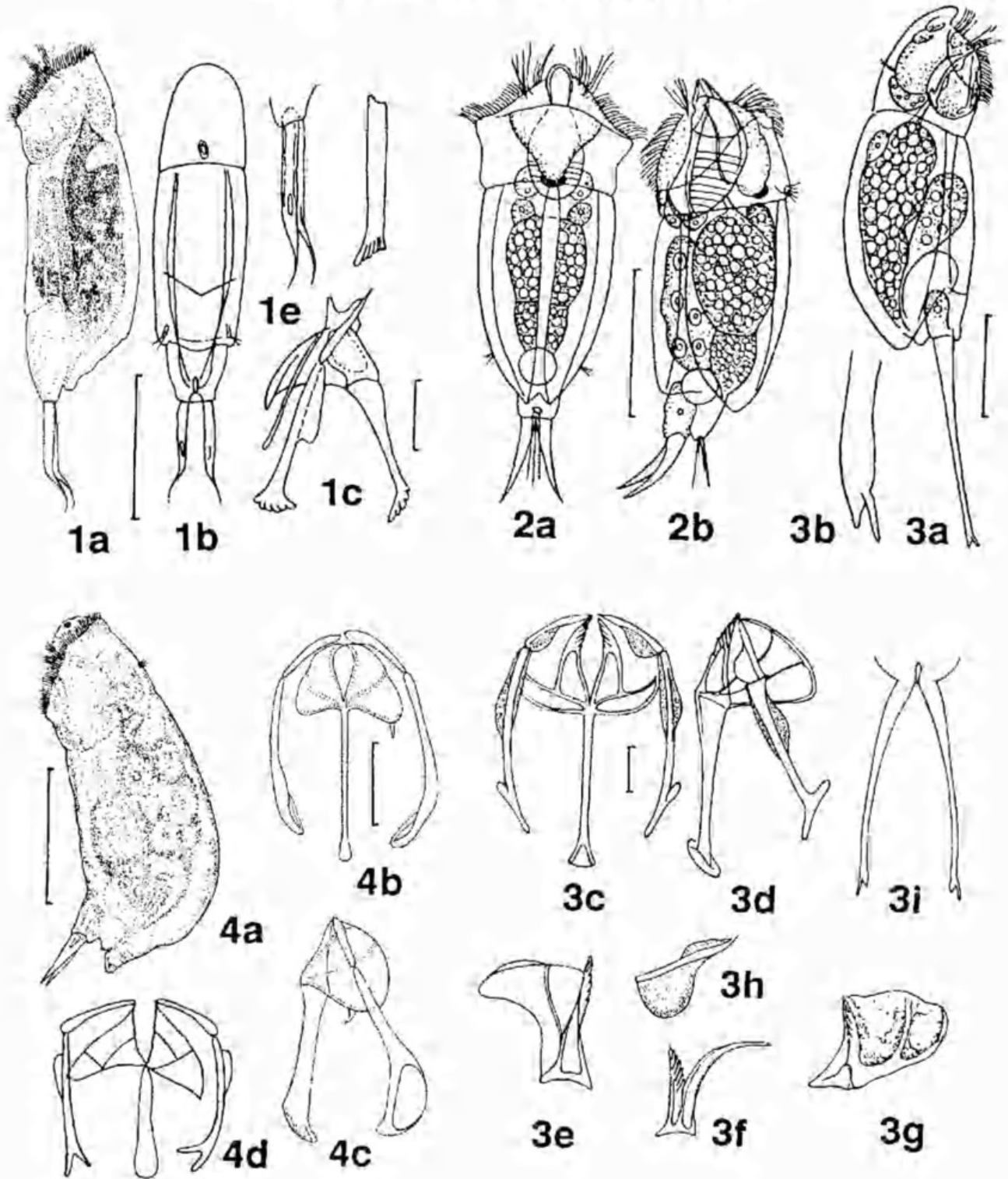


Fig. 7. 1, *Cephalodella apocolea* Myers: (a) lateral; (b) dorsal; (c) trophi, lateral; (d) toe tips, lateral; (e) fulcrum, lateral. 2, *C. auriculata* (Müller): (a) dorsal; (b) lateral; for trophi see Fig. 3:1a, b. 3, *C. biungulata* Wulfert: (a) lateral; (b) toe tip, lateral; (c) trophi, ventral; (d) trophi, lateral; (e) uncus; (f-h) views of ramus; (i) toes, ventral. 4, *C. catellina* (Müller): (a) lateral; (b) trophi, ventral; (c) trophi lateral; (d) trophi of *C. armata* Rudescu. 1, 2 after Wulfert (1940); 3 after Wulfert (1937); 4a-c after Haring & Myers (1924); 4d after Rodewald-Rudescu (1960). Scale lines: adults 50 μ m; trophi 10 μ m.

Cephalodella biungulata Wulfert

FIG. 7:3

Cephalodella biungulata Wulfert, 1937, p. 617-618, Fig. 26.**Type locality:** (Germany).**Holotype:** Not designated.

Description: Body hyaline, oval, dorsally arched; head short, slightly oblique; abdomen projects over short foot, both covered by dorsal plates; toes long, flexible, $>1/3$ total length, with distinctive bifurcate tips due to presence of spinule at distal end; mastax lacks salivary glands; trophi of *C. gibba* type (B), with symmetrical rami denticulate on inner margin; manubria double-crooked, with bilateral proximal lamellae (Fig. 7:3c); shaft of uncus with semicircular lamella. Eyes absent. Close to *C. gibba*. Distinguished from it by the lack of eyes, characteristic longer bifurcate toes and trophi differences.

Total length 250–313 μm ; toes 88–112 μm ; trophi 50–54 μm .

Ecology: Rare in littoral/moss of pools and streams

in Europe. Several individuals in a collection from the filling Dartmouth reservoir in 1978, probably incursions from a submerged littoral habitat. Not collected subsequently.

Cephalodella catellina (Müller)

FIGS 7:4, 8

Cercaria catellina Müller, 1786, p. 130, Fig. 20:12,13.*Cephalodella catellina*: Bory de St-Vincent, 1826, p. 43.

See Harring & Myers (1924, p. 183–184) and Koste (1978, p. 371) for extensive synonymy.

Type locality: Copenhagen.**Holotype:** Not designated.

Description: Body short, stout, bulbous posteriorly; abdomen laterally compressed, with wide lateral sulci separating indistinct lorica plates; foot short, ventral, beneath overhanging 'tail'; toes short, approx. $1/10$ body length, thin to conical; mastax with ventral salivary glands (may be absent in small specimens); trophi type C, with long fulcrum slightly expanded distally; manubria rod-shaped, decurved, ending in semicircular dorsal expansion (Fig. 8f). Hooked manubria ends may result from hypochlorite digestion (cf. Fig. 7:4d) (Koste 1978); two separate red frontal eyespots.

Total length 80–160 μm ; toes 9–14 μm (18–20 μm in Harring & Myers 1924); trophi 27 μm (45 μm in Harring & Myers); male 140 μm , toes 17 μm .

Ecology: Cosmopolitan in fresh to brackish water, occasionally reported in coastal (marine) waters. N.S.W., Tas., Vic. 12.5–23.5°C, pH 4.4–6.8, 69.5–600 $\mu\text{S cm}^{-1}$, 2.9–300 NTU. A parasite of *Volvox* colonies (Europe and North America) is referred to *C. catellina*, *C. catellina volvocicola* (Zawadowsky). It is not recorded from Australia. **Literature:** Evans 1951; Shiel & Koste 1979; Koste & Shiel 1987b.

Cephalodella euderbyi Wulfert

FIG. 9:1

Cephalodella euderbyi Wulfert, 1940, p. 564, Fig. 4.**Type locality:** Birkhorster Moor (eastern Germany).**Holotype:** Not designated.

Description: Body stout, lightly arched dorsally; head approx. $1/3$ body length; corona with slightly protruding lips; posterior dorsal lorica compressed, resembles keel; foot short, almost covered by pointed 'tail'; toes short, approx. $1/5$ total length, thin, straight, occasionally slightly recurved; mastax large, with distinct salivary glands; trophi of type A – fulcrum spatulate distally; manubria thin, rodlike, with single crook distally; rami single, with very small alula teeth; two small ruby-red cerebral eyespots.

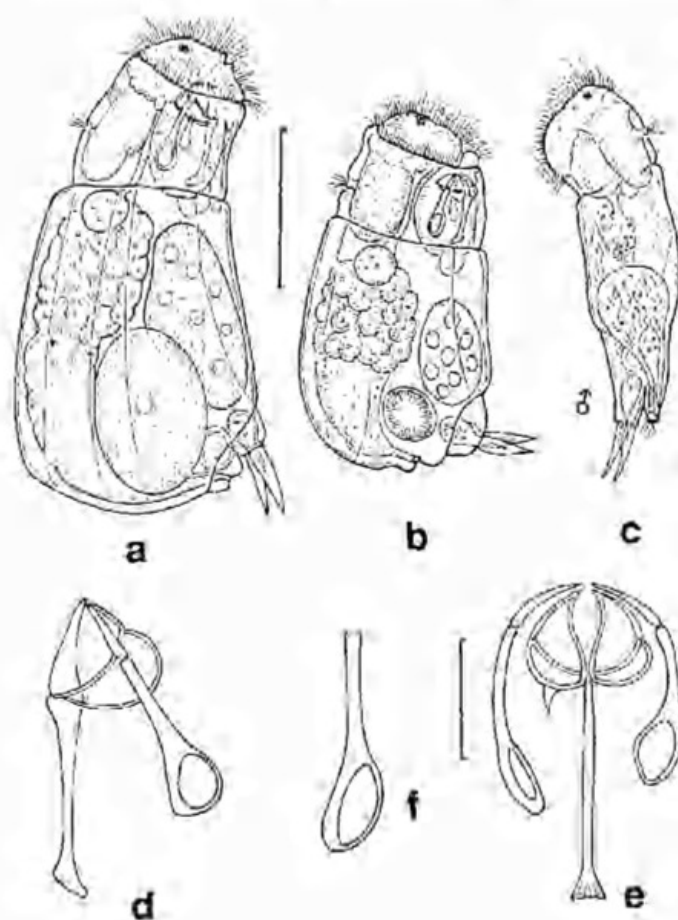


Fig. 8. *Cephalodella catellina* (Müller). (a) lateral; (b) second individual, lateral; (c) male, lateral; (d) trophi, lateral; (e) trophi, ventral; (f) distal end of manubrium. Koste, orig. Scale lines: adult 50 μm ; trophi 10 μm .

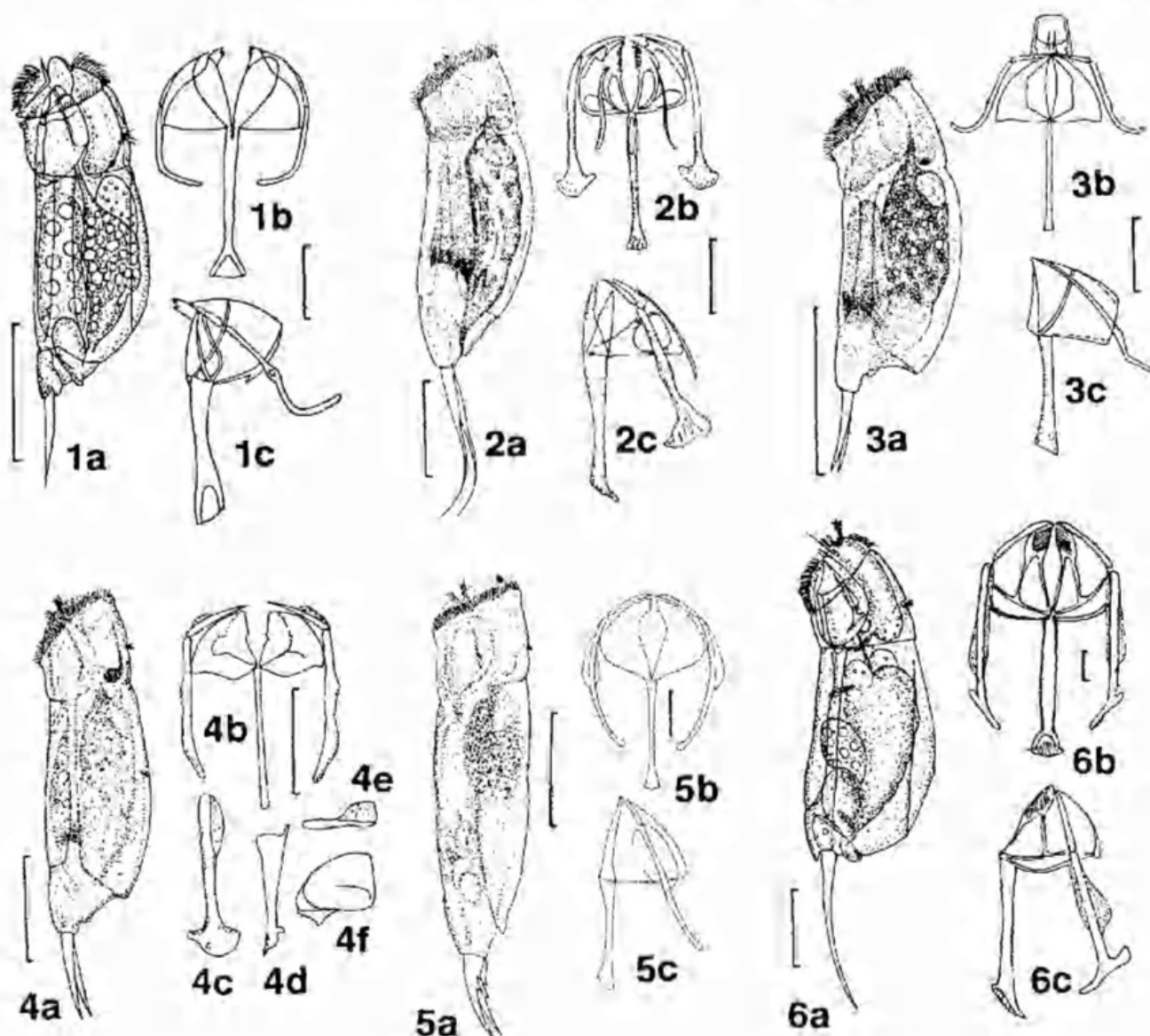


Fig. 9. 1, *Cephalodella euderhyi* Wulfert: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 2, *C. eva* (Gosse): (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 3, *C. exigua* (Gosse): (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 4, *C. forficata* (Ehrenberg): (a) lateral; (b) trophi, ventral; (c) manubrium, lateral; (d) fulcrum, lateral; (e) uncus; (f) ramus. 5, *C. forficula* (Ehrenberg): (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 6, *C. gibba* Ehrenberg: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 1, 2b, c, 3c after Wulfert (1940); 2a, 3a, 4a, 5 after Harring & Myers (1924); 3b, 4c-f after Donner (1949); 4b after Wiszniewski (1936); 6 after Wulfert (1937). Scale lines: adults 50 μ m; trophi 10 μ m.

Total length 150–168 μ m; trophi 32 μ m; toes 28 μ m; male 110 μ m; resting egg 53 μ m.

Ecology: Described from a shallow moor in Germany, where it was noted to graze green algae. Single unverified record from Boar's Lagoon, Vic. Not seen in our material.

Literature: Berzins 1982.

Cephalodella eva (Gosse)

FIG. 9:2

Furcularia eva Gosse, 1887, p. 864, Fig. 14:9.

Cephalodella eva: Harring & Myers, 1924, p. 507.

Type locality: (England). "Lacustrine."

Holotype: Not designated.

Description: Body slender, laterally compressed, dorsally gibbous; head short, broad, neck clearly marked; plates distinct; corona oblique without projecting lips; foot large, with large pyriform foot glands; toes long, approx. 1/2 total length, very slender and generally curved ventrally; trophi type B, with long, strongly crooked manubria; no eyespot or retrocerebral organ.

Total length 190–285 μ m; trophi 23–30 μ m

(fulcrum 19 μm , manubrium 23 μm , right uncus 11 μm); toes 50–85 μm .

Ecology: Cosmopolitan in periphyton, moss, beach sand, moors. Grazes diatoms. Rare, from a billabong near Eildon, Vic; Tas. 17.9–19.7 °C, pH 7.2–7.3, DO 9.2, 87 $\mu\text{S cm}^{-1}$, 0.5 NTU.

Cephalodella exigua (Hudson & Gosse)

FIG. 9:3

Diaschiza exigua Hudson & Gosse, 1886, 2, p. 78, Fig. 22:15.

Cephalodella exigua: Harring & Myers, 1924, p. 481.

Type locality: Cheltenham, England. "... window lank."

Holotype: Not designated.

Description: Body short, stout, appears truncated at posterior end; lateral sulci between lorica plates distinct; neck clearly demarcated; foot small, tubular; toes short, <1/5 body length, tapering gradually to acute tips; salivary glands not described, may be absent; trophi modified type B, fulcrum slightly expanded distally, rami denticulate, manubria strongly curved distally, but two ends do not meet to form the fenestration typical of type C trophi; two red cerebral eyespots; caudal antenna very distinct; male known; resting egg with smooth dark brown shell.

Total length 90–125 μm ; toes 20–26 μm ; trophi 30 μm ; male 74 μm ; toes 19 μm .

Ecology: Cosmopolitan between water plants, *Sphagnum*. Common in R. Murray (Vic.) billabongs in Spring, Tas. 11.0–13.6 °C, pH 6.2–7.4, 220–1900 $\mu\text{S cm}^{-1}$, 2.7–120 NTU.

Literature: Berzins 1982; Koste & Shiel 1987b.

Cephalodella forficata (Ehrenberg)

FIG. 9:4

Notommata forficata Ehrenberg, 1832, p. 134.

Cephalodella forficata: Harring & Myers, 1924, p. 499, Fig. 33:7.

Type locality: Berlin.

Holotype: Not designated.

Description: Body elongate, slender slightly compressed laterally; neck well-marked; lorica plates distinct; sulci narrow, parallel-sided; toes approx 1/4 body length, widely spaced at base, short, stout, taper to acute apices; foot glands large, pyriform; gastric glands large, red-pigmented in older individuals; trophi type B, manubria crooked, eyespot absent.

Total length 148–265 μm ; toes 36–58 μm ; trophi 16–26 μm .

Ecology: Cosmopolitan in vegetation of standing and flowing waters. Rare: N.S.W., Qld, Tas. 16.5–18.5 °C, pH 4.8–6.3, 25–100 $\mu\text{S cm}^{-1}$.

Literature: Shiel & Koste 1979.

Cephalodella forficula (Ehrenberg)

FIG. 9:5

Distemma forficula Ehrenberg, 1832, p. 139.

Cephalodella forficula: Harring, 1913, p. 29.

Type locality: Berlin.

Holotype: Not designated.

Description: Elongate, spindle-shaped body, slight constriction at neck; integument flexible, without lorica plates; abdomen tapers to ill-defined foot; toes short, stout, recurved, about 1/5 total length; toes have distinctive transverse spicule row (2–4) on dorsal median surface which terminates in a larger spine; mastax with salivary glands; trophi type D, manubria dilated distally, but not crooked, with distinctive oval basal plate; single frontal eyespot; no retrocerebral organ.

Ecology: Pancontinental. 12.0–25.0 °C, pH 4.8–6.8, 25–440 $\mu\text{S cm}^{-1}$, TDS 19.7 mg l⁻¹, 7.3–25 NTU.

Literature: Shiel & Koste 1979; Koste & Shiel 1987b.

Cephalodella gibba (Ehrenberg)

FIG. 9:6

Furcularia gibba Ehrenberg, 1832, p. 130, Fig. 4:16.

Cephalodella gibba: Harring & Myers, 1924, p. 472.

Type locality: Berlin.

Holotype: Not designated.

Description: Body slightly elongated, compressed laterally; gibbous rump; lorica firm with distinct plates; sulci widen slightly posteriorly; toes long, straight or recurved, slender (ca. 1/3 body length); mastax very large; trophi type B; rami with denticulate lamellar combs on inner ventral margins; manubria strongly crooked, shaft with both sides lamellate; no retrocerebral organ; single frontal eyespot.

Total length 250–450 μm ; toes 67–150 μm ; trophi 70–90 μm .

Ecology: Cosmopolitan in littoral of fresh-brackish waters, also in branchial chambers of Crustacea. Eats unicellular algae, flagellates, also carnivorous, particularly on ciliates. Eurytopic, pancontinental in Australia, most common representative of the genus. Abundant in acid waters in Tasmania. 9.5–23.0 °C, pH 4.7–7.8, 9.2–700 $\mu\text{S cm}^{-1}$, 1.7–110 NTU.

Comment: Several forms (ecotypes or a species complex?) are listed in Koste (1978). Harring & Myers (1924) noted that *C. gibba* is "somewhat variable". A distinctive ssp., *C. gibba microdactyla* Koch-Althaus, 1963 (Fig. 10:1) was recorded from a roadside pool near Scotts Peak Dam, Tas. 18.0 °C, pH 6.4, 122 $\mu\text{S cm}^{-1}$. This appears to be a good species, however more detailed comparison of the Tasmanian material with the nominate species is required.

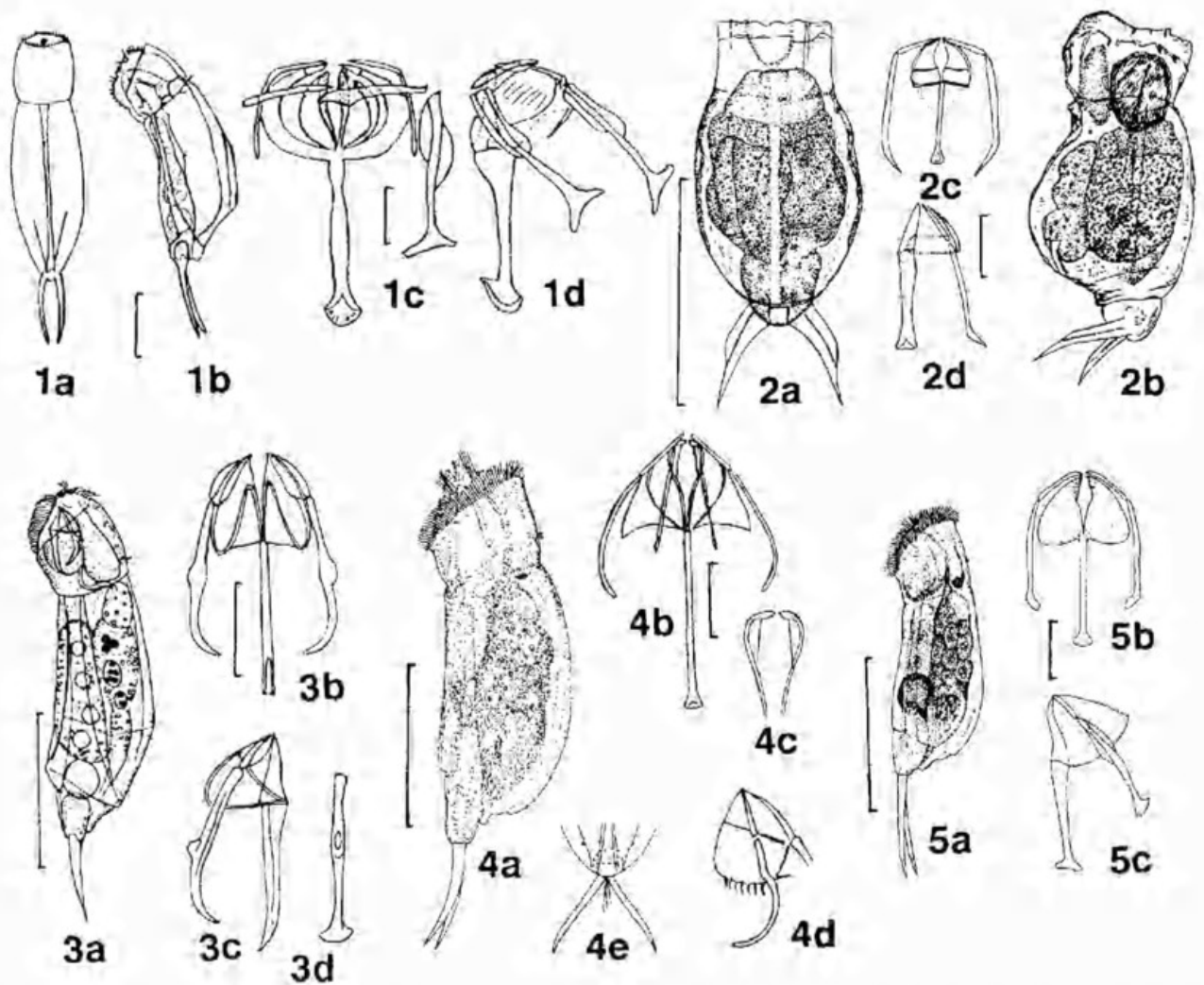


Fig. 10. 1, *Cephalodella gibba microdactyla* Koch-Althaus: (a) dorsal; (b) lateral; (c) trophi, ventral, right manubrium omitted; (d) trophi, lateral. 2, *C. gisleni* Berzins: (a) dorsal; (b) lateral; (c) trophi, ventral; (d) trophi, lateral. 3, *C. gracilis* Ehrenberg: (a) lateral; (b) trophi, ventral; (c) trophi, lateral; (d) manubrium, lateral. 4, *C. hoodi* (Gosse): (a) lateral; (b) trophi, ventral; (c) forcipate rami; (d) trophi, lateral; (e) posterior end and toes. 5, *C. intuta* Myers: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 1 after Koch-Althaus (1963); 2 after Berzins (1953); 3 after Wulfert (1937); 4a, 5 after Harring & Myers (1924); 4b-e after Donner (1950). Scale lines: adults 50 μ m; trophi 10 μ m.

Literature: Pourriot 1965; Koste 1978; Koste & Shiel 1986, 1987b.

Cephalodella gisleni Berzins

FIG. 10:2

Cephalodella gisleni Berzins, 1953, p. 4-6, Figs 1-4.

Type locality: Porongorups, W.A.

Holotype: Not designated.

Description: From Berzins' description of a single contracted individual . . . "Body squat, rounded, with small bulge in dorsal posterior part; ventral margin lightly convex; head very large, almost 1/2 body length, somewhat narrower than body; dorsally a distinct longitudinal sulcus visible; lateral sulci indistinct; cuticle somewhat stiff, enabling head to be seen; dorsal and lateral boundaries of plates obscured, not distinct; animal very hyaline; foot stout, distal, extending slightly over base of toes; toes proximally thickened, compressed dorso-ventrally, tapering abruptly in distal 1/3 to sharp points; in dorsoventral view [there is] a very peculiar semicircular deflection of toes; in thickened part of toes is relatively large duct; mastax large, with two salivary glands; trophi symmetric, intermediate between type A (manubria) and type B (rami); fulcrum slender [unusually short for genus], slightly dilated distally; manubria slender, terminally [slightly] crooked; rami wide, of simple construction, without teeth . . . eyes or lenses not observed".

Total length (contracted) 85 μm , body (contracted) 44 μm ; head width 40 μm ; trophi 20 μm ; toes 20 μm ; proximal toe thickness 5 μm .

Ecology: No ecological information other than that collections came from small alkaline waters or "Brackwasser". A single individual closely resembling Berzins' description was recorded from Salt Creek, near Berri, S. Aust. (19.0°C, pH 7.8, 220 $\mu\text{S cm}^{-1}$, DO 9.2 mg l^{-1} , TDS 132 mg l^{-1} , 45 NTU) (Shiel & Koste 1979) and another in Ryan's 1 Billabong at Albury (Shiel unpublished).

Comment: We regard *C. gisleni* as a valid species on the basis of the distinctive trophi, toes, and other characters described above, despite its description from a single specimen. This species may be more widely distributed across southern Australia than the sparse records indicate.

Cephalodella gracilis (Ehrenberg)

FIG. 10:3

Furcularia gracilis Ehrenberg, 1830, p. 130; 1838, p. 421, Fig. 48:6.

Cephalodella gracilis: Harring & Myers, 1924, p. 474.

Type locality: Berlin.

Holotype: Not designated.

Description: Short, laterally compressed body, round posteriorly; lorica thin, flexible, plates distinct; sulci narrow, small tail; toes short, ca. 1/5 body length, slender, recurved slightly to acute tips; foot glands moderately large, pyriform; mastax large, trophi (type A) variable (Koste 1978); fulcrum curved, manubria distally crooked or fanlike; demicles may be developed on inside of rami, pseudoallulae symmetric or asymmetric; occasionally a reduced number of nuclei in vitellarium (4-6); single eyespot may be colourless.

Total length 125-150 μm ; toes 22-30 μm ; trophi 22-27 μm ; male 65-75 μm .

Ecology: Cosmopolitan in fresh, also in athalassic saline waters. Berzins (1982) noted it was "widespread" in Victoria. We have found *C. gracilis* only twice: a 1987 collection in Tasmania (shallow vegetated pool, Miena-Deloraine road near Golden Valley), and Sept. 1990 in Ryans 2 Billabong, Wodonga, Vic. 16.0-22.0°C, pH 6.4-6.85, 114-292 $\mu\text{S cm}^{-1}$.

Literature: Koste *et al.* 1988.

Cephalodella hoodi (Gosse)

FIG. 10:4

Diaschiza hoodi Hudson & Gosse, 1886, p. 79, Fig. 22:15.

Cephalodella hoodi: Harring & Myers, 1924, p. 482.

Cephalodella remanei Wisniewski, 1934, p. 353, Fig. 59:17-21.

Type locality: Loch near Dundee, Scotland.

Holotype: Not designated.

Description: Fusiform body, gibbous dorsally; abdomen unusually elongate, with dorsal plates; foot small, conical; tail prominent; toes short (1/4 total length), stout, decurved, tapering to acute tips; foot glands small, pyriform; corona oblique, with prominent beak-like lips (rostrum); trophi type A, with slender, short, rodlike manubria, curved at end but not crooked; two pleural rods present; rami sometimes with 'pseudallulae', toothed inner margin; caudal antennae setae long; retrocerebral organ present; eyespot large, at posterior end of cerebral ganglion.

Total length 110-195 μm ; toes 32-47 μm ; trophi 30-38 μm (fulcrum 16-25 μm , rami 14 μm , manubria 14-20 μm , unci 8 μm); male 110-115 μm .

Ecology: Cosmopolitan in fresh and inland saline waters, in beach sand, submerged moss, also in flowing waters. Rare, Gippsland, Vic. and Mt Field Nat. Park, Tas. 16.0°C, pH 7.4 (Shiel & Tan unpublished).

Literature: Berzins 1982.

Cephalodella intuta Harring & Myers

FIG. 10:5

Cephalodella intuta Harring & Myers, 1924, p. 500-501, Fig. 35:2-5.

Type locality: Loon Lake, Vilas County, Wisconsin. "collected among submerged *Sphagnum*."

Holotype: Not designated. ?Myers collection, AMNH, N.Y. No. 566 in AMNH is a co-type.

Description: Body moderately elongated; head longer dorsally than ventrally, corona markedly oblique; lorica rigid, plates distinct; toes long and slender (1/4 body length), tapering to acute tips with transverse basal septa; mastax large with salivary glands; trophi type B; fulcrum expanded distally; manubria crooked; rami ends strongly toothed; rami with small alulae (easily lost in caustic or bleaching solution used to clear trophi); gastric glands red to red-brown; ducted retrocerebral sac present; no eyespot. May be confused with *C. forficata*, but has relatively longer toes (toe:total length ratio <4 in *C. intuta*, >4 in *C. forficata*).

Total length 115–225 μm ; toes 30–60 μm ; trophi 30–40 μm .

Ecology: Cosmopolitan in standing and flowing fresh waters, in moss and periphyton of submerged vegetation. Rare, N.T., Tas., Vic., 13.0–18.0, pH 4.7–7.8, 42–213 $\mu\text{S cm}^{-1}$.

Literature: Koste 1981; Koste & Shiel 1986.

Cephalodella lindamaya Koste & Shiel

FIG. 11:1

Cephalodella lindamaya Koste & Shiel, 1986, p. 95–6, Fig. 3–4.

Type locality: Stock dam 1 km south of Copping, Tasmania.

Holotype: South Australian Museum (SAM) V4019. Coll. R. J. Shiel, 01.xii.1985.

Description: Body short, stout; head broad, deflexed; lorica flexible, plates indistinct; toes relatively long (>1/4 body length), basally thickened; terminal claws curved with acute tips, four distinct spinules in row inside claw; mastax large; trophi type B, fulcrum long, narrowest in the centre, flaring at distal end; manubria unusual, terminally crooked, leaf-shaped; rami with denticulate inner margin behind tips, uncus with one tooth and basal lamella; foot glands large, club shaped; eyespot not recorded.

Total length (contracted) 245 μm ; toes 68 μm (spinules 4–6 μm); trophi 43 μm (manubria 38 μm , fulcrum 24 μm , uncus 17 μm , rami 14 μm).

Ecology: Endemic. Known only from acid stock dam at Copping, eastern Tas. 21.7°C, pH <4.0, 80 $\mu\text{S cm}^{-1}$.

Cephalodella megaloccephala (Glasscott)

FIG. 11:2

Furcularia megaloccephala Glasscott, 1893, p. 56, Fig. 4:3.

Cephalodella megaloccephala Harring & Myers 1924, p. 494.

Type locality: (Ireland).

Holotype: Not designated.

Description: Body stout, dorsally gibbous; head very large, ciliary field extremely oblique; apical field with two large cirri; lorica thin, flexible, plates indistinct; dorsal median sulcus may have convex rather than concave connecting integument (Hauer 1921); foot 2-segmented; toes short (1/6 total length), decurved, sharply pointed; trophi of peculiar type (E); simple rod-shaped fulcrum; manubria two sigmoid curved slender rods; rami appear semicircular from above; uncus multi-toothed, rake-like. Sometimes triangular, lamellar, thin epipharynx distinguishable; no eyespot; retrocerebral organ transparent.

Total length 195–210 μm ; toes 34–38 μm ; trophi 30 μm . Larger forms to 325 μm (Donner 1949) may be ecotypic variants or species complex.

Ecology: Cosmopolitan; mud flats, beaches, sand, periphyton of fresh water, margins of flowing water. Feeds on diatoms and Chlorophyceae. Wentworth Falls, N.S.W.; St Marys, Tas., Ryans 2 billabong, Wodonga, Vic. 14–21.0°C, pH 6.2–6.8, 73–351 $\mu\text{S cm}^{-1}$.

Literature: Berzins 1982; Koste & Shiel 1986.

Cephalodella misgurnus Wulferi

FIG. 11:3

Cephalodella misgurnus Wulferi, 1937, p. 620, Fig. 29.

Type locality: Single locality not specified. "[...] bottom of muddy streams like the Saale and Unstrut [...]". (Germany).

Holotype: Not designated.

Description: Body elongate, widest in posterior third; head and trunk loricate, three large and two smaller plates; neck clearly defined; toes long, ca. 1/3 total length, slightly wider at base, parallel for much of their length, terminating in acute tips; mastax small with two small salivary glands; trophi type C, symmetrical; fulcrum straight, flaring distally, manubria with straight shafts (no lamellae), ending distally in a distinctive open ring; uncus robust with quadratic plate on outer half; subcerebral gland present; two frontal eyespots with crystalline lens in common capsule.

Total length 165–190 μm ; toes 49–61 μm ; trophi 22 μm .

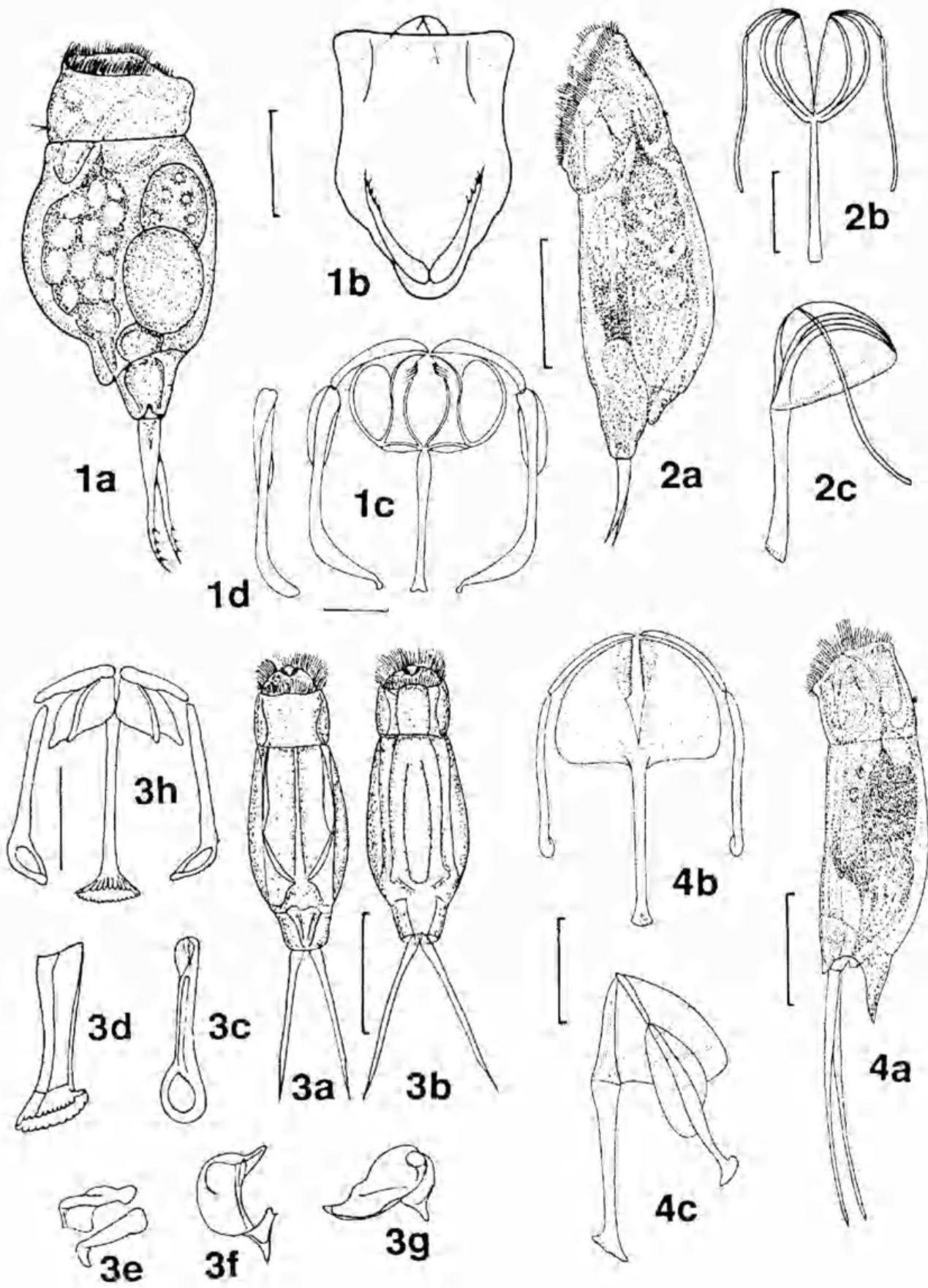
Ecology: Europe, recorded in mud, flowing water. Single record, Magela Ck, N.T.

Literature: Koste 1981.

Cephalodella mucronata Harring & Myers

FIG. 11:4

Cephalodella mucronata Harring & Myers, 1924, p. 510, Fig. 36:2–4.



Type locality: Vilas and Oneida Counties, Wisconsin, "in weedy, soft-water ponds."

Holotype: Not designated. ?Myers collection, AMNH, NY. No. 252 in AMNH is a co-type.

Description: Elongate slender body, with rigid lorica extending beyond end of foot; longitudinal sulci deep; foot sheath has triangular ventral point and dorsal spine, separated by deep, rounded sinus; toes exceptionally long (ca. body length) slender, recurved and pointed; mastax typical for genus; trophi type B; fulcrum long and straight, manubria slender, distally crooked, rami denticulate on inner margin; retrocerebral sac present; no eyespot.

Total length 265–275 μm ; toes 120–140 μm ; trophi 36 μm .

Ecology: Pan-tropical-pansubtropical warm stenotherm (20–32°C) in shallow vegetated ponds, also New Zealand. Eats diatoms, unicellular algae. Koste (1978) noted that *C. mucronata* also was predatory on bdelloid rotifers. Isolated records from N.S.W., N.T., W.A. Widespread in shallow pools in Tas., where it appears to occupy a greater thermal range than elsewhere: 9.0–29.0°C, pH 3.1–7.6, 11.8–98.3 $\mu\text{S cm}^{-1}$.

Literature: Koste & Shiel 1986.

Cephalodella nana Myers

FIG. 12:1

Cephalodella nana Harring & Myers, 1924, p. 491–2, Fig. 1.

Type locality: Corduroy Creek, Absecon, New Jersey, "collection in *Sphagnum*."

Holotype: Not designated. ?Myers Collection, AMNH, NY.

Description: Body short, conical, tapering gradually from corona to base of toes; head large, ca. 1/2 length of body, and wider than abdomen; lorica moderately flexible, plates distinct; toes ca. 1/3 body length, long slender, set wide apart at base with gentle sigmoid curve, tapering to bristle-like apices; foot glands small, pyriform; corona oblique with prominent beaklike lips; mastax very large; trophi type A; fulcrum slightly expanded distally; manubria slender, slightly clubbed and recurved ends but not crooked; salivary glands small; eyespots at posterior end of ganglion; no retrocerebral organ.

Total length 105–160 μm ; toes 35–52 μm ; trophi 30–34 μm .

Ecology: In submerged *Sphagnum* Europe, N.

America; recorded from Clunes, Vic. and Little Pine Lagoon, Tas. 8.0°C, pH <5.0, 33 $\mu\text{S cm}^{-1}$.

Literature: Berzins 1982; Koste & Shiel 1987b.

Cephalodella panarista Harring & Myers

FIG. 12:2

Cephalodella panarista Harring & Myers, 1924, p. 478–9, Fig. 5–7.

Type locality: Four Mile Run, Washington, D.C.

Holotype: Not designated. ?Myers collection, AMNH, N.Y.

Description: Body large, elongate, slender; dorsal margin curves downwards posteriorly to base of foot; integument very flexible, plates indistinct; toes very long (ca. 1/3 total length), stout and recurved, tapering to acute tips; occasionally a dorsal toothlike spine 1/3 of length along toes; foot glands extremely long, clubbed; mastax large, trophi robust (Type D); fulcrum long, straight slightly expanded posteriorly; manubria short, recurved posteriorly but not crooked; with large basal plate; unci have typical single tooth; eyespot frontal with front part of capsule colourless resembling "lens".

Total length 360–375 μm ; toes 102–105 μm ; trophi 65 μm .

Ecology: Rare. N. America, S. E. Europe. Billabong, Magela Ck N.T., R. Murray N.S.W.

Literature: Koste 1978.

Cephalodella parasitica (Jennings)

FIG. 12:3

Pleurotrocha parasitica Jennings, 1900, p. 84, Fig. 16:13, 14.

Cephalodella parasitica Harring & Myers, 1924, p. 512.

Type locality: Small pool near Lake St. Clair (U.S.A.).

Holotype: Not designated.

Description: Body fusiform, curved and gibbous dorsally; head unusually long, tapers from neck to corona; integument flexible, no sign of fissured lorica; foot short and conical; toes ca. 1/6 body length, slightly decurved to slightly sigmoid, tapering to acute tips; mastax large with two large salivary glands; trophi type A, with sharply pointed unci and rounded, curved rami which have curved alulae on their outer margins; gastric glands brownish to black; no eyespot.

Total length 110–200 μm ; toes 28–35 μm ; trophi 32 μm .

Fig. 11. 1, *Cephalodella lindamaya* Koste & Shiel: (a) lateral; (b) ventral; (c) trophi; (d) manubrium. 2, *C. megaloccephala* (Glasscott): (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 3, *C. misgurnus* Wulfert: (a) dorsal; (b) ventral; (c) manubrium; (d) fulcrum, lateral; (e) two views of uncus; (f, g) two views of ramus; (h) trophi, ventral. 4, *C. mucronata* Myers: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 1 after Koste & Shiel (1986); 2, 4 after Harring & Myers (1924); 3 after Wulfert (1937). Scale lines: adults 50 μm ; trophi 10 μm .

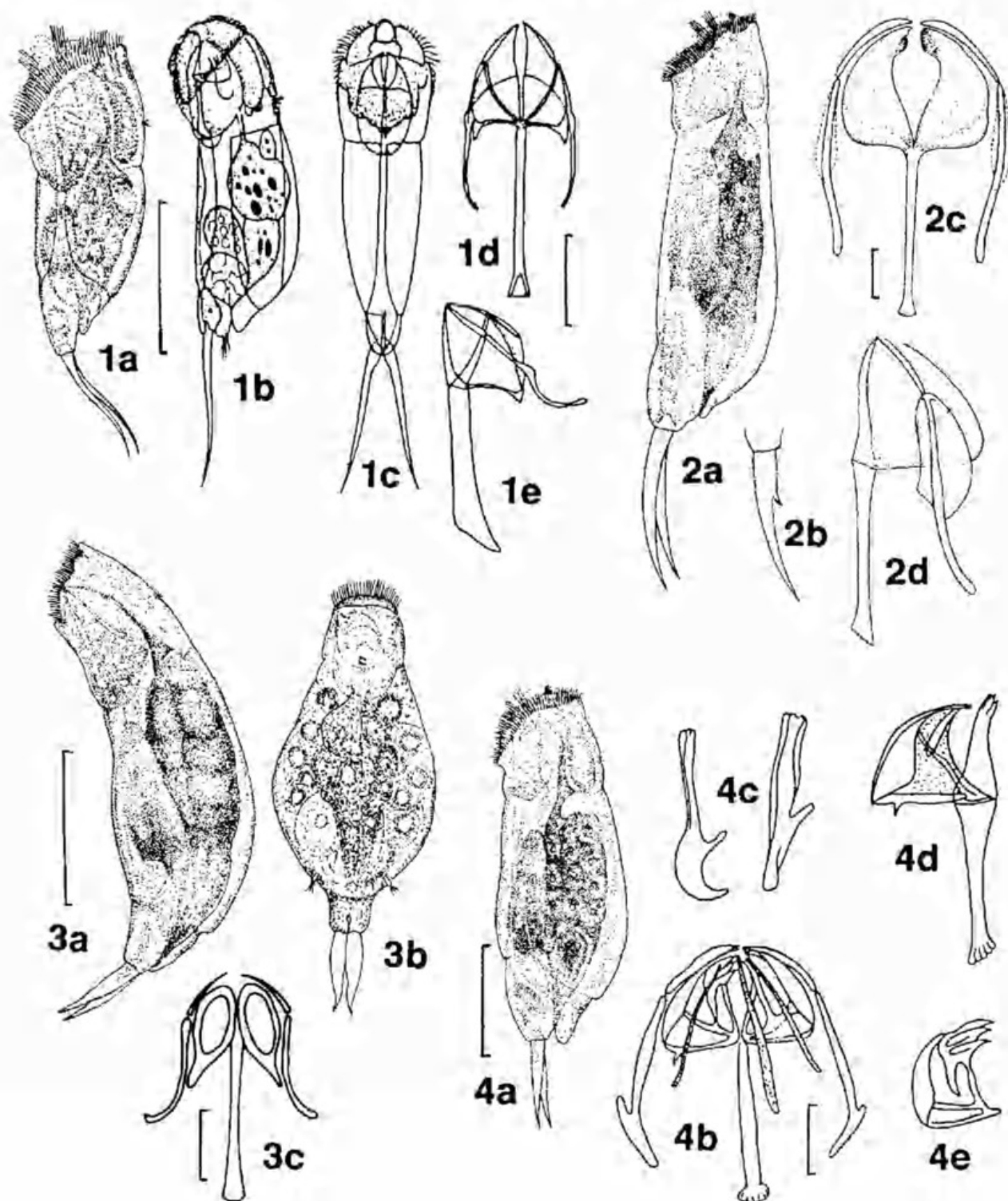


Fig. 12. 1, *Cephalodella nana* Myers: (a, b) lateral; (c) dorsal; (d) trophi, ventral; (e) trophi, lateral. 2, *C. panarista* Myers: (a) lateral; (b) toes, lateral; (c) trophi, ventral; (d) trophi, lateral. 3, *C. parasitica* Jennings: (a) lateral; (b) dorsal; (c) trophi, ventral. 4, *C. sterea* (Gosse): (a) lateral; (b) trophi, ventral; (c) views of manubria; (d) trophi, lateral; (e) uncus. 1a, 2, 3a, 4a after Harring & Myers (1924); 1b-d after Wulfert (1940); 3b Koste orig.; 4b-e after Wulfert (1937). Scale lines: adult 50 μ m; trophi 10 μ m.

Ecology: Europe, N. America, occasionally free-swimming, but more commonly parasitic on oligochaetes (*Chaetogaster*, *Nais*, *Stylaria*, etc). Single report from Diggers Ck, Mt Kosciuszko. Not seen in our collections.

Literature: Koste 1978; Berzins 1982.

Cephalodella sterea (Gosse)

FIG. 12:4

Furcularia sterea Gosse, 1887, p. 864, Fig. 14:8

Cephalodella sterea: Harring & Myers, 1924, p. 474.

Type locality: Rockery pond in the grounds of Watcombe Park near Torquay, England.

Holotype: Not designated.

Description: Body fusiform; head large; lorica firm, plates well marked; foot large, robust; tail extends beyond distal end of foot; toes short, stout slightly recurved posteriorly, may have slightly undulate margins, generally $< 1/4$ body length; foot glands large and pyriform; mastax large with four small salivary glands; trophi asymmetric type B; manubria strongly crooked; unci with variable inner margin denticulation; rami with three pleural rods; retrocerebral sac present; two red frontal eyespots in single capsule.

Total length 140–250 μm ; toes 26–56 μm ; trophi 37–39 μm .

Ecology: Cosmopolitan, in moss, in mud margins of standing and flowing waters. Rare: N.T., Tas., Vic., 12.0–22.0°C, pH 5.3–6.9, 73–351 $\mu\text{S cm}^{-1}$.

Literature: Koste 1981; Koste *et al.* 1988.

Cephalodella tantilloides Hauer

FIG. 13:1

Cephalodella tantilloides Hauer, 1935, p. 69, Fig. 9.

Type locality: High Moor pond, Black Forest, Germany.

Holotype: Not designated.

Description: Body squat, vaulted dorsally, abdomen falls sharply to clearly demarcated foot; plates and sulci distinct; dorsal sulcus relatively deep; lateral sulci margin parallel almost to base of toes; toes long ($1/3$ body length), parallel sided for $3/4$ of their length, to a distinctly segmented tip, slightly recurved; toe tips acute; foot glands small; lips project from mouth area; trophi type A; fulcrum dilated distally into a broad plate; rodlike manubria curve upwards; rami with inner denticles; cerebral eye present; retrocerebral sac not recorded.

Total length 104–175 μm ; toes 45–56 μm ; toe points 14 μm ; trophi 34 μm .

Ecology: Europe, in *Sphagnum*. Single record, Bromfield Swamp, Qld. No ecological data given.

Literature: Green 1981; Koste 1978.

Cephalodella tenuiseta (Burn)

FIG. 13:2

Furcularia tenuiseta Burn, 1890, p. 34, text fig.

Diaschiza tenuiseta: Dixon-Nuttall & Freeman 1903, p. 138, Fig. 1:2.

Cephalodella tenuiseta: Harring & Myers, 1924, p. 508.

Type locality: (England).

Holotype: Not designated.

Description: Body elongate, laterally compressed; head large, short; abdomen unusually long, gibbous posteriorly; lorica flexible, plates indistinct; foot short, conical; toes very long ($1/2$ body length), slender, slightly recurved; mastax large, trophi type D; fulcrum slightly expanded posteriorly, manubria rodlike not crooked; no eyespot.

Total length 205–314 μm (Koste) 380–390 (H&M); toes 59–96 μm (Koste) 120–125 (H&M); trophi 35–39 μm .

Ecology: N. America, Europe, Rare: Vic., W.A., 16.0°C, pH 7.1, 264 $\mu\text{S cm}^{-1}$. Eats unicellular green algae and diatoms.

Literature: Berzins 1953; Koste 1978.

Cephalodella tinca Wulferi

FIG. 13:3

Cephalodella tinca Wulferi, 1937, p. 622, Fig. 31.

Type locality: Drain outflow (Bad Lauchstädt) Germany.

Holotype: Not designated.

Description: Body elongate, laterally compressed; abdomen slightly bulbous prior to short tail extending beyond foot; plates and sulci distinct; toes relatively short, ca. $1/3$ total body length, thickened at base, with slight medial swellings; mastax with two large salivary glands; trophi type D; fulcrum dilated distally, broad-bladed proximally (seen laterally), rodlike viewed apically; manubria with blunt, slightly enlarged tips; paired eyespots in single capsule.

Total length 260–280 μm ; trophi 29–31 μm ; toes 52–70 μm ; male 160 μm ; subitaneous egg 60 μm .

Ecology: Europe, in drains, decomposing vegetation, manure pits and piggery outflows. Eats diatoms. Rare: Vic. (billagong), Tas. (stock dam) 15.0–19.0°C, pH 4.9–7.1, 264–273 $\mu\text{S cm}^{-1}$, DO 10.3 mg l^{-1} .

Literature: Koste *et al.* 1988.

Cephalodella ventripes Dixon-Nuttall

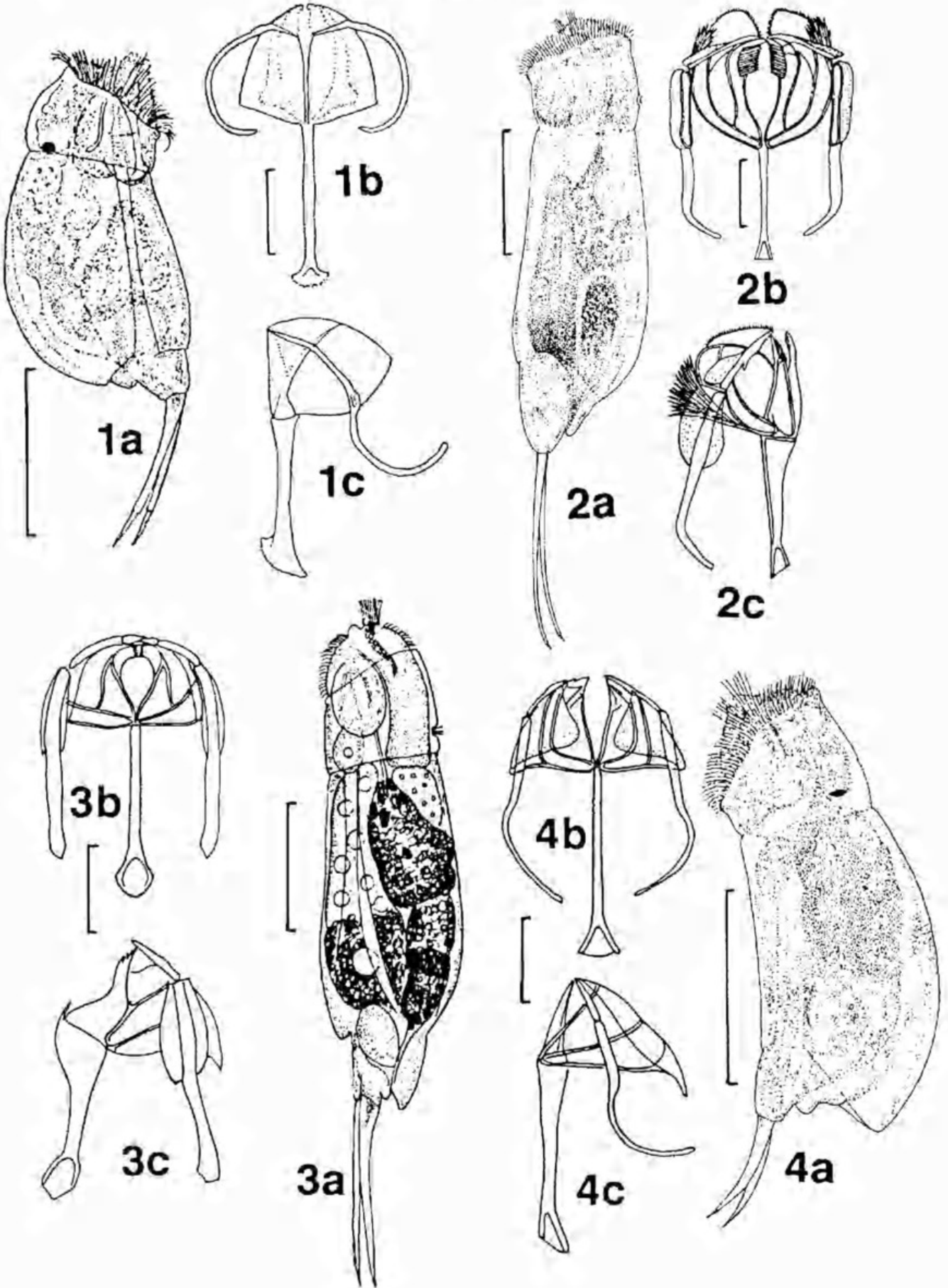
FIG. 13:4

Diaschiza ventripes Dixon-Nuttall, 1901, p. 25, Fig. 2:1–3.

Cephalodella ventripes: Harring & Myers, 1924, p. 484.

Type locality: Knowsley Park, Lancashire, England.

Holotype: Not designated.



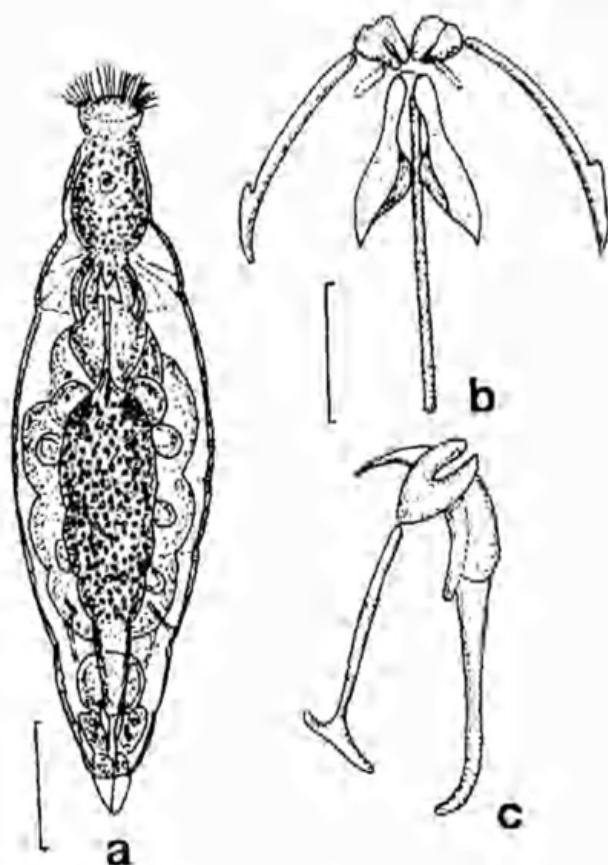


Fig. 14. *Drilophaga bucephalus* Vejdovsky: (a) dorsal; (b) trophi, ventral; (c) trophi, lateral. After Koste (1978). Scale lines: adult 50 μ m; trophi 10 μ m.

Description: Body short, stocky, bulbous dorsally; abdomen may extend beyond distal end of the foot; plates and sulci distinct; dorsal sulcus a distinct V-shaped groove; foot ventral, small; toes short and stout, decurved, ca. 1/5 total length; corona with prominent lips; mastax large; trophi type A; fulcrum dilated distally; distal ends of manubria sickle-shaped, not crooked; double cerebral eye.

Total length 135–140 μ m; toes 25–28 μ m; trophi 30–34 μ m.

Ecology: In littoral periphyton of most standing fresh waters; N. America, Europe. Uncommon in billabongs of River Murray, N.S.W., Goulburn River, Vic., also dams in northeast Tasmania 13.0–21.0°C, pH 4.8–7.1, 18–351 μ S cm^{-1} .

Literature: Berzins 1982; Koste & Shiel 1987b.

Genus *Dorystoma* Harring & Myers

Dorystoma Harring & Myers, 1922, p. 555. Monotypic genus.

Type: *Proales caudata* Bilfinger, 1894.

Dorystoma caudata (Bilfinger)

FIG. 15:1

Proales caudata Bilfinger, 1894, p. 46, Fig. 2:3–4.

Dorystoma caudata: Harring & Myers, 1922, p. 555.

Type locality: Württemberg, Germany.

Holotype: Not designated.

Description: Stout, illoricate notommatid rotifer; transparent body, gut may be coloured; corona oblique, with lateral ciliary tufts ('auricles') for swimming; constriction separates head and abdomen; abdomen bulbous, with longitudinal striations; foot short, apparently two-jointed; toes long, pointed, short; at base of foot, bulb above anus carries short spine; gut yellowish, often filled with yellow-gold balls; mastax specialized virgate, with long pharyngeal tube; trophi modified to support mastax walls; specialized piercing epipharynx present; manubria with wide crook; unci absent; single bright red cerebral eyespot, (sometimes absent); dorsal and lateral antennae in pits in cuticle, sensillae distinct; subitaneous egg smooth-shelled.

Total length 130–260 μ m; toes 16–22 μ m; spine 10–22 μ m; trophi 18 μ m; pharyngeal tube 22 μ m; subitaneous egg 56 $\times$ 44 μ m.

Ecology: Isolated records from periphyton of submerged plants, esp. *Potamogeton*, *Nuphar*, also in *Sphagnum*. Europe, N. and S. America. Eats algae. Single Australian record: Yarnup Swamp, W.A. 17°C, 1600 μ S cm^{-1} .

Literature: Koste 1978; Koste *et al.* 1983.

Genus *Drilophaga* Vejdovsky

Drilophaga Vejdovsky, 1883, p. 390.

Type: *Drilophaga bucephalus* Vejdovsky, 1883, p. 390, Fig. 1:1–8.

Body slender fusiform; cuticle soft, flexible, with indistinct annuli; head cylindrical, elongate, with simple circumapical ciliation; small tail projects over foot; toes minute, conical, ca. 1/20 body length; foot glands with reservoirs; mastax with two lateral and one posterior salivary glands; trophi with

Fig. 13. 1, *Cephalodella tantilloides* Hauer: (a) lateral; (b) trophi, ventral; (c) trophi, lateral; 2, *C. tenuiseta* (Burn): (a) lateral; (b) trophi, ventral; (c) trophi, lateral; 3, *C. tinca* Wulfert: (a) lateral; (b) trophi, ventral; (c) trophi, lateral; 4, *C. ventripes* Wulfert: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 1 after Hauer (1935); 2a, 4a after Harring & Myers (1924); 2b–c, 3b–c, 4b–c after Wulfert (1937). Scale lines: adult 50 μ m; trophi 10 μ m.

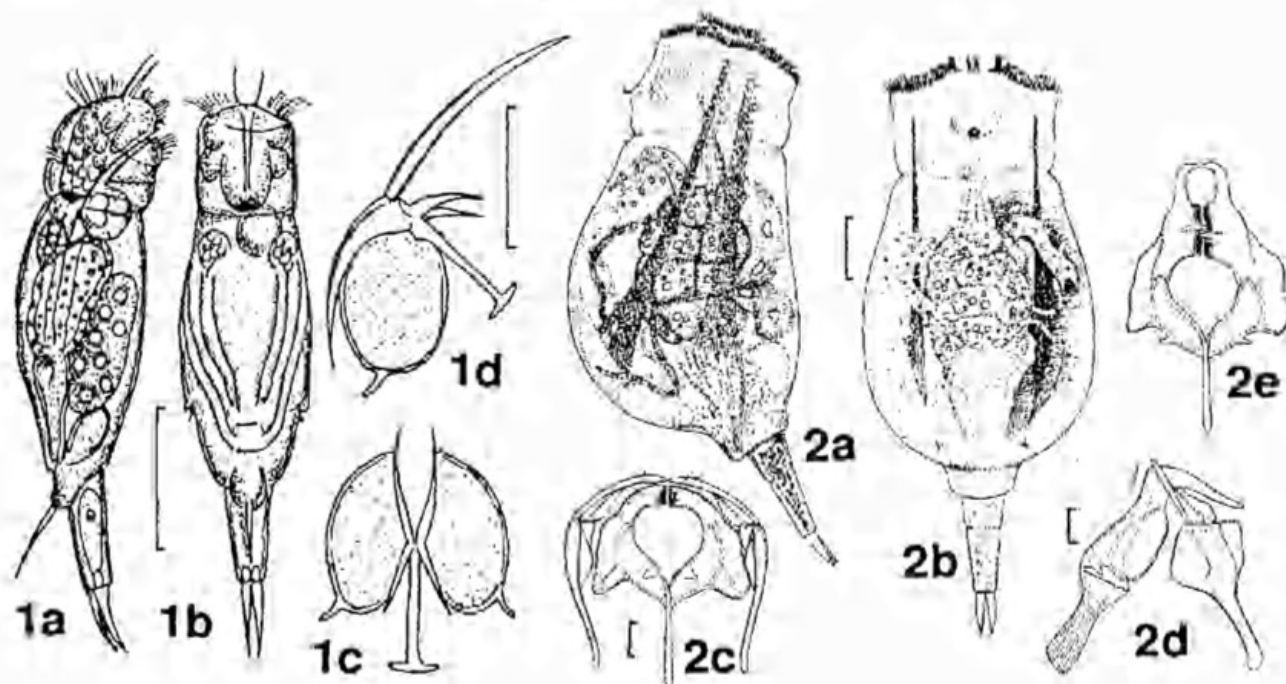


Fig. 15. 1, *Dorystoma caudata* (Bilfinger): (a) lateral; (b) dorsal; (c) trophi, ventral; (d) trophi, lateral. 2, *Enteroplea lacustris* Ehrenberg: (a) lateral; (b) dorsal; (c) trophi, ventral; (d) trophi, lateral; (e) incus, oblique frontal view. 1 after Wulfert (1960); 2 after Harring & Myers (1924). Scale lines: adult 50 μ m; trophi 10 μ m.

anchor-shaped incus; rami curved inwards; unci short, thick, bidentate; manubria distally crooked; fulcrum long, straight to lightly curved distally; pleural rods present; gastric glands spherical; stomach and intestine separate; vitellarium large; large retrocerebral sac dorsal to ganglion; eyespots absent; dorsal and lateral antennae present, latter projecting from small tubular extensions of integument.

Two other described species were synonymised with *D. bucephalus* (Fig. 14) Koste (1978). *D. bucephalus* is parasitic on the integument of oligochaetes and leeches (*Lumbriculus*, *Rynchelmis*, *Stylodrilus*, *Nais*, *Herpobdella*, *Hirudo*) (Koste 1978).

Total length 110–355 μ m; toes 6–11 μ m; trophi 20–32 μ m (unci 8 μ m, manubrium 16 μ m, fulcrum 25 μ m); subitaneous egg 50–62 $\times$ 35–39 μ m.

Comment: The synonymy of *D. bucephalus*, *D. delagei* Beauchamp and *D. judayi* Harring & Myers requires re-examination. Although Koste (1978) attributed interspecific differences as described and figured to observational errors or preservation artefacts, habit differences were noted by the different authors, i.e., parasitic v. free-swimming (*judayi*), also differences in morphology, particularly trophi.

A single free-swimming animal identified as *Drilophaga* was collected by WK from Ryan's 2 billabong at Wodonga on Sept. 27, 1990, the first

record of the genus from the continent. No oligochaetes or leeches occurred in the sample. The living rotifer was filmed on videotape, but the mastax was lost during clearing, preventing specific determination. Until further material becomes available, we can note only that *Drilophaga* occurs in Australia.

Literature: Beauchamp 1904; Harring & Myers 1922.

Genus *Enteroplea* Ehrenberg

Enteroplea Ehrenberg, 1830, p. 46. Monotypic genus.

Type: *Enteroplea lacustris* Ehrenberg, 1830

Enteroplea lacustris Ehrenberg

FIG. 15:2

Enteroplea lacustris Ehrenberg, 1830, p. 46.

Type locality: Berlin.

Holotype: Not designated.

Description: Body with wide head, saccate abdomen; foot directed ventrally, three-segmented, offset from body; toes short, laterally barrel-shaped, frontally claw-like; corona an oblique disc circled by ciliary whorl (circumnapical band and ventral part of buccal field); dorsal margin of buccal field with type of pseudotrochus made of four closely-situated membranelles; ventrolaterally, beside mouth wide row of membranelles stand on 'pedestal'; inner part

of buccal field unciliated; two frontal eyespots on papillae in 'forehead' region; mastax resembles *Eosphora*, with more pronounced seizing function: pincer-like angled rami can be protruded through the mouth opening; inner rami margin with single large tooth, margin finely denticulate before and behind; unci with one main- and one ancillary tooth; no basal apophysis, however, small processes present at insertion point of rami adductor muscle; fulcrum boardlike; two small ventral salivary glands; oesophagus long; stomach rounded, cellular; intestine thin, ropelike. For additional details of internal morphology, see Koste (1978).

Total length 500–600 μm ; toes 30–35 μm ; trophi 70 μm (fulcrum 21 μm ; rami 56 μm ; unci 35 μm ; incus width 46 μm , length 70 μm) subitaneous egg 155–160 $\times$ 110–130 μm ; male 306 μm .

Ecology: In shallow pools, ephemeral waters, Europe, E. Asia, N. and S. America. Reported to be carnivorous on other rotifers (*Rhinoglena*) in culture (Pourriot 1965). Recorded by Colledge (1914) from Qld, not found again until Oct. 15–18, 1990, when individuals were identified from submerged scales of *Ricciocarpus natans*, Ryan's 2 billabong, Wodonga (Manuel & Shiel in prep.).

Literature: Colledge 1914.

Genus *Eosphora* Ehrenberg, 1830

Eosphora Ehrenberg 1830, p. 47.

Type locality: Tobolsk, Siberia.

Type: *Eosphora najas* Ehrenberg, 1830, pp. 47, 84, Fig. 7:3.

Body plump; head and neck distinguished by transverse sutures; abdomen sac-like with rounded or weakly trilobed tail; foot two-, three- or unsegmented; two toes with long foot glands; corona frontal; circumapical band interrupted dorsally; two ciliary bundles laterally; buccal field lightly or non-ciliated; cerebral eye at posterior end of brain (absent in *E. anthadis*); retrocerebral and subcerebral glands present, size and shape variable; mastax three-lobed; unci single toothed, may have small ancillary teeth; rami with symmetric braces, occasionally with strong basal apophyses; at bend of rami teeth on inner margin vary from 1–2 strong to 4–5 smaller teeth in different species; fulcrum wide plank or handle-like; salivary glands differ between species; five of six species are known from Australia.

Key to species of *Eosphora* recorded from Australian inland waters

1. Foot segmented, 2
- Foot unsegmented, 1

- 2(1). Papilla at base of toes, *E. najas*
Ehrenberg (Fig. 16:3)
- No papilla at base of toes, *E. ehrenbergi*
Weber (Fig. 16:2)
- 3(1). Obvious cerebral eye present, 4
- Cerebral eye absent, *E. anthadis*
Harring & Myers (Fig. 16:1)
- 4(3). Trophi length <40 μm , *E. thoides*
Wulfert (Fig. 17:1)
- Trophi length 50 μm , *E. thoa*
Harring & Myers (Fig. 16:4)

Eosphora anthadis Harring & Myers FIG. 16:1

Eosphora anthadis Harring & Myers, 1922, p. 641, Fig. 58:9–13.

Type locality: Not specified "... appears to be widely distributed."

Holotype: Not designated. ?Myers Coll., AMNH, N.Y.

Description: Body broad and robust, ca. three times longer than wide; integument soft, body transparent; stout abdomen tapers from median line to base of broad foot; foot wrinkled but not segmented; toes short, stout (1/20 length), seen dorsally margin almost forms hemisphere; seen laterally, dorso-ventrally flattened, appear as normal conical toes; mastax modified virgate; rami symmetrical with four or five small teeth in median section on each ramus margin; unci with one tooth, small subsquare striated plate at base vestiges of accessory teeth; fulcrum of two plates joined longitudinally to form V; manubrium a straight rod slightly expanded at each end; salivary glands not seen; gastric glands large, elongate, cylindrical, terminating in mucus reservoir at base of toe, retrocerebral sac and two subcerebral glands present; no eyespot.

350–410 μm ; toes 16–22 μm ; trophi 33–35 μm (fulcrum 20 μm , rami 18 μm , manubria 22 μm).

Ecology: In acid waters or mildly saline waters (*Utricularia*) in Europe, N. America, New Zealand, Japan.

Single Record: Crackers Swamp, off Brand Hwy, W.A. 20.0°C, 800 $\mu\text{S cm}^{-1}$.

Literature: Koste 1978; Koste *et al.* 1983.

Eosphora ehrenbergi (Ehrenberg) FIG. 16:2

Notommata najas Ehrenberg, 1832, p. 132.

Eosphora ehrenbergi: Weber & Montel 1918, p. 123.

Type locality: Berlin.

Holotype: Not designated.

Description: Body broad, robust, coloured light brown in fresh specimens; integument firm; indistinct transverse folds between head/neck and

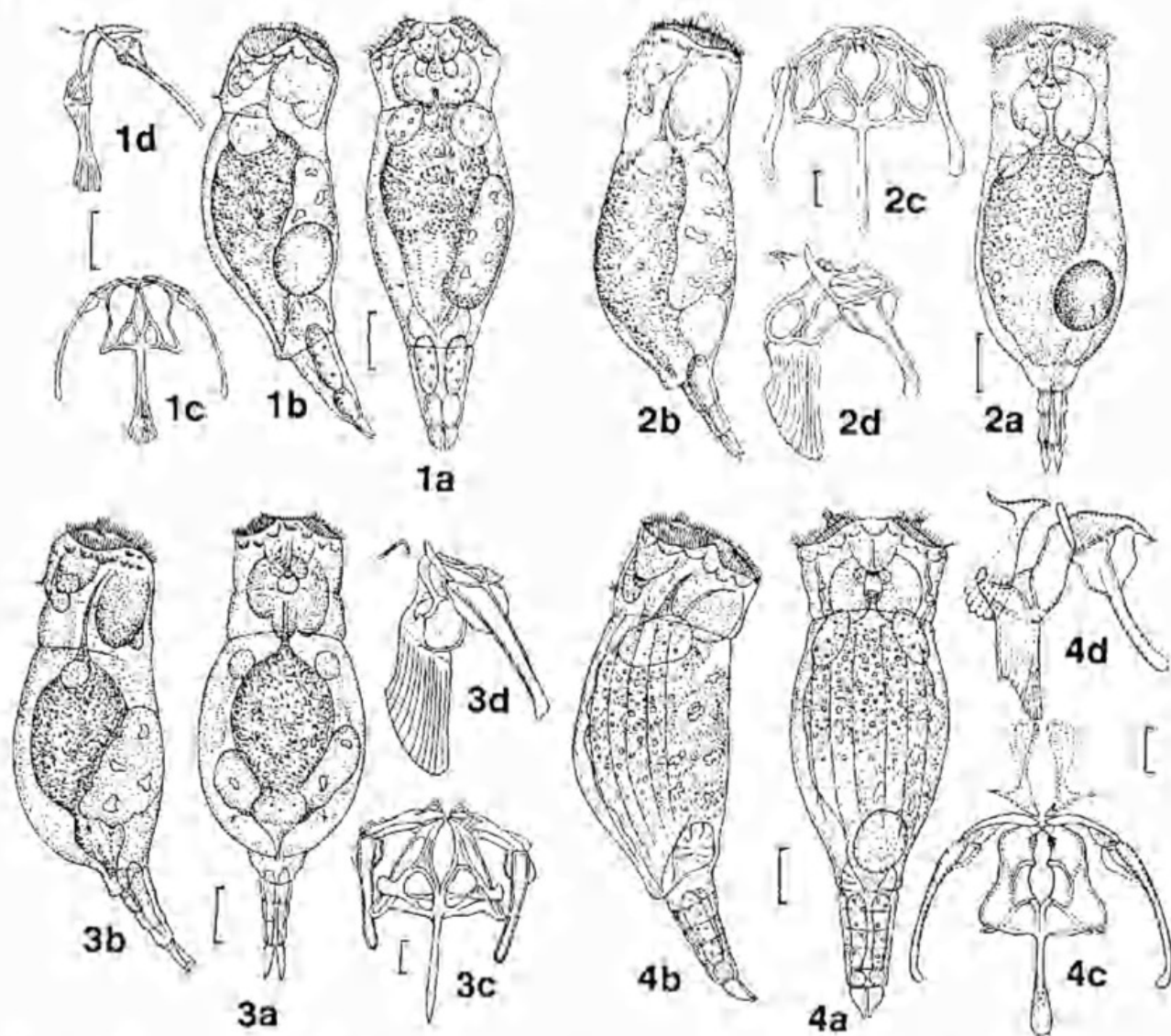


Fig. 16. 1, *Eosphora anthadis* Harring & Myers: (a) dorsal; (b) lateral; (c) trophi, ventral; (d) trophi, lateral. 2, *E. ehrenbergi* Weber: (a) dorsal; (b) lateral; (c) trophi, ventral; (d) trophi, lateral. 3, *E. najas* Ehrenberg: (a) dorsal; (b) lateral; (c) trophi, ventral; (d) trophi, lateral. 4, *E. thoa* Harring & Myers: (a) dorsal; (b) lateral; (c) trophi, ventral; (d) trophi, lateral. 1, 2 after Harring & Myers (1922); 3, 4 after Harring & Myers (1924). Scale lines: adult 50 μ m; trophi 10 μ m.

neck/abdomen; abdomen rounded posteriorly with short tail (two small lateral lobes); foot long, cylindrical, two-segmented; toes short, acute, conical; virgate trophi adapted for seizing prey; rami approximately triangular, two teeth on each ramus; fulcrum a broad plate with diagonal ventral edge where abductor muscles attach; unci with large subsquare basal plate with strong ventral tooth; manubrium with straight central section, expanded anteriorly into broad triangular plate; two large salivary glands present; foot glands long, without mucus reservoir; retrocerebral sac and two subcerebral glands; eyespot large, dark red, at posterior end of ganglion; hypopharynx muscle rudimentary. Male known.

Total length 350–450 μ m; toe length 24–30 μ m; trophi 65 μ m; male 212 μ m.

Ecology: Probably cosmopolitan between water plants in fresh to slightly saline water. Single unverified record from Victoria.

Literature: Anderson & Shephard 1892; Koste 1978.

Eosphora najas Ehrenberg
FIG. 16:3

Eosphora najas Ehrenberg, 1830, pp. 47, 84, Fig. 7:3.

Type locality: Tobolsk, Siberia.

Holotype: Not designated.

Description: Body robust, integument firm, body in fresh material light orange in colour. Head and

neck sutures distinct; abdomen broad and oval; tail with larger median lobe, two small lateral lobes; foot indistinctly three-segmented; toes long, straight, slender; mastax modified virgate (for seizing prey); rami triangular in ventral view; left ramus with single large tooth, right with two teeth; rami with finely denticulate dorsal extension; unci small, subsquare basal plate with single clubbed ventral tooth; manubrium broad, lamellate, anteriorly tapering to knobbed posterior end; ventral salivary glands distinct, right longer than left; retrocerebral sac and subcerebral gland as in other species; eyespot at anterior end of ganglion, two (occasionally four) lateral eyespots in small projections of corona.

Length 260–610 μm ; toes 26–48 μm ; trophi to 80 μm ; male to 300 μm ; subitaneous egg 140–150 $\times$ 120–130 μm ; resting egg 130 $\times$ 170 μm ; male egg 100–110 $\times$ 120–130 μm .

Ecology: Cosmopolitan in littoral between water plants, preys on rotifers including *Colurella*, *Lepadella*, *Lecane*, *Monostyla* and bdelloids. Early records from Vic. and Qld. In our material, Gwydir R. at Moree, N.S.W. (24.v.78), and recently (30.v.90) in *Myriophyllum* in a flooded roadside marsh,

Ryans property, Wodonga, Vic. 13.0–22.5°C, pH 5.97–8.0, DO 8.4 mg l⁻¹, 60–400 $\mu\text{S cm}^{-1}$, 160 NTU.

Literature: Colledge 1914; Evans 1951; Koste 1978.

Eosphora thoa Harring & Myers

FIG. 16:4

Eosphora thoa Harring & Myers, 1924, p. 523, Fig. 39:1–5

Type locality: Cemetery Pond, near Eagle River, Vilas County, Wisconsin.

Holotype: Not designated. ?Myers collection, AMNH, N.Y.

Description: Body robust, integument flexible, hyaline; head and neck fixed but suture visible between neck and abdomen; abdomen tapers to broad tail; unsegmented conical foot; toes heart shaped in dorsal view; mastax modified virgate; fulcrum short and broad; rami elongate with single blunt tooth on inner edges and posteriorly with ca. 20 denticles; unci with robust clubbed ventral tooth; small retrocerebral sac and two subcerebral glands; large eyespot at posterior end of brain.

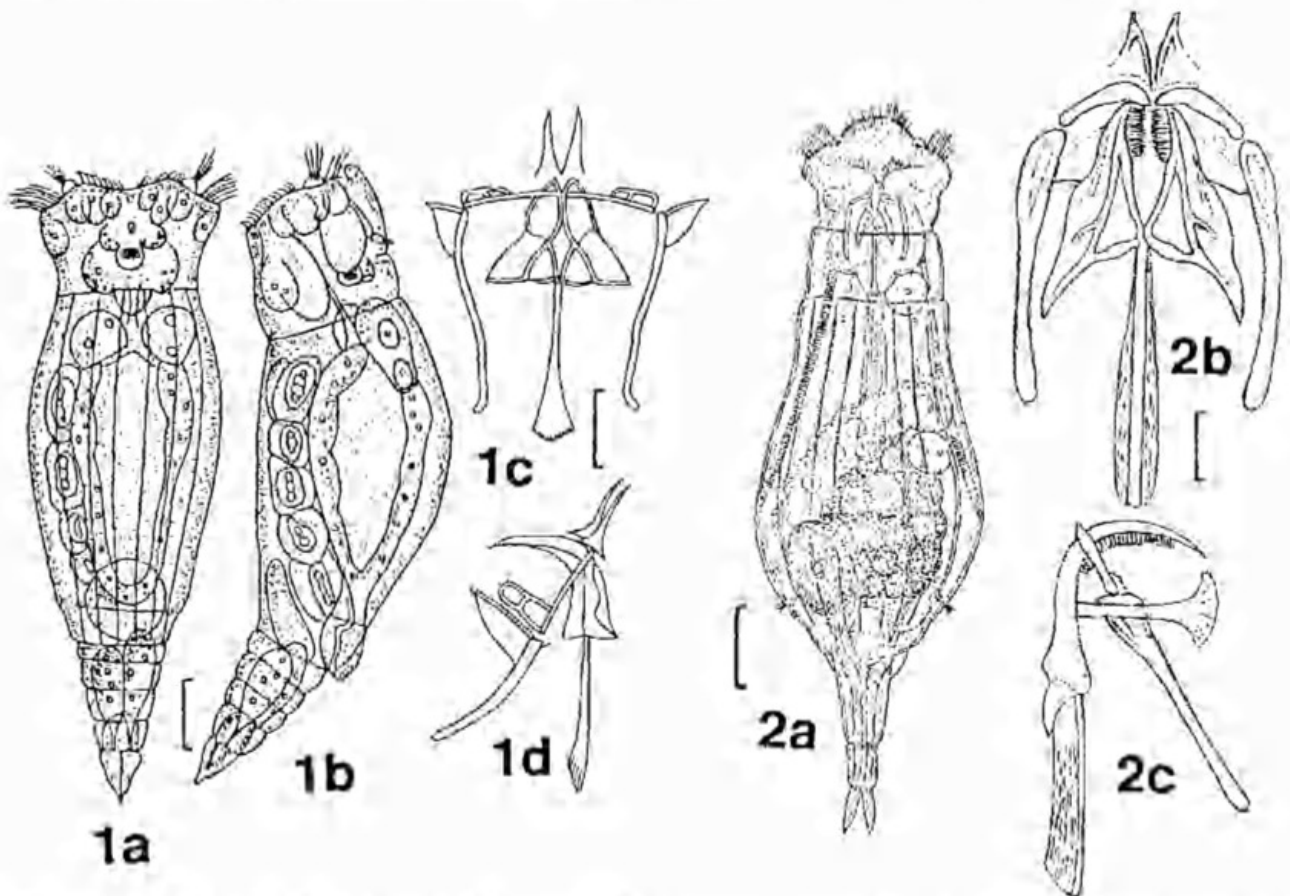


Fig. 17. 1, *Eosphora thoides* Wulfert: (a) dorsal; (b) lateral; (c) trophi, ventral; (d) trophi, lateral. 2, *Eothinia elongata* (Ehrenberg): (a) dorsal; (b) trophi, ventral; (c) trophi, lateral. 1 after Wulfert (1935); Scale lines: adult 50 μm ; trophi 10 μm .

Length 300–500 μm ; toes 20–35 μm ; trophi 50 μm long, 60 μm wide.

Ecology: Soft water, N. America. Two records: Forestdale Lagoon, near Perth, W.A. (Coll. J. van Alphen, Murdoch University) and Ryans 2 billabong at Wodonga, Vic. (Coll. J. De Manuel, University of Barcelona). 16.0–24.0°C, pH 6.5–6.7, 263–310 $\mu\text{S cm}^{-1}$.

Eosphora thoides Wulfert

FIG. 17:1

Eosphora thoides Wulfert, 1935, p. 600, Fig. 15a–d.

Type locality: Saale River, eastern Germany.

Holotype: Not designated.

Description: Body resembles *E. thoa* as above; long cilia from lateral margin of head but not auricles *per se*; neck suture distinct; abdomen tapers to wide front, its greatest width in anterior third; foot 3–4 segmented by light transverse lines; toes appear triangular in dorsal view, conical in lateral view; mastax with lateral salivary glands extends slightly past neck suture; trophi with long, distally widened fulcrum; rami triangular in dorsal view; in lateral view curve downwards at right angle to acute tips; unci with double-looped framework at free end (Fig. 17:1c); manubria slightly asymmetric, with fanlike lamellae at base; bifurcate epipharynx above trophi; foot glands large, right larger than left; mucus reservoir as large as toe present; retrocerebral sac, subcerebral glands and eye as in *E. thoa*.

Body length 460–510 μm ; toes 26–35 μm ; trophi 37 μm .

Ecology: Europe. Two records: billabong of Magela Creek, N.T. (Koste 1981), and margin of L. Mulwala, Vic. (Shiel, unpublished).

Literature: Wulfert 1935; Koste 1981.

Comment: Wulfert noted the resemblance of *E. thoides* to *E. thoa*, the former is distinguished by the toe morphology, more elongate vitellarium; and above all, differences in trophi structure as described. The animals found in our samples resemble *E. thoides*, however minor differences in trophi structure were noted. Further material is necessary for detailed examination.

Genus *Eothinia* Harring & Myers

Eothinia Harring & Myers, 1922, p. 555.

Type: *Eosphora elongata* Ehrenberg, 1832 = *Eothinia elongata* (Ehrenberg, 1832).

Type locality: Berlin.

Eothinia was erected by Harring & Myers to accommodate *Eosphora elongata* Ehrenberg, 1832, the mastax of which differed from *Eosphora* but which could not be included in the related genus

Sphyrias because of other morphological differences.

Body elongate, slender; head and neck clearly marked by transverse sutures; trunk with longitudinal lines tapering to tail of variable form; cuticle very transparent; foot short, 2–3 segmented; two toes and foot gland; corona slightly oblique, with ciliated buccal field and marginal wreath of cilia (reduced dorsally) with two lateral auricle-like curves of strongly developed cilia; mastax virgate; trophi with compact, fine denticles on inner margin of triangular rami; unci generally single-toothed; no preuncial teeth; fulcrum elongate, distally dilated; manubria rod-shaped with triangular-section at proximal end; large retrocerebral and subcerebral glands; cerebral eye and two widely separated frontal eyes. Eight taxa were referred to the genus by Koste (1978); one is known from Australia.

Eothinia elongata (Ehrenberg)

FIG. 17:2

Eosphora elongata Ehrenberg, 1832, p. 140.

Eothinia elongata: Harring & Myers 1922, pp. 555, 646–648, Fig. 61:1–5.

Type locality: Saale R., eastern Germany.

Holotype: Not designated.

Description: Transverse folds indistinct; foot longer, 2-segmented; toes straight with conical tips, about 1/10 total length; corona frontal; trophi with triangular rami; symmetrical; inner edges armed with numerous compact denticles; fulcrum of long straight plates fused in a V-shape; distal end of fulcrum finely subdivided; unci single toothed; manubria straight rod-like; two pleural rods pair transversely across mastax for support during pumping action-embedded in mastax walls at dorsal ends of rami (Fig. 17:2c); eyespots at posterior end of brain; two accessory eyespots on corona.

Length 350–510 μm ; toes 32–45 μm ; trophi 56–69 μm ; unci 14 μm ; male 150–215 μm ; toes 13 μm ; spiny subitaneous egg 92 $\times$ 115 μm ; spines to 38 μm long. **Ecology:** Widespread in littoral between water plants. Europe, Asia, N. America. Carnivore of other rotifers, particularly bdelloids. Known only from Ryans billabongs at Wodonga, Vic. 14.0–22.0°C, pH 6.2–7.1, DO 4.1 mg l⁻¹, 73–274 $\mu\text{S cm}^{-1}$, 5 NTU.

Literature: Koste 1978; Koste & Shiel 1980.

Genus *Itura* Harring & Myers

Itura Harring & Myers, 1928, p. 684.

Type: *Diglena aurita* Ehrenberg, 1830 = *Itura aurita* (Ehrenberg).

Type locality: Berlin.

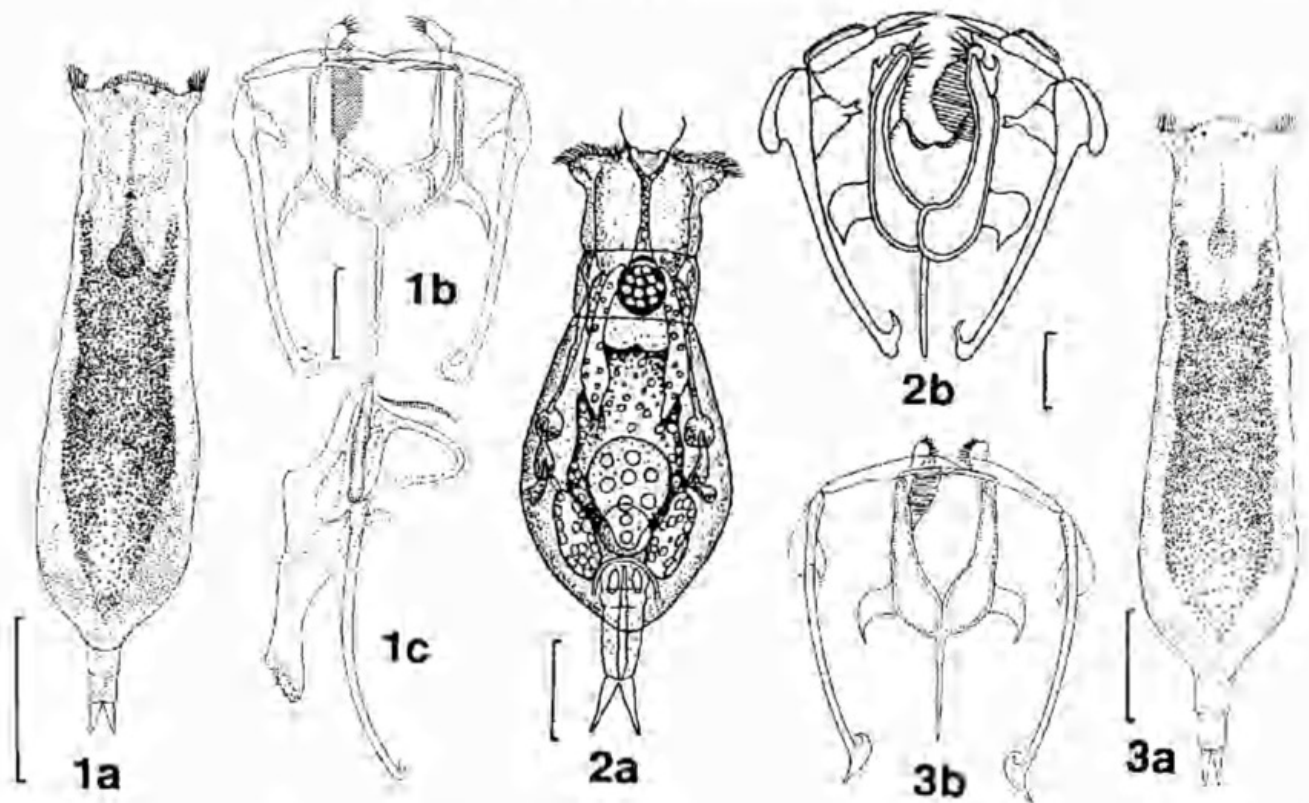


Fig. 18. 1, *Itura aurita* (Ehrenberg): (a) dorsal; (b) trophi, ventral; (c) trophi, lateral. 2, *I. myersi* Wulfert: (a) dorsal; (b) trophi, ventral. 3, *I. viridis* (Stenroos): (a) dorsal; (b) trophi, ventral. 1, 3 after Harring & Myers (1928); 2 after Wulfert (1935). Scale lines: adult 50 μ m; trophi 10 μ m.

Body elongate, fusiform, gibbous posteriorly; cuticle thin, flexible, body may be green due to symbiotic zoochlorellae; two dorsal transverse sutures separate head and neck; corona with stumpy, non-retractile lateral processes; foot and toes short; one cerebral eye at end of brain; two frontal eyes on apical field, the latter sometimes with speckled pigment flecks; single dorsal antenna; lateral antennae small; retrocerebral sac large; mastax resembles forcipate type of *Dicranophorus* spp., but rami cannot be extended through mouth; unci long, with bifurcate tips and knoblike median swelling; manubria long rods, proximally with small lamellae (dorsal and ventral), distally hooked, crooked or dilated; rami lyrate or forcipate, widely separated, with dorsally curving tips; tips dilated distally, toothed; inner rami margins (one or both sides) with finely striate or smooth lamellae, sometimes also on outer margin; alulae, sometimes asymmetrical, may be present; fulcrum in lateral view hooked or boardlike, frontally rodlike; rudimentary epipharynx and oral plate may be present. Female 180–500 μ m. Male known but undescribed. Three species are known from Australia.

Key to species of *Itura* recorded from Australian inland waters

1. Rami with asymmetric lamellae on outer border.
..... *I. aurita* (Ehrenberg) (Fig. 18:1)
- Rami without lamellary ribs on outer border... 2
- 2(1). Subcerebral glands very long..... *I. myersi*
Wulfert (Fig. 18:2)
- Subcerebral glands missing or poorly developed.
..... *I. viridis* (Stenroos) (Fig. 18:3)

Itura aurita (Ehrenberg)

FIG. 18:1

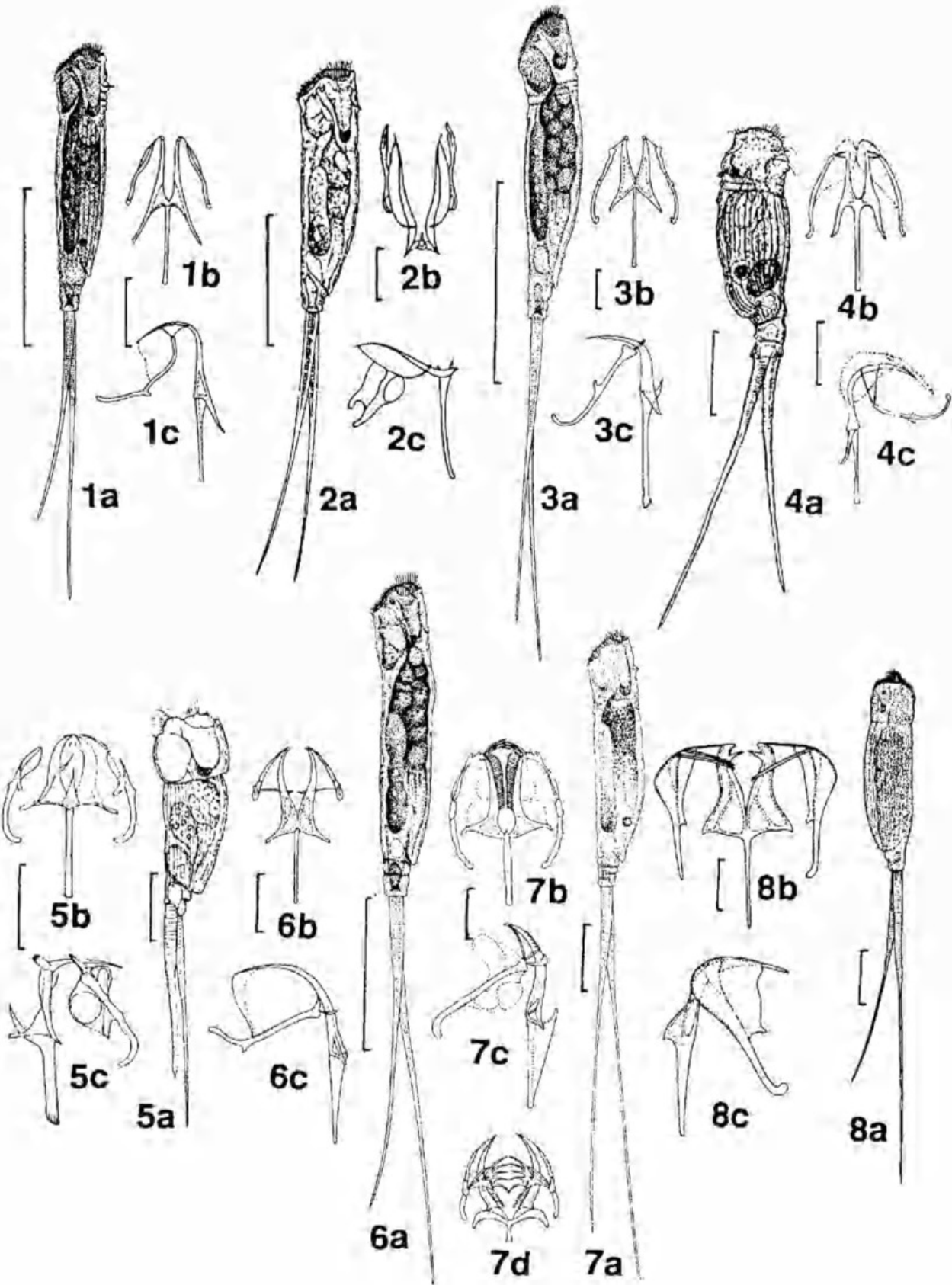
Diglena aurita Ehrenberg, 1830, p. 16.

Itura aurita: Harring & Myers 1928, p. 685.

Type locality: Berlin.

Holotype: Not designated.

Description: Body elongate, fusiform, may be green due to symbiotic zoochlorellae; toes short, conical with obtuse tips; mastax virgate; trophi asymmetric, robust; rami lyrate, knobbed at tip and bearing 5–6 long teeth; inside left ramus has narrow lamella, right ramus has broad denticulate lamella; alulae large, acutely pointed; manubria broadly expanded proximally, abruptly curved distally; gastric glands



absent; retrocerebral sac present; cerebral eye and two frontal eyespots (with lenses) present.

Length 180–220 μm ; toes 9–18 μm ; trophi 38–45 μm (e.g. fulcrum 20 μm , manubria 30–33 μm , unci 18 μm).

Ecology: In littoral of still and slowly flowing waters; Europe, N. America. Eats euglenoids and other unicellular algae. Early record from Qld. In our material, rare, only in Vic. (billabongs) and Tas. (stock dams), 13.0–18.0°C, pH 4.7–7.7, 42–3330 $\mu\text{S cm}^{-1}$.

Literature: Colledge 1914; Koste & Shiel 1986.

Itura myersi Wulfert

FIG. 18:2

Itura myersi Wulfert, 1935, p. 589, Fig. 6a–c.

Type locality: Near Halle, eastern Germany.

Holotype: Not designated.

Description: Variable form, may be broader or narrower than figured; toes short, tapered; frontal eyes with lenses; gut sac glassy green, whereas in other species food balls are brown; long asymmetric subcerebral glands; trophi robust; rami elliptical in outline with inwardly curving tips which carry 5–6 teeth; right ramus with broad denticulate lamella on inner margin, left ramus with narrower finely denticulate lamella; alulae winglike expansion, without sharp points; fulcrum distinctive for species, very short and wide.

Total length 270–406 μm ; toes 21–27 μm ; (Fulcrum 13–16 μm); rami 27–34 μm ; manubria to 33 μm ; unci 22 μm .

Ecology: Europe, Asia. Eats *Euglena*, *Scenedesmus*, *Pediasium*, *Trachelomonas*. Single record from an *Eleocharis* bed, Snowdon's Billabong, Wodonga, Vic. 14.7°C, pH 7.1, DO 4.1 mg l^{-1} , 240 $\mu\text{S cm}^{-1}$, 5 NTU.

Literature: Koste 1978; Koste & Shiel 1980.

Itura viridis (Stenroos)

FIG. 18:3

Eosphora viridis Stenroos, 1898, 136; Fig. 1:30–32.

Itura viridis: Harring & Myers 1928, p. 692, Fig. 24:1–2.

Type locality: Lake Nurmijarvi, Finland.

Holotype: Not designated.

Description: Variable in form, readily confused with congeners; duct of retrocerebral sac much shorter than congeners; rami armed with 12 teeth; right

ramus has broad striate, denticulate lamella, left ramus not lamellate; alulae large, broad, pointed posteriorly; fulcrum nearly as long as rami; frontal eyes with large spherical lenses and generally with accessory pigmentation; characteristic straight, narrow, sharply pointed toes; zoochlorellae in gut.

Total length 260–400 μm ; toes 16–26 μm ; trophi 45–48 μm .

Ecology: Littoral, possibly cosmopolitan, Europe, Asia, N. and S. America. Recorded from Trentham, Vic. (Coll. I. J. Powling, Melbourne) and Rapseys 3 stock dam, Wodonga (Coll. F. Dunn, MDFRC), 22°C, pH 6.0, 98.1 $\mu\text{S cm}^{-1}$.

Literature: Koste 1978.

Genus *Monommata* Bartsch

Monommata Bartsch, 1870, p. 344.

Type: *Vorticella longisetu* Müller, 1786 = *Monommata longisetu* (Müller, 1786).

Type locality: Copenhagen.

Body cylindrical or fusiform; suture between head and abdomen; cuticle thin, firm, laterally and dorsally with longitudinal striae; foot indistinctly two-jointed; toes extremely long, almost twice body length, right longer than left (with exception of *M. aequalis*); corona slightly oblique, with marginal whorl of cilia and lateral auricle-like tufts of longer cilia for swimming; apical field unciliated, buccal field ciliated; mastax variable, from simple virgate to intermediate between virgate and forcipate type; in former type (Fig. 19:1b), rami lyrate or triangular without inner teeth, manubria simple rods, unci with one weak tooth or reduced to thin lamellar plates (Myers 1930); in intermediate type (Fig. 19:7b), rami lyrate with one or more teeth on inner margin, manubria broad and lamellar at base, unci with three unequal long, slender clubbed teeth; dorsal antennae single or paired on papillae in some species; lateral antennae normal; cerebral eye at posterior end of brain (absent in *M. caeca*). Variations from generic characters are detailed by Koste (1978) and summarised in the species diagnoses below. Eleven species have been recorded from Australia.

Key to species of *Monommata* recorded from Australian inland waters

1. Toes of similar length. *M. aequalis* Ehrenberg (Fig. 19:2)

Fig. 19. 1, *Monommata oelices* Myers: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 2, *M. aequalis* Ehrenberg: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 3, *M. aeschyna* Myers: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 4, *M. arndti* Remane: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 5, *M. dentata* Wulfert: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 6, *M. diaphora* Myers: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 7, *M. grandis* Tessier: (a) lateral; (b) trophi, oblique frontal; (c) trophi, lateral; (d) trophi, dorsal. 8, *M. longisetu* (Müller): (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 1, 3, 6–8 after Myers (1930); 2 after Myers (1937); 4 after Koste (1972); 5 after Wulfert (1940). Scale lines: adult 50 μm ; trophi 10 μm .

- Toes of dissimilar length.....2
- 2(1). Stomach with sacs.....*M. viridis*
Myers (Fig. 20:3)
- Stomach without sacs.....3
- 3(2). Dorsal antenna single.....5
- Dorsal antennae paired.....4
- 4(3). Body >200 µm; right:left toe ratio <1.2.....*M. arndti* Remane (Fig. 19:4)
- Body <200 µm; right:left toe ratio >1.2.....*M. actices* Myers (Fig. 19:1)
- 5(3). Rami with teeth on inner margin.....8
- Rami without teeth on inner margin.....6
- 6(5). Toes <200 µm; trophi 25-35 µm.....7
- Toes >200 µm; trophi <25 µm.....*M. diaphora*
Myers (Fig. 19:6)
- 7(6). Right toe >165 µm; rami lyrate; unci with 5-6
linear teeth.....*M. phoxa* Myers (Fig. 20:2)
- Right toe <165 µm; rami triangular; unci single-
rooted.....*M. aeshyna* Myers (Fig. 19:3)
- 8(5). Rami with 1-5 inner margin tooth pairs.....9
- Rami with 1 or 2 occasionally unpaired inner
margin teeth.....*M. dentata* Wulfert (Fig. 19:5)
- 9(8). Unci with plate-like teeth terminally with finger-
like extensions.....*M. grandis* Tassin (Fig. 19:7)
- Unci only with long dagger-like teeth.....10
- 10(9). Unci teeth paired.....*M. maculata*
Harring & Myers (Fig. 20:1)
- Unci teeth single.....*M. longiseta*
(Müller) (Fig. 19:8)

Monommata actices Myers

FIG. 19:1

Monommata actices Myers, 1930, pp. 394-5, Figs 4-7.

Type locality: Permanent bodies of acid-waters in Atlantic County, New Jersey.

Holotype: Not designated. ?Myers Coll., AMNH, N.Y.

Description: Body slender, cylindrical, tapering to foot; head clearly separated from trunk by dorsal projections and folds of integument, which is striate; single dorsal antenna tubular, retractile, when extended has papillate base; lateral antennae with two associated round reddish or clear areas in lumbar region; corona oblique, typical; mastax minute, simple virgate; fulcrum long, rodlike; rami slender, lyrate, crooked downward medially; alulae rodlike; unci with two short teeth; pair of thin lamellar plates bounded by dorsal pair of unci teeth; oesophagus short; gastric glands round; no constriction between stomach and intestine; foot glands, bladder and retrocerebral sac small; eyespot at posterior end of ganglion; egg spinulate.

Body length 150-195 µm; trophi 22-24 µm; right toe 200-210 µm; left toe 150-170 µm; subitaneous egg 48×58 µm, spinules 15 µm.

Ecology: Europe, N. America, in moor pools and lightly acid waters. Rare, billabong at Jabiluka, N.T.; Goulburn R. billabong at Seymour Vic.; Cradle M.

Nat. Park, Tas. 23.0-25.0°C, pH 5.7-6.2, 48 µS cm⁻¹, DO 3.7 mg l⁻¹.

Literature: Donner 1978; Koste & Shiel; Koste *et al.* 1988.

Comment: The single dorsal antenna was considered by Wulfert (1960) to be doubtful; Koste (1978) suggested that paired antennae were overlooked by Myers, and that the appearance of *M. actices* is identical with *M. arndti* Remane. The dimensions given in Koste (1978) are contradictory, and there are differences in the trophi as figured by the two authors. We retain both taxa here until finer resolution of them can be made.

Monommata aequalis Ehrenberg

FIG. 19:2

Notommata longiseta aequalis Ehrenberg, 1832, p. 134.

Monommata aequalis: Eysenck, 1878, p. 84.

Type locality: Berlin.

Holotype: Not designated.

Description: Long, slender, hyaline body indistinctly demarcated from head; single dorsal antenna; rami lacks inner margin teeth; rami, seen laterally, at right angles to fulcrum; unci uniformly lamellate, fluted or with marginal denticles; fulcrum rodlike; manubria bilaterally lamellate; subcerebral glands absent; toes of equal or similar length; red or yellow-orange vesicles beside intestine.

Total length 200-227 µm; toes 110-120 µm.

Ecology: Rare in vegetated waters, Europe, S. America, Early record from Qld. In our Tasmanian collections from Great Lake, Central Plateau 9.0-11.0°C, pH 7.6-7.8, 9.0-13.4 µS cm⁻¹.

Literature: Koste 1978; Koste *et al.* 1988.

Monommata aeshyna Myers

FIG. 19:3

Monommata aeshyna Myers, 1930, p. 387, Fig. 24:4-6.

Type locality: Cordoy Creek, Atlantic County, New Jersey.

Holotype: Not designated. ?Myers Coll., AMNH, N.Y.

Description: Body elongate, fusiform; head demarcated by slight constriction; body tapers gradually to 3-segmented foot from midline; single dorsal antenna on low papilla; mastax virgate, small, simple; fulcrum long, straight, slightly dilated distally; rami triangular, without teeth or denticles; alulae prominent; manubria simple rods, distally curved, with medial blunt tooth-like process dorsally; unci single-toothed; gastric glands, retrocerebral sac small; eyespot on ventral side of ganglion.

Body length 130-150 µm; right toe 150-165 µm; left toe 120-145 µm; trophi 25-35 µm.

Distribution: In *Sphagnum*, melt-water pools, Europe, N. America. Rare, billabong at Seymour, Ryans 2 Billabong, Wodonga, Vic., and shallow pools, western Tas. 13.0–27.0°C, pH 5.4–6.9, 25–292 $\mu\text{S cm}^{-1}$, TDS 16.2–21.1 mg l⁻¹, 1.1–7.3 NTU.

Literature: Koste 1978.

Monommata arndti Remane
FIG. 19:4

Monommata arndti Remane, 1933, p. 567–68.

Type locality: Moor pool near Kiel, Germany.

Holotype: Not designated.

Description: Resembles *M. actices*. Paired dorsal antennae also on retractile papillae; lateral antennae tubular; mastax with two paired and one single salivary gland; retrocerebral sac with distinct paired excretory ducts present; two tubular subcerebral glands; gut contents generally yellow-gold; Koste (1978) notes that paired red lumbar bodies develop in response to food intake, and possibly are excretory deposits; ratio of body/toe length changes during development; subitaneous egg spiny, male egg smooth-shelled. Male undescribed.

Length 210–500 μm ; right toes to 250 μm ; left toe to 210 μm ; subitaneous egg 85 $\times$ 75 μm ; male egg 48 $\times$ 40 μm .

Ecology: Europe. Eats phytoflagellates, e.g. *Synura*, by holding colonies in the corona and sucking cell contents. Single record: billabong of Goulburn R. at Alexandra, Vic. 20.0°C, pH 7.2, DO 9.1 mg l⁻¹.

Literature: Koste 1972; Koste & Shiel 1980.

Monommata dentata Wulfert
FIG. 19:5

Monommata dentata Wulfert, 1940, p. 578, Fig. 22

Type locality: *Sphagnum* pool, Birkhorster Moor, between Scharfenbrück and Neuendorf.

Holotype: Not designated.

Description: Body squat, glassy; stomach and intestine yellow-grey; right toe shorter than body; coloured vesicles absent, although mastax sometimes contains colourless balls/spheres; single dorsal antenna; trophi structure variable; rami with paired or single (or missing) teeth on inner margin; pleural rod present; unci two-toothed; fulcrum spatulate distally; basal apophysis (medial pointed process on fulcrum) present; manubria bilaterally lamellate, not crooked terminally.

Total length to 400 μm ; right toe 115–200 μm ; left toe 89–160 μm ; trophi length 16–22 μm .

Ecology: Previously known only from Europe. Described by Koste (1978) as pH tolerant, eurytherm, oligo-euryhaline. A population closely resembling *M. dentata* was collected from Tasmania (Golden Valley) in 1987, with a second record from

Ryans 2 Billabong, Wodonga in Oct. 1990. 15–23.0°C, pH 6.2–6.7, 140–310 $\mu\text{S cm}^{-1}$, 4.0 NTU.

Literature: Koste & Shiel 1987b.

Monommata diaphora Myers
FIG. 19:6

Monommata diaphora Myers, 1930, p. 388–9, Figs 7–9.

Type locality: Acid water of the littoral region of ponds and lakes in Atlantic County, New Jersey.

Holotype: Not designated. ?Myers Coll., AMNH, N.Y.

Description: Body very long, cylindrical; characteristic swelling above anterior part of stomach; right toe shorter than body; corona typical; single dorsal antenna; mastax virgate; fulcrum without basal apophysis; rami triangular in ventral view, laterally right-angled, without teeth or denticles; alulae prominent; manubria reduced to simple rods, crooked terminally, attached to rami by thin lamellar plates; unci single toothed; mastax with two large confluent salivary glands; eyespot with lens on ventral side of brain at posterior end; retrocerebral sac with rudimentary excretory duct.

Body length 225 μm ; right toe 260 μm ; left toe 225 μm ; trophi 25 μm .

Ecology: Littoral of weakly acid waters (pH 6.2–6.4), southeast Europe, N. America. Single record from Rushy Billabong, R. Murray near Barnawartha, Vic. (Shiel unpubl.).

Monommata grandis Tassin
FIG. 19:7

Monommata grandis Tassin, 1890, p. 151, Fig. 7:11–12

Type locality: Rostock, eastern Germany.

Holotype: Not designated.

Description: Body elongate, fusiform; single dorsal antenna on raised prominence; lateral antennae usual; characteristic red pigment spots beneath lateral antennae; foot indistinctly two-jointed; mastax of intermediate type; fulcrum similar length to rami; rami with thin lamellae medially; large basal apophysis; large alulae; inner margins of rami with 25+ comb-like ventral denticles and two pairs of four long, slender opposing oral teeth; each uncus with plate-shaped ventral tooth, ending in five tooth-like projections at tip, and distal rod-like tooth; manubria crooked distally, lamellate proximally; retrocerebral sac small, clearly ducted to corona surface; no subcerebral glands; mastax has confluent salivary glands; eyespot ventral at posterior end of ganglion.

Total length 350–680 μm ; body 190–240 μm ; right toe 210–470 μm ; left toe 150–336 μm .

Ecology: Cosmopolitan, rare, generally single finds

in littoral of standing waters in Europe. Rare, Qld, Tas., Vic, 16.7–27.0°C; pH 4.52–7.2; 25.4–60.0 IS cm^{-1} ; TDS 16.2–24.9 mg l^{-1} ; 1–9.4 NTU.

Literature: Koste & Shiel 1980, 1983, 1987b.

Monommata longiseta (Müller)

FIG: 19:8

Vorticella longiseta Müller, 1786, p. 295, Fig. 42: 9–10.

Monommata longiseta: Bartsch 1870, p. 344.

Type locality: Copenhagen.

Holotype: Not designated.

Description: Body slender, elongate, with transparent integument marked with closely spaced striae; resembles *M. dentata*. Can be distinguished by trophi differences: rami bent at right angle near

mid length, with long slender tooth at angle on each ramus; right uncus has three long slender teeth, left uncus two; fulcrum lacks basal apophysis; manubria broad lamellar proximally, distally rodlike, outward curving; length of toes variable.

Total length 200–250 μm ; body length 86–115 μm ; right toe 155 μm ; left toe 120 μm ; trophi 15–16 μm .

Ecology: Cosmopolitan in vegetated waters. Earlier records from N.S.W., Qld, Vic. In our material a single record from Scottsdale, Tas. 15.0°C, pH 7.1, 105 $\mu\text{S cm}^{-1}$.

Comment: This taxon may not be as widely distributed in Australia (or globally) as the records suggest, because of confusion with other species by earlier authors.

Literature: Shiel & Koste 1979; Koste *et al.* 1988.

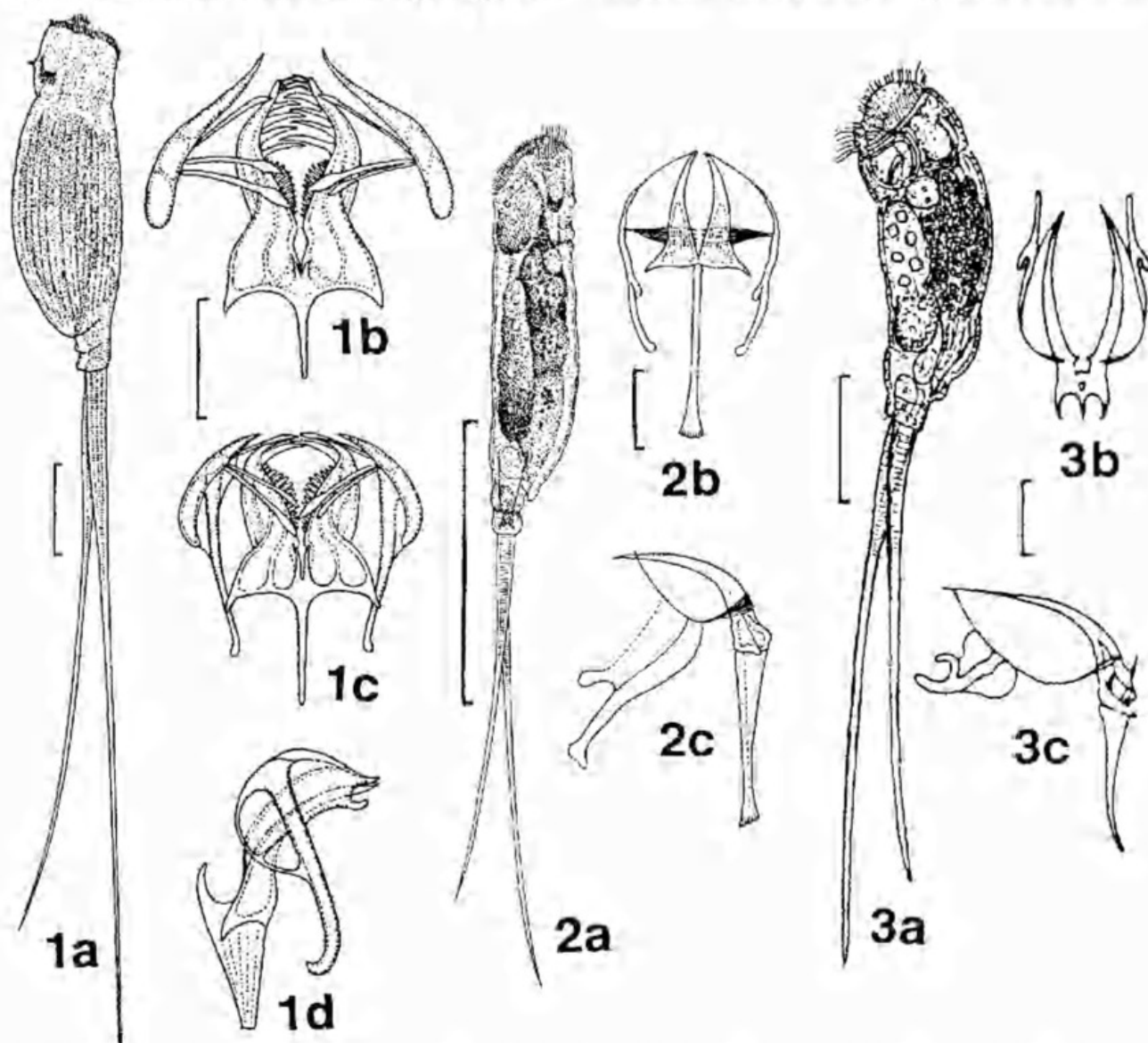


Fig. 20. 1, *Monommata maculata* Harring & Myers: (a) lateral; (b) trophi, oblique frontal view; (c) trophi, ventral; (d) trophi, lateral. 2, *M. phoxu* Myers: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 3, *M. viridis* Myers: (a) lateral; (b) trophi, ventral; (c) trophi, lateral. 1, 2, after Harring & Myers (1924); 3 after Koste (1972). Scale lines: adult 50 μm ; trophi 10 μm .

Monommata maculata Myers
FIG. 20:1

Monommata grandis Harring & Myers, 1924, p. 538, Fig. 43: 6-10.

Monommata maculata Myers, 1930, p. 385.

Type locality: Not specified. "... common in weedy ponds ...".

Holotype: Not designated. ?Myers Coll. AMNH, N.Y.

Description: Body slender, elongate; integument striated; foot two-segmented; toes variable, but always unequal; mastax intermediate between virgate and forcipate; fulcrum frontally short, dagger-like, laterally planklike; abnormally large basal apophysis; inner margin of rami with unique, complex denticulation - three groups of teeth: ventral group with 12-14 comb-like teeth; middle oral group with four large curved, pointed interlocking teeth; dorsal group with three long needle-like teeth; unci with three long clubbed teeth; manubrium terminally crooked with ventral strong lamella; retrocerebral sac present.

Total length to 680 μm ; right toe 340-470 μm ; left toe 270-410 μm ; trophi 26-34 μm .

Ecology: Europe, Asia, N. and S. America in vegetated waters. N.T., Qld, Tas., W.A. 19.0-27.0°C, pH 5.4-6.9; 25.4-33.5 $\mu\text{S cm}^{-1}$, TDS 16.2-21.4 mg l^{-1} , 1.1-2.2 NTU.

Literature: Koste 1978; Koste *et al.* 1988.

Monommata phaxa Myers
FIG. 20:2

Monommata phaxa Myers, 1930, p. 395-6, Fig. 26: 8-10.

Type locality: Acid pond near English Creek, Atlantic County, New Jersey.

Holotype: Not designated. ?Myers Coll. AMNH, N.Y.

Description: Body long, cylindrical; single minute dorsal antenna; trophi virgate, with long, distally spatulate fulcrum; rami lyrate in ventral view; unci with 5-6 linear teeth; two rods run from bases of teeth to tips of rami, marking limits of two thin lamellar plates resting on sides of rami; manubria with median lobulate projection, distally with slight expansion and outward curve; retrocerebral sac small.

Body length 150 μm ; right toe 190 μm ; left toe 140 μm ; trophi 35 μm .

Ecology: Europe, Asia, N. America, ?Africa, in acid moor pools, Tas., Vic. 25.0-27.0°C, pH 5.4-5.8, 25-119 $\mu\text{S cm}^{-1}$, TDS 16.2-76.3 mg l^{-1} , 2.0-2.2 NTU.

Literature: Koste *et al.* 1988.

Monommata viridis Myers
FIG. 20:3

Monommata viridis Myers, 1937, p. 10-11, Fig. 12, 19, 21.

Type locality: Atlantic County, New Jersey. "... in the littoral region among *Sphagnum* in bodies of acid waters."

Holotype: Not designated. ?Myers Coll., AMNH, N.Y. Paratype: Cat No. 604, AMNH.

Description: Body slender, no constriction behind head; dorsal antenna double papillose projection; stomach ends in four blind sacs; gut contents yellow-green spheres; gastric glands present; mastax modified virgate; fulcrum short, in lateral view curved, tapering; rami slender, lyrate, bent dorsally near mid-length at approximate right angle; dorsal portion has small tooth on inner margin; unci reduced to thin lamellar plates, posterior edges thickened to resemble slightly clubbed teeth; manubria curve dorsally, have small digitiform process near mid length; retrocerebral sac round, clear, ductless.

Total length 382 μm ; body length 166 μm ; right toe 216 μm ; left toe 150 μm ; subitaneous egg 65 $\times$ 52 μm .

Ecology: Common in *Sphagnum*, pH 4.5-6.5, N. America, Europe. Single record from dune lakes area, western Tas. 17.0°C, pH 3.1, 80.6 $\mu\text{S cm}^{-1}$.

Literature: Koste 1978; Koste *et al.* 1988.

Genus *Notommata* Ehrenberg

Notommata Ehrenberg, 1830, p. 46.

Type: *Vorticella aurita* Müller, 1786 = *Notommata aurita* (Müller)

Type locality: Copenhagen.

Body cylindrical, spindle-shaped, sac-like, conical, or with lateral alae; neck suture evident; caudal tail usually present; foot short, often 2-segmented, occasionally indistinctly segmented; also rudimentary; with and without caudal sensillae, always with two toes; cuticle generally soft, often with longitudinal striae; corona broadly triangular, displaced ventrally ("*Notommata* type") (Fig. 21:1b), in some species extending into pronounced "chin"; auricles generally large, narrowly to widely separated, retractable; apical field small; mastax virgate; trophi asymmetric in most species; unci often with accessory teeth, occasionally also with rudimentary fulcrum, long and plank-like, straight or curved; pleural rods, epipharynx and oral plates may be present; hypopharynx muscle attached to fulcrum; stomach and intestine separated by weak constriction; retrocerebral organ generally well-developed; protonephridia visible in head- 4-6 pairs of flame cells; cerebral eyespots present or absent;

male not known for all species. Fifty-five *Notommata* species are listed or described in Koste (1978); 12 of these are known from Australia, with two endemic species described subsequently. These are keyed below, however we caution that in view of gross morphological similarities between some taxa, and ready confusion of juveniles of large species with adults of smaller forms, the key can be used reliably only with living adults. For preserved material, and doubtful live material, trophi differences as described and figured enable accurate specific identification.

Key to species of *Notommata* recorded from Australian inland waters

1. Cylindrical, fusiform or conical body, without lateral extensions (alae).....2
Body with pronounced alae.....
..... *N. spinata* nov. nom. (Fig. 24:4)
- 2(1). Rump with projecting digitiform process (Fig. 23:1d).....3
Rump without obvious appendage.....4
- 3(2). Body >500 µm; trophi >80 µm; caudal process with articulated tip, does not reach base of toes.....
..... *N. copeus* (Ehrenberg) (Fig. 23:1)
Body <200 µm; trophi <30 µm; caudal process not articulated, extends past base of toes.....
..... *N. tripus* Ehrenberg (Fig. 25:1)
- 4(2). Caudal 'tail' more or less covering base of foot.....5
Rump rounded, with no obvious tail.....12
- 5(4). Toes <10 µm; body vermiform; auricles indistinct.....
..... *N. contorta* (Stokes) (Fig. 22)
Toes >10 µm; body fusiform or gibbous; auricles distinct.....6
- 6(5). Toes >35 µm.....7
Toes <35 µm.....8
- 7(6). Toes 40-42 µm; body <310 µm; trophi 40-45 µm.....
..... *N. doneta* Harring & Myers (Fig. 23:3)
Toes 35-75 µm; body 300-800 µm; trophi >75 µm.....
..... *N. pachyura* (Gosse) (Fig. 24:1)
- 8(6). Trophi <40 µm; toes 16-20 µm; body <350 µm.....
..... *N. aurita* (Müller) (Fig. 21:1)
Trophi >40 µm; toes 15-35 µm; body 300-750 µm.....9
- 9(8). Mastax large, trophi 100 µm; body 500-750 µm.....
..... *N. collaris* (Ehrenberg) (Fig. 21:4)
Mastax smaller, trophi <70 µm; body 300-680 µm.....10
- 10(9). Tail with median lobe and two lateral lobes; trophi 45-60 µm.....31
Tail rounded; trophi 60-70 µm.....
..... *N. glyphura* Wulfert (Fig. 23:4)
- 11(9). Toes 30-35 µm; trophi symmetric, unci single-toothed.....
..... *N. pseudocerberus*
De Beauchamp (Fig. 24:2)
Toes 15-35 µm; trophi asymmetric, unci 3-5-toothed.....
..... *N. cerberus* (Gosse) (Fig. 21:2)
- 12(4). Toes 20-30 µm; trophi 30-35 µm.....
..... *N. cyropus*
Gosse (Fig. 23:2)
Toes <20 µm; trophi <25 µm.....13

- 13(12). Body 160-200 µm; toes 8-10 µm, trophi 24 µm.....
..... *N. silpha* (Gosse) (Fig. 24:3)
Body <140 µm; toes 12-16 µm, trophi 20 µm.....
..... *N. tyleri* Koste et al. (Fig. 25:2)

***Notommata aurita* (Müller)**

FIG. 21:1

Vorticella aurita Müller, 1786, p. 288, Fig. 41:1-3.
Notommata aurita: Ehrenberg 1830, p. 46.

Type locality: Copenhagen.

Holotype: Not designated.

Description: Body short, stocky, integument transparent, with longitudinal striae; foot 2-segmented, first segment nearly covered by tongue-shaped caudal projection ('tail'); small 'peg' between toes; auricles short; corona with well-developed 'chin' region; mastax virgate; trophi in ventral view with left ramus more strongly developed; fulcrum long and stout, distal end Y-shaped for attachment of hypopharynx muscle; rami subsquare in ventral view, bent at right angles to anterior point; unci plates with single main tooth, basal plate with 1-2 rudimentary teeth; small preuncial teeth at tip of right unci; manubria with broad angular anterior plate; triangular oral plate and thin pleural rods present; retrocerebral sac large, spherical, generally opaque; cerebral glands rudimentary; eyespot large, beneath retrocerebral sac, only visible laterally.

Total length 250-350 µm; toes 16-20 µm; trophi 34-36 µm; male 180 µm.

Ecology: Cosmopolitan in fresh to brackish water, abundant in spring and autumn in Palaearctic waters; preys on bdelloid and other rotifers as well as algae. Early records from N.S.W., Qld, Vic., recently collected (Sept.-Oct. 1990) in Ryans Billabongs, Wodonga. 13.0-17.0°C, pH 6.85-6.92, 274-292 µS cm⁻¹.

Literature: Koste 1978; Shiel & Koste 1979.

***Notommata cerberus* (Hudson & Gosse)**

FIG. 21:2, 3

Copeus cerberus Hudson & Gosse, 1886, p. 34, Fig. 16:3.

Notommata cerberus: Beauchamp 1908, p. 401, Fig. 1-3.

Type locality: Sandhurst Wood, Berkshire.

Holotype: Not designated.

Description: Body slender, integument flexible; slight transverse folds between head and neck; tail rounded, with median lobe and rudimentary lateral lobes; foot with two joints; small setose pit in centre of dorsal side of second joint; toes slender pointed, 1/15 total length; corona extends ca. ¼ length of body ventrally; auricles short, with robust cilia tufts; mastax virgate; Y-shaped lamellae at base of

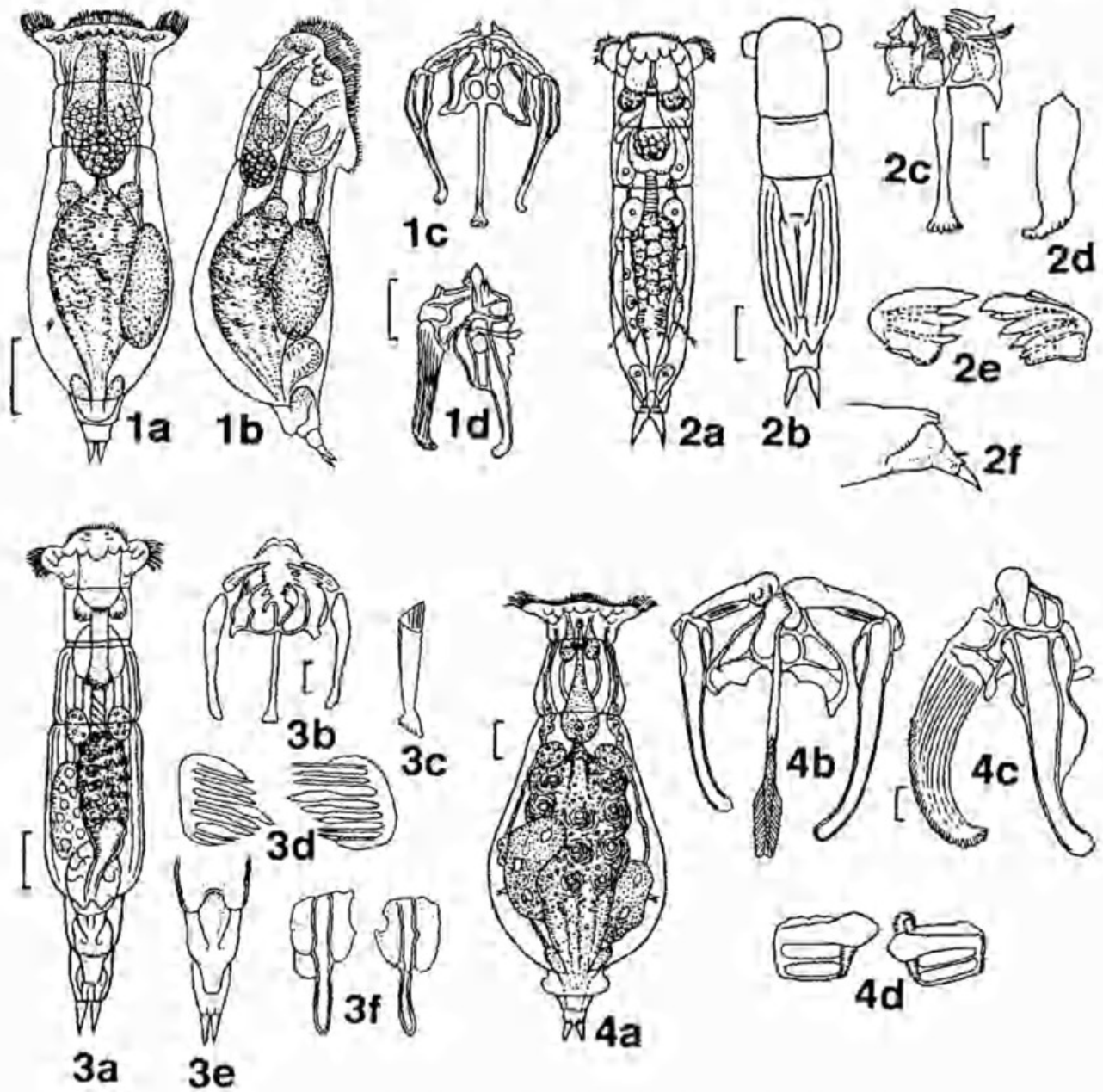


Fig. 2f. 1, *Notommata aurita* (Müller): (a) dorsal; (b) lateral; (c) trophi, ventral; (d) trophi, lateral. 2, *N. cerberus* (Gosse): (a) dorsal; (b) patterning of integument, dorsal; (c) trophi, ventral, manubria omitted; (d) fulcrum, lateral; (e) uncus; (f) foot and toes, lateral. 3, *N. cerberus longinus* Wulfert: (a) dorsal; (b) trophi, ventral; (c) fulcrum, lateral; (d) uncus; (e) abdomen, foot and toes, dorsal; (f) manubria. 4, *N. collaris* Ehrenberg: (a) dorsal; (b) trophi, ventral; (c) trophi, lateral; (d) uncus. 1, 4 after Harring & Myers (1922); 2 after Wulfert (1940), 3 after Wulfert (1961). Scale lines: adult 50 μ m; trophi 10 μ m.

fulcrum to which hypopharyngeal muscles attach; rami asymmetric, inner edges striate but not denticulate, outer margin with asymmetric apophyses and short toothed alulae; right more developed than left; pleural rods present; uncus plates with 3–5 teeth; ventral main tooth has small accessory teeth; four foot glands, one pair large, one pair small; retrocerebral sac pyriform reaches almost to end of mastax; eyespot large, lenticular.

Total length 300–600 μ m; toes 15–35 μ m; trophi 46–60 μ m (46 μ m trophi has 42 μ m rami; 32 μ m fulcrum; 21 μ m uncus).

Ecology: *Sphagnum*, periphyton, waters in northern hemisphere. Omnivore, eats rotifers, desmids, diatoms, flagellates. Early records from N.S.W., Qld, Vic. Recently collected (Sept. 1990) from a billabong of the Mitta Mitta River at Tallandoon, Vic.

Literature: Evans 1951; Shiel & Koste 1979.

Comment: A variant described by Wulfert (1961) as *N. cerberus* var. *longinus* occurs in eastern Tasmania. Comparison of the morphological differences shown in Figs 21:2 and 21:3, particularly trophi, suggests that specific status may be warranted. 19.0°C, pH 6.8, 215 $\mu\text{S cm}^{-1}$.

Notommata collaris Ehrenberg

FIG. 21:4

Notommata collaris Ehrenberg, 1832, p. 131, Fig. 4:11.

Type locality: Berlin.

Holotype: Not designated.

Description: Body short, stout, integument 'leathery', transparent; neck long to accommodate large mastax; anterior sutures well marked; abdomen bulges to twice anterior width to rounded posterior with short broad tail which covers ca. $\frac{1}{2}$ of first of two foot joints; toes short, conical about 1/30 total length; auricle ciliation continuous with corona; corona elongate to form prominent post-oral chin; mastax vitgate, trophi asymmetric, the largest (in proportion to body) of all *Notommata* spp.; fulcrum with V-shaped lamellae for muscle attachment; right ramus with broad lamellar tooth with denticulate lamellar margin; left ramus excavated; unci with three teeth, only ventral tooth developed; inner unci margin striated; manubria long and broad with wide thin lamella extending nearly to posterior end on dorsal margin; pleural rods present; foot glands slender; retrocerebral sac long, pyriform; eyespot at posterior end of brain.

Length 500–750 μm ; toes 25–32 μm ; trophi 100 μm ; male 240 μm ; resting egg 170 $\times$ 215 ($\pm$ 15) μm .

Ecology: Palaearctic, Nearctic, abundant in dystrophic waters in periphyton. Eats *Closterium* and filamentous algae. N.S.W., N.T.

Literature: Shiel & Koste 1979; Koste 1981.

Notommata contorta (Stokes)

FIG. 22

Diglena contorta Stokes, 1897, p. 630, Fig. 14:5.

Notommata contorta: Harring 1913, p. 78.

Type locality: "... shallow clear-water pool in a rocky wood near Trenton, New Jersey".

Holotype: Not designated.

Description: Body elongate-subcylindrical, vermiform, gibbous posteriorly, integument notably flexible; head rounded, convex, with small hook-like proboscis beneath which frontal border is conspicuously emarginate; rump depressed into cylindrical tail overhanging and almost completely surrounding short papillate foot; two small conical divergent toes; buccal field elongate, almost horizontal, extending ventrally ca. 1/3 body length; 'chin' absent; lateral ciliated auricles small, rarely

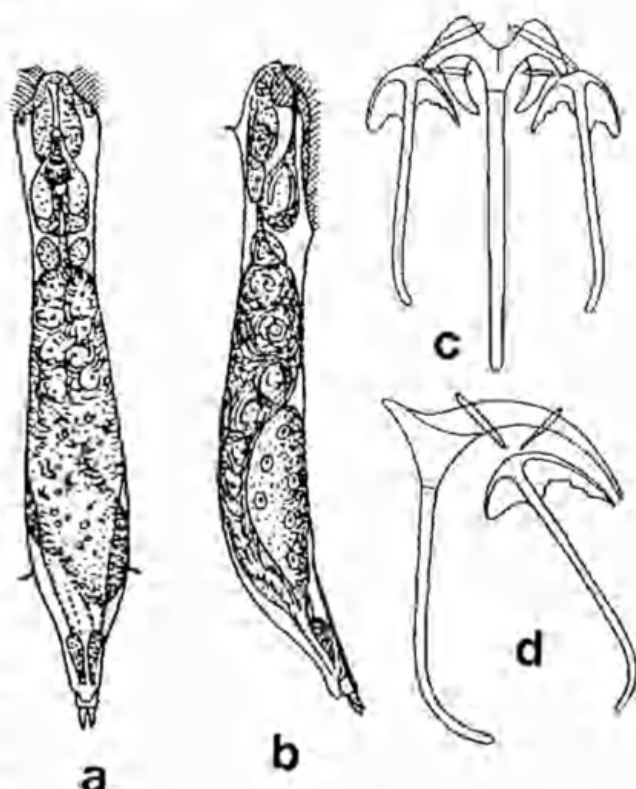


Fig. 22. *Notommata contorta* (Stokes): (a) dorsal; (b) lateral; (c) trophi, ventral; (d) trophi, lateral. After Harring & Myers (1922). Scale lines: adult 50 μm ; trophi 10 μm .

extended; two dorsal and two lateral antennae; small yellowish-orange cerebral eye; retrocerebral sac with bacteroids; subcerebral glands short; trophi simple forcipate; fulcrum long, dagger-like, with basal apophysis and terminal hook-like dorsal curve; unci single-toothed; rami simple, with strong right-angled bend.

Total length 206–300 μm ; toes 7–10 μm ; buccal field 83–86 μm ; trophi 17–20 μm (fulcrum 12 μm , manubria 13 μm).

Ecology: In acid waters, in periphyton of submerged plants in pools and lakes. Previously known from Palearctic and Nearctic (Koste 1978). First record from Australia 19 Sept. 1990, Ryans 1 Billabong, Wodonga, in *Azolla*. Subsequently also found in nearby Ryans 2 in *Ricciocarpus*, 20.0–22°C, pH 6.39–6.57, 114–274 $\mu\text{S cm}^{-1}$.

Notommata copeus Ehrenberg

FIGS 2, 23:1

Notommatus copeus Ehrenberg, 1834, p. 213.

Type locality: Berlin.

Holotype: Not designated.

Description: Large species, elongate body, truncate posteriorly; anterior sutures distinct; tail a long round, conical projection with articulated tip

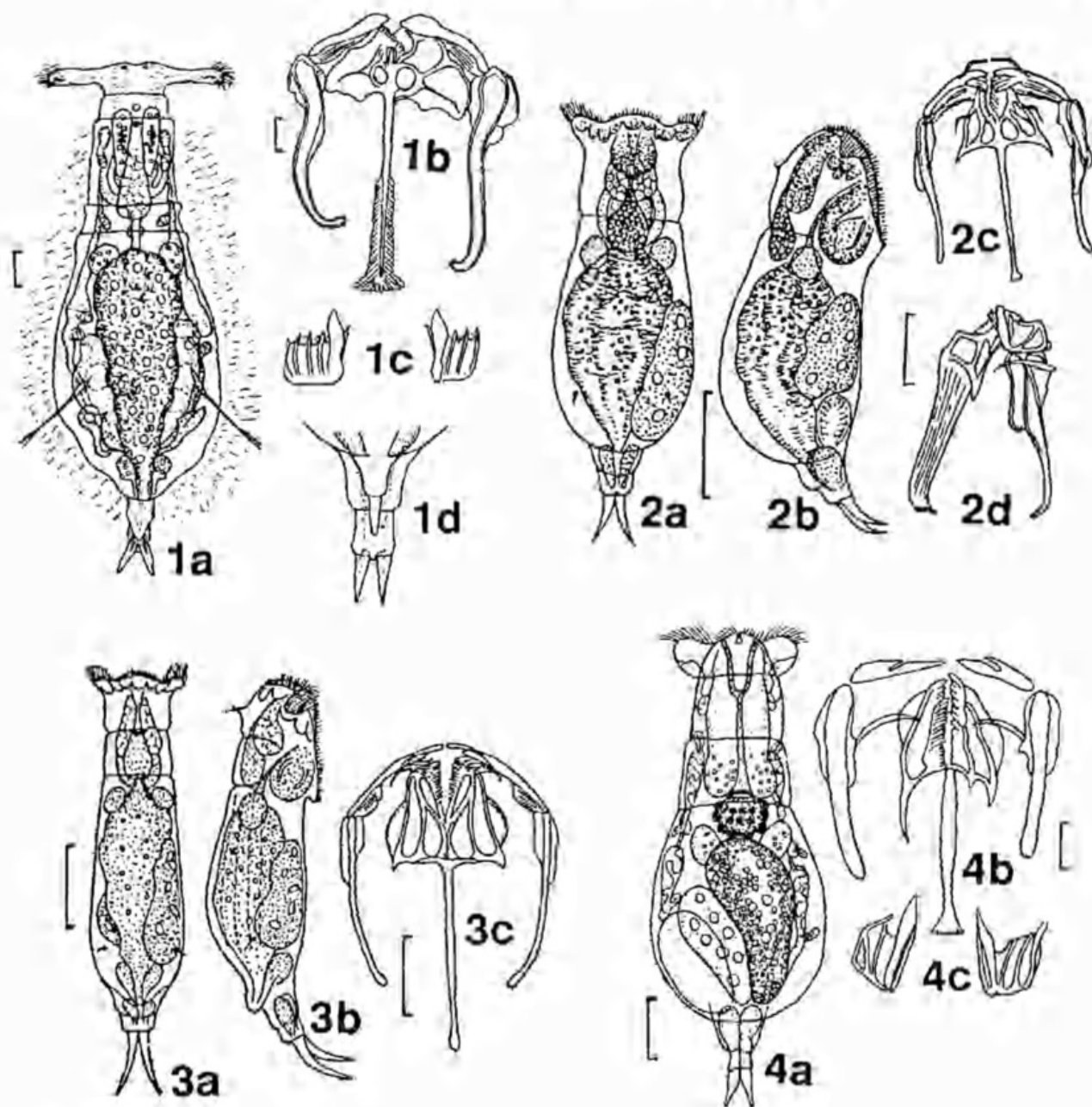


Fig. 23. 1, *Notommata copeus* Ehrenberg: (a) dorsal; (b) trophi, ventral; (c) unci; (d) foot and toes, dorsal. 2, *N. cyrtopus* Gosse: (a) dorsal; (b) lateral; (c) trophi, ventral; (d) trophi, lateral. 3, *N. doneta* Harring & Myers: (a) dorsal; (b) lateral; (c) trophi, ventral. 4, *N. glyphura* Wulfert: (a) dorsal; (b) trophi, ventral; (c) unci. 1a, c, d after Donner (1954); 1b, 2 after Harring & Myers (1922); 3 after Harring & Myers (1924); 4 after Wulfert (1935). Scale lines: adult 50 μ m; trophi 10 μ m.

segment; foot with two broad segments, with setose papilla at distal end of second joint between toes; toes ca. 1/16 total length, long and slender, slightly decurved; very long ciliary auricles (seldom extended) and exceptionally elongated chin; lateral antennae setae long; mastax virgate, asymmetric, left side more developed; rami triangular with broad lamellar tooth on right ramus, socket on left; left uncus with large ventral tooth and three smaller teeth; right ramus with four undeveloped teeth; manubria and pleural rods as *N. collaris*;

retrocerebral sac and subcerebral glands present; eyespot large, at posterior end of brain.

Total length 500–1100 μ m; toes 40–65 μ m; trophi 80–100 μ m; male 280–350 μ m; toes 36 μ m.

Ecology: Cosmopolitan in algal-rich standing waters, pH 4–6.5, temp. 15–30°C. Eats filamentous algae (*Spyrogira*, *Zygnema*, *Mougeotia*); swallows smaller filaments in short pieces. N.S.W., N.T., Qld., Vic.

Literature: Shiel & Koste 1979; Koste 1981.

Notommata cyrtopus Hudson & Gosse
FIG. 23:2

Notommata cyrtopus Hudson & Gosse, 1886, 2: 22, Fig. 17:7.

Type locality: Widcombe Pond, Bath.

Holotype: Not designated.

Description: Body stout, integument flexible, transparent; single obvious suture between neck/abdomen; abdomen rounded posteriorly without tail; foot 2-segmented; toes long (1/7 total length), curved and tapering; auricles short, ciliation continuous with corona; mastax virgate; trophi slightly asymmetric; fulcrum stout; rami approximately triangular in ventral view; inner edge of right ramus concave, left convex, both denticulate; alulae well-developed; right ramus has four short curved preuncinal teeth at tips, left has five; unci with single main tooth and rudimentary second tooth (two thin slightly curved pleural rods); retrocerebral sac, subcerebral glands and eyespot (at posterior end of brain) present; male known.

Total length 175–250 µm; toes 22–28 µm; trophi 30–35 µm (manubria 18–23 µm, fulcrum 18–21 µm; rami 12–14 µm) male total 139 µm; toes 20 µm.

Ecology: Cosmopolitan in periphyton in littoral of flowing and standing waters. Single early record from N.S.W., and a Sept. 1990 record from Ryans 1 Billabong at Wodonga, Vic.

Literature: Koste 1978; Shiel & Koste 1979.

Notommata doneta Harring & Myers
FIG. 23:3

Notommata doneta Harring & Myers, 1924, p. 448–50, Fig. 22: 1–4.

Type locality: Starvation Lake, Vilas County, Wisconsin.

Holotype: Not designated. ?Myers Coll., AMNH, N.Y.

Description: Body transparent; prominent tail with rounded median lobe; foot with two short joints; toes ca. 1/6 total length; corona extends to small chin; mastax virgate, trophi nearly symmetric; rami broadly triangular in ventral view, armed on inner margins with ca. 12 minute teeth; fulcrum long, slender, slightly curved distally; unci with well developed main tooth and rudimentary second tooth; left uncus with seven small accessory teeth, right uncus with six; manubria long, slender, with small basal plate; pleural rods and two slender epipharyngeal rods present; retrocerebral and subcerebral glands large. Distinguished from close relatives (*aurita*, *cyrtopus*) by long, peculiar toes.

Ecology: In *Sphagnum*, periphyton on submerged plants, Europe, N. America. A notommatid resembling *N. doneta* was collected from a humic

pool adjacent to L. Straatan, W. Tas. 14.0°C, pH 5.55.

Notommata glyphura Wulffert
FIG. 23:4

Notommata glyphura Wulffert, 1935, p. 590, Fig. 7a e.

Type locality: pools near Merseburg, Germany.

Holotype: Not designated.

Description: Body with wide, plump abdomen; tail rounded; head and neck clearly defined; foot covered by tail (except distal end of terminal segment); toes straight, tapered to blunt tips; auricle of medium size; corona extends ventrally to form chin; retrocerebral sac brown to black; subcerebral glands long, wide; mastax large; trophi asymmetric; rami with hook-like alulae exceptionally long with inner margin teeth; unci plates with main and three secondary teeth on right uncus fused to rectangular plate; three preuncinal teeth in front of main tooth; manubria dilated distally.

Length 325–500 µm; toes 20–24 µm; trophi 60–70 µm; male to 280 µm; resting egg (spiny) 115 × 150 µm.

Ecology: Europe, in fresh to brackish water, in littoral standing and flowing waters. Eats algae, rotifers, scavenges dead microcrustacea. Recorded from billabongs of the Goulburn and Murray, Vic. 13.0–17.8°C, pH 6.2–7.2, DO 8.9 mg l⁻¹, 74 µS cm⁻¹, 8 NTU, also from Nankeen Billabong, Magela Ck, N.T.

Literature: Koste 1978, 1981.

Notommata pachyura (Hudson & Gosse)
FIG. 24:1

Copeus pachyurus Hudson & Gosse, 1886, 2, p. 31, Fig. 16:4.

Notommata pachyura: Harring 1913, p. 79.

Type locality: pools, Sandhurst, England.

Holotype: Not designated.

Description: Body fusiform, transparent; anterior sutures distinct; lobulate tail projects over first foot joint; foot 2-segmented with small papilla between toes; toes long (ca. 1/12 total length), conical; auricles large, stout; post-oral chin prominent; mastax virgate, strongly asymmetric; fulcrum long, stout, posterior cross section Y-shaped; right ramus with broad lamellar tooth, left with socket; alulae large, also asymmetric; unci with one main and four secondary teeth on left, one main and three secondary on right; two sigmoid pleural rods; somewhat quadrangular oral plate present; foot glands long; retrocerebral sac extremely long, clear; subcerebral glands small; large eyespot at posterior end of brain.

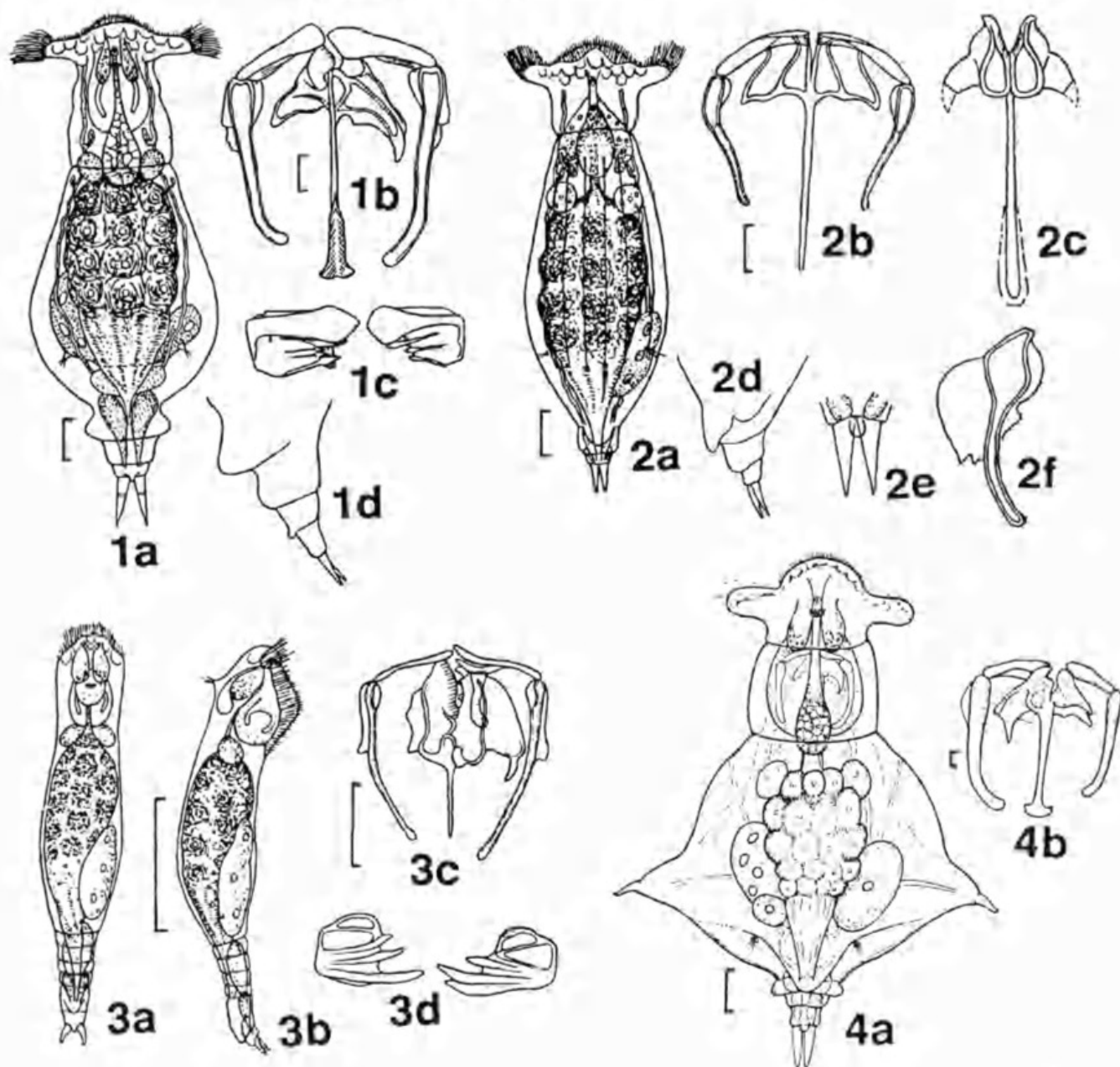


Fig. 24. 1, *Notommata pachyura* (Gosse): (a) dorsal; (b) trophi, ventral; (c) unci; (d) foot and toes, lateral. 2, *N. pseudocerberus* De Beauchamp: (a) dorsal; (b) trophi, ventral; (c) fulcrum & rami, lateral; (d) foot and toes, lateral; (e) toes, dorsal; (f) manubrium. 3, *N. silpha* (Gosse): (a) dorsal; (b) lateral; (c) trophi, ventral; (d) unci. 4, *N. spinata* nom. nov. (a) dorsal; (b) trophi, ventral. 1, 2a, b, d, 3 after Haring & Myers (1922); 2c, e, f after Donner (1954); 4 after Koste (1981). Scale lines: adult 50 μm ; trophi 10 μm .

Total length 300–800 μm ; toes 35–75 μm ; trophi 75–102 μm ; male 300 μm .

Ecology: Cosmopolitan in aquatic plants of littoral of pools, floodplain waters etc., in *Sphagnum*. Eats desmids, occasionally nematodes and rotifers. Early records from N.S.W., Qld, Vic. In our samples, N.T. and Tas. 14.7°C, pH 6.5, 23.2 $\mu\text{S cm}^{-1}$.

Literature: Koste 1978; Koste & Shiel 1986.

Notommata pseudocerberus Beauchamp
FIG. 24;2

Notommata pseudocerberus Beauchamp, 1908, p. 400.

Type locality: ?France.

Holotype: Not designated.

Description: Body slender, integument 'leathery', striated; tail has small tonguelike rounded median

lobe, two lateral lobes; foot two-segmented, toes conical, slender, ca. 1/12 body length; corona extends down ventral side for ca. 1/4 body length; rostrum above mouth, slight chin below; auricles long, robust; mastax virgate, simple; fulcrum long slender; rami broad, lamellate, without denticulation on inner edges; unci with single slender tooth, 4-5 accessory denticles on either side; pleural rods present; salivary glands vestigial; retrocerebral and subcerebral glands large.

Total length 400-680 μm ; toes 30-35 μm ; trophi 45-56 μm (fulcrum 24-27 μm).

Ecology: Cosmopolitan, rare finds in periphyton of littoral, standing and flowing waters. Preys on sessile ciliates. Single record from a stream near Bicheno, Tas. 19.0°C, pH 6.8, 215 $\mu\text{S cm}^{-1}$, 11 NTU.

Literature: Koste *et al.* 1988.

Notommata silpha (Gosse)

FIG. 24:3

Diglena silpha Gosse, 1887, p. 2, Fig. 1:2.

Notommata forcipata In Hudson & Gosse, 1886: 2, p. 23, Fig. 18:1. [non-*N. forcipata* Ehrenberg, 1838].

Notommata silpha: Harring 1913, p. 79.

Type locality: "... the middle of Ireland".

Holotype: Not designated.

Description: Body elongate, fusiform distally with annular striae; foot rudimentary; toe apices curved lightly inwards and ventrally elevated; evertile ciliated auricles and chin absent; trophi prehensile without sucking function; fulcrum short, ventrally stick-like and laterally plank-like; rami bifurcate, asymmetric (Fig. 24:3c); unci with three large teeth, nearly symmetrical, clubbed at tips; ventral basal lamella of manubria with hood-like process; retrocerebral sac rarely with bacteroids; subcerebral gland absent.

Total length 160-200 μm ; toes 8-10 μm ; trophi 24 μm .

Ecology: Isolated records from Nearctic and Palaearctic in periphyton and in dystrophic waters. Single unconfirmed early record from N.S.W.. Not seen in our material.

Literature: Koste 1978; Shiel & Koste 1979.

Notommata spinata nom. nov.

FIGS 24:4; 25

Notommata pachyura f. *triangulata*: Koste 1981, p. 121, Fig. 16a-e, 18.

non-*Copeus triangulatus* Kirkman, 1906, p. 264, Fig. 12:1-2.

Type locality: Magela Creek, N.T., Australia.

Holotype: Not designated.

Description: Body laterally expanded into two distinct alae so that total width is only slightly less than total length (in preserved material alae may



Fig. 25. *Notommata spinata* nom. nov., photomicrograph.

exceed body length due to contraction of head and foot); lateral tips of each ala armed with stout triangular cusp (possibly retractile; partly contracted individuals may have alary tips withdrawn (Fig. 25); no dorsal "hump" (cf. *pachyura*); triangular tail commences at level of lateral antennae, distal end a blunt point at beginning of first foot joint; head and neck sutures distinct; two foot segment; toes conical, long, taper to point; corona ventral, "chin" present; lateral auricles with long swimming cilia; mastax modified virgate; trophi asymmetric; fulcrum expanded into fan at distal end, manubria curved posteriorly, dilated distally; retrocerebral sac long, extending past neck/abdomen suture; pigmented, subcerebral glands large; eyespot hemispherical at posterior of brain.

Total length 600-720 μm ; toes 58-60 μm ; trophi 140 μm (fulcrum 100 μm ; rami 80/60 μm ; unci 60/48 μm ; manubria 116/100 μm).

Ecology: Recorded from billabong of Magela Ck, N.T. A similar form also occurs in W.A. (C.H. Fernando pers. comm.)

Literature: Koste 1981.

Comment: Koste's (1981) record of this taxon included figures and measurements but no

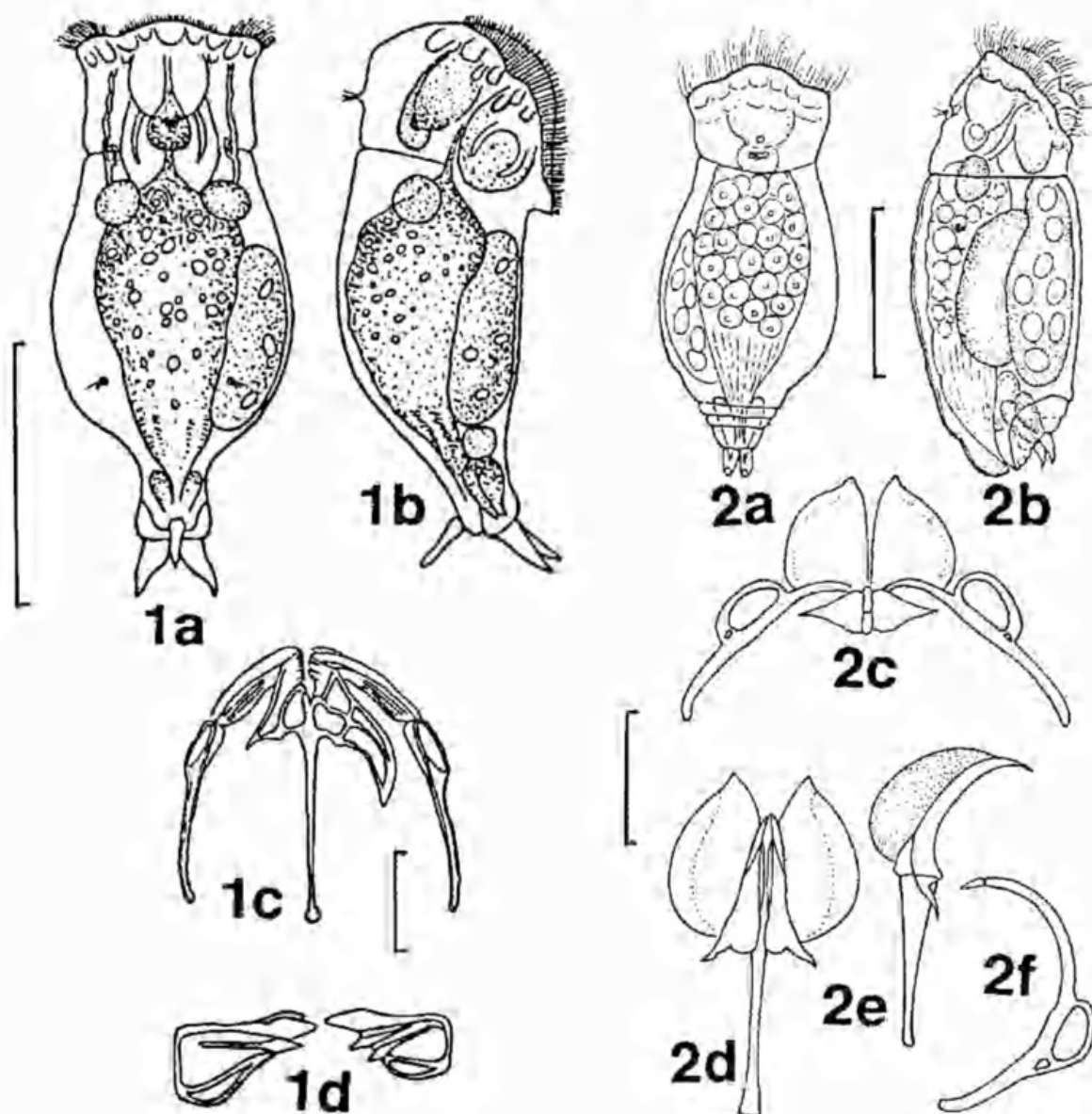


Fig. 26. 1, *Notommata tripus* Ehrenberg: (a) dorsal; (b) lateral; (c) trophi, ventral; (d) unci. 2, *N. tyleri* Koste & Shiel: (a) dorsal; (b) lateral; (c) trophi, ventral; (d) incus; (e) incus, lateral; (f) manubrium, lateral. 1 after Harring & Myers (1922); 2 after Koste & Shiel (1986). Scale lines: adult 50 μ m; trophi 10 μ m.

description. The above description must be considered provisional until more material is available, however its status as a distinct species rather than a form of *N. pachyura* is justified on the basis of the characteristic alae morphology, particularly the distal tooth, shorter toes, much larger trophi and a differences in trophi morphology. It differs from the winged taxon figured by Harring & Myers 1922: Fig. 43: 1-4 (*Copeus triangulatus* - *Notommata triangulata* (Kirkman, 1906).

Notommata tripus Ehrenberg
FIG. 26:1

Notommata tripus Ehrenberg, 1838, p. 434, Fig. 1:4.

Type locality: Berlin.

Holotype: Not designated.

Description: Body short, broad; integument rigid, transparent; head and neck form a single segment, dorsally humped; single transverse suture distinct; abdomen rounded posteriorly; projection carries tail and toes, no true foot present; dorsum has keeled appearance due to tapering of top half of abdomen from about 1/3 its length towards tail; rounded tail has spur-like projection with knobbed base, which projects about 1/3-1/2 the length of toes; toes relatively long (1/10 total length), straight, acutely pointed; auricles short, stout, ciliation continuous with corona; mastax virgate, trophi highly asymmetric; rami roughly triangular; right ramus

minutely denticulate, left ramus with four blunt teeth; right alula of normal size; left alula hugely developed; unci teeth 3/3, one main tooth; manubria broad triangular lamellate proximally, distally slender curved rods; foot glands large, pyriform; retrocerebral sac almost spherical; eyespot at posterior end of brain.

Total length 150–200 μm ; toes 16–20 μm ; trophi 26–30 μm ; caudal process 16–22 μm .

Ecology: Grazer of algae and periphyton, littoral vegetation. Europe, N. America. Rare: N.S.W., N.T., Tas. Vic., 22.0–24.5°C, pH 5.7–6.4, 45.5–114 $\mu\text{S cm}^{-1}$.

Literature: Koste 1978; Koste & Shiel 1986.

Notommata tyleri Koste, Shiel & Tan

FIG. 26:2

Notommata tyleri Koste, Shiel & Tan, 1988, p. 125–6, Fig. 15.

Type locality: Arthur's Lake, Tasmania, Australia.

Holotype: SAM V4110. Collected by R. J. Shiel 22.ix.87.

Description: Very small, stout species; body dilated distally to rounded rump; indistinctly segmented lobulate foot with two short, acutely pointed toes; mastax modified virgate; rami strongly convex on outer margins, no inner denticulation; fulcrum straight, spatulate distally; manubria slender, curved, with distinctive median ringlike fenestration; foot glands elongate, club-shaped.

Total length 120–139 μm ; toes 12–16 μm ; incus 19 μm ; subitaneous egg 30–45 $\times$ 50–65 μm .

Ecology: Endemic. Free-living in Arthurs Lake, Tasmania. 8.0°C, pH 7.7, 17.4 $\mu\text{S cm}^{-1}$.

Genus *Pleurotrocha* Ehrenberg, 1830

Pleurotrocha Ehrenberg 1830, p. 46.

Type: *Pleurotrocha petromyzon* Ehrenberg.

Type locality: Berlin.

Notommatid rotifers with short, stout illoricate body; head and neck clearly demarcated; foot long, cylindrical; toes short, conical; corona slightly oblique with ciliated circumapical band and lateral auricle-like tufts of long cilia for swimming; buccal field finely ciliate; mastax virgate, trophi simple; fulcrum long, rod-like; rami curved, triangular, not denticulate; manubria long with reduced basal plate; unci with only single tooth; hypopharynx large; no retrocerebral organ; eyespot single. Fourteen species are referred to this genus (Koste 1978). Only *P. petromyzon* is known from Australia.

Pleurotrocha petromyzon Ehrenberg

FIG. 27:1

Pleurotrocha petromyzon Ehrenberg, 1830, p. 46.

Type locality: Berlin.

Holotype: Not designated.

Description: Body short, stout, abdomen wider than head; integument soft, transparent; constriction between neck and abdomen; abdomen pyriform, tapers posteriorly to base of foot; no tail; foot 2-segmented, basal square, distal twice basal segment length; toes short, conical; foot glands long with reservoirs; circumapical band of cilia and two lateral auricle-like tufts; mastax virgate, trophi simple; rami triangular with large rounded alulae; fulcrum very long slender rod, slightly expanded distally; unci triangular plates with one weak ventral and second rudimentary tooth; manubria slightly sigmoid with characteristic lobe projecting ventrally from 1/3 along its length; pleural rods present; no retrocerebral organ; eyespot minute at posterior end of ganglion.

Total length 220–480 μm ; toes 20–26 μm ; trophi 30–37 μm .

Ecology: Mass development after cladoceran "pulses" or in bacteria or protozoa blooms, in a wide range of fresh to brackish waters. Cosmopolitan. Necrophage – cleans out carapaces of dead mites and microcrustacea, also eats sessile ciliates. Rare, N.S.W., Tas., Vic. 12.0–26.0°C, DO 10.4, pH 6.4–7.7, 114–3330 $\mu\text{S cm}^{-1}$.

Literature: Evans 1951; Shiel & Koste 1979; Koste & Shiel 1986.

Genus *Resticula* Harring & Myers

Resticula Harring & Myers, 1924, p. 518.

Type: *Furcularia melandocus* Gosse, 1887 =

Resticula melandocus (Gosse)

Type locality: Woolston, England.

Very slender, fusiform illoricate body, tapering gradually from mid-length to base of toes; two toes short, with bulbous enlargement at base containing mucus reservoir; corona frontal or oblique with marginal wreath of short cilia and two lateral auricle-like tufts of long swimming cilia; buccal field ciliated; mastax virgate; fulcrum long, slender; rami triangular, symmetrical with right-angled median bend; unci with single well-developed tooth; epipharynx rudimentary or absent; two salivary glands; retrocerebral organ a small round ductless sac; eyespot a loose aggregation of red pigment granules in vacuoles of sac.

Seven species are recognized by Koste (1978); three of them are known from Australia.

Key to species of *Resticula* recorded from Australian inland waters

1. Foot from end of abdomen to base of toes long (ca. 1/4 total length) *R. gelida* (Harring & Myers) (Fig. 27:2)

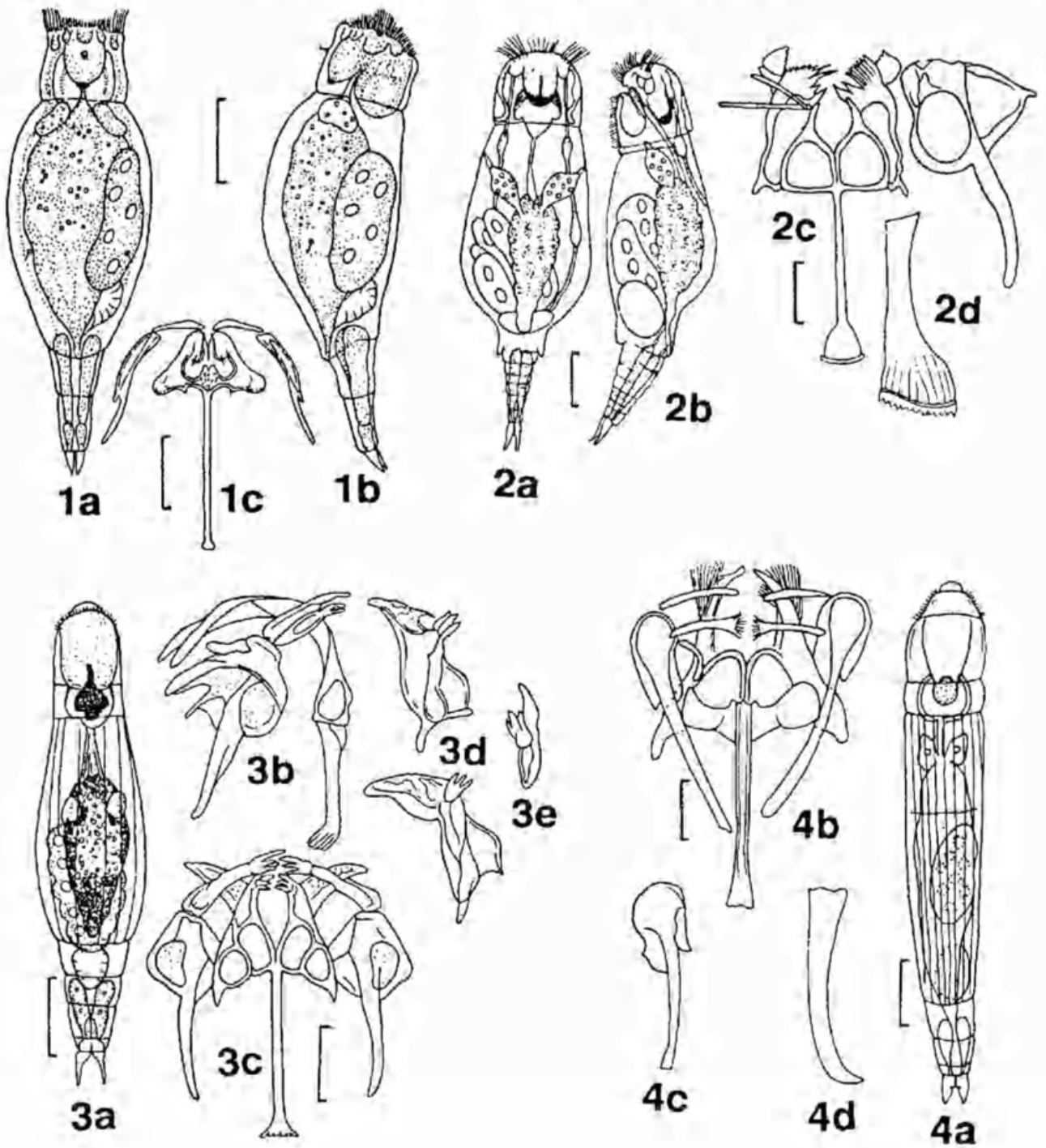


Fig. 27. 1, *Pleurotrocha petromyzon* Ehrenberg: (a) dorsal; (b) lateral; (c) trophi, ventral. 2, *Resticula gelida* Harring & Myers: (a) dorsal; (b) lateral; (c) trophi, ventral, right manubrium omitted; (d) fulcrum, lateral. 3, *R. melandocus* (Gosse): (a) dorsal; (b) trophi, lateral; (c) trophi, ventral; (d) different views of ramus; (e) uncus. 4, *R. nyssa* Harring & Myers: (a) dorsal; (b) trophi, ventral; (c) manubrium; (d) fulcrum. 1 after Harring & Myers (1924); 2 after Wulfert (1935); 3 after Wulfert (1939); 4 after Koch-Althaus (1962). Scale lines: adult 50 μ m; trophi 10 μ m.

Foot short and indistinct, less than length of toes

2(1). Eyespot a mass of red pigment granules. 2

..... *R. nyssa*
Harring & Myers (Fig. 27:4)

No eyespot discernible. *R. melandocus*
(Gosse, 1887) (Fig 27:3)

Resticula gelida (Harring & Myers)

FIG. 27:2

Eosphura gelida Harring & Myers, 1922, p. 642, Fig. 60:1-6.

Resticula gelida: Harring & Myers 1924, p. 519.

Type locality: Washington DC.

Holotype: Not designated. ?Myers Coll., AMNH, N.Y.

Description: Body fusiform; transparent cuticle with variable folding; abdomen occasionally conspicuously wide; head clearly defined; tail rudimentary; foot long ($>3\times$ toes), without segments; toes short (1/20 total length) tapering to obtuse tips; corona frontal, circumapical band interrupted dorsally; mastax modified virgate (for seizing prey); rami broad triangular; intricate supporting fenestrated framework of slender, round rods (Fig. 27:2c); fulcrum long and straight, spatulate at distal end for attachment hypopharynx muscle; unci reduced to single slender tooth with three small preuncial teeth on left and two on right; manubrium slender, curving slightly posteriorly with ventral lobe anteriorly and triangular dorsal lobe; retrocerebral organ small, has pigment granules, clustered at posterior end of ganglion where eyespot would be.

Total length 350-600 μm ; toes 18-30 μm ; trophi 45-75 μm (in 45 μm trophi, fulcrum 26 μm , unci 17 μm ; manubria 32 μm); male 150-200 μm .

Ecology: Isolated occurrence in periphyton, still and slowly flowing water, Europe and Asia. N. America. Single record, from Yarnup Swamp, W.A. 17.0°C, 1800 $\mu\text{S cm}^{-1}$.

Literature: Koste *et al.* 1983.

Resticula melandocus (Gosse)

FIG. 27:3

Parcularia melandocus Gosse, 1887, p. 2, Fig. 1:4.

Resticula melandocus: Harring & Myers 1924, p. 518.

Type locality: Woolston, England (lacustrine).

Holotype: Not designated.

Description: Body transparent, variable shape; cuticle thin, with longitudinal striae; foot 3-4 segmented; toes variable, bulbed at base; toe points curve inwards; single salivary gland to right of mastax; unci with single main tooth, left uncus with two preuncial teeth, right uncus with one; rami triangular in ventral view, right angle bend at

midpoint toward dorsal surface; two large teeth in each ramus; manubria nearly straight, dorsal and ventral extensions are thin lamellae; pleural rods which support mastax during pumping action embedded in wall of mastax on each side, under upper ends of manubria.

Total length 210-320 μm ; toes 25-37 μm ; trophi 34-42 μm .

Ecology: Cosmopolitan in detritus-rich periphyton. Carnivorous on rotifers (particularly bdelloids) in littoral. Rare, N.T., Qld, Tas, Vic. 22.0-30.9°C, pH 3.4-5.4, DO 4.15 mg l^{-1} , 29.0-59.3 $\mu\text{S cm}^{-1}$.

Literature: Shiel & Koste 1979; Koste & Shiel 1983, 1986.

Resticula nyssa Harring & Myers

FIG. 27:4

Resticula nyssa Harring & Myers, 1924, p. 521, Fig. 38:1-4.

Type locality: Atlantic City, New Jersey.

Holotype: Not designated.

Description: Vermiform with longitudinal and transverse striae, head protrusion anteriorly corresponds to rostrum in other taxa; foot two jointed, very short, broad; toes short, with bulbous basal enlargement and claw-like tip; mastax modified virgate; fulcrum long, spatulate distally; rami triangular with large asymmetric alulae; basal apophysis prominent; three or four small teeth at apex of rami; unci with two teeth each, five accessory teeth on left uncus only; manubria long and slender; pleural rods slender, fibrillate at ends and fused to rami; pedal glands small pyriform; retrocerebral sac but no subcerebral glands; no true eyespot, but mass of red pigment granules occupy portion of sac.

Total length 300-630 μm ; toes 14-21 μm ; trophi 50-60 μm ; male 160 μm .

Ecology: Periphyton, Europe, Asia, N. America, Acidophile. Single record: Lake Garcia, western Tas. 0.2 $\times$ 0.87, 17.0°C, pH 4.3, 98.3 $\mu\text{S cm}^{-1}$, 0.5 NTU, dark, humic water.

Literature: Koste 1978; Koste *et al.* 1988.

Genus *Scaridium* Ehrenberg

Scaridium Ehrenberg 1830, p. 47.

Type: *Trichoda longicauda* Müller = *Scaridium longicaudum* (Müller).

Type locality: Copenhagen.

Body cylindrical or fusiform, partially loricate both dorsally and ventrally; neck behind dorsal antennae also with stiffened cuticle; foot very long, three-segmented, not retractable, with short basal-, long distal-segment; complex internal foot musculature to move very long, straight toes; corona

oblique, with perioral buccal field and narrow dorsally-interrupted circumapical ciliation; dorsal- and lateral antennae small; eyespot and retrocerebral organ absent; mastax rounded, trophi virgate; unci toothed plates, points offset; manubria widened proximally, hooked distally; fulcrum long, strong, distally spatulate; rami somewhat triangular with alulae, long pointed ends of which curve ventrally; each ramus with a long pointed tooth arising ventrally; epipharynx large, complex, reddish colouration resembles an eyespot; gastric glands large; separate stomach and intestine; male significantly smaller, with much shorter foot and toes, cerebral eye present; subitaneous egg hairy, resting egg spinulate.

Of the two described species, only *S. longicaudum* is known from Australia.

Scaridium longicaudum (Müller)
FIG. 28:1

Trichoda longicauda Müller, 1786, p. 216, Fig. 31:8-10.
Scaridium longicaudum: Ehrenberg 1830, p. 47.

Type locality: Copenhagen.

Holotype: Not designated.

Description: As for genus; toes almost as long as foot; unci lamellar plates with acute offset teeth; manubria proximally 'fish-hook' shape, distally almost right angled.

Total length 360-450 µm; foot 118-150 µm; toes 122-145 µm; trophi 48 µm (fulcrum 30 µm; rami 15 µm; manubrium 22 µm; ramus 16 µm); male 150 µm; subitaneous egg 50 µm.

Ecology: Cosmopolitan warm stenotherm, pH tolerant, swims slowly between macrophytes in shallow waters. Pancontinental, common in wide range of habitats. 8.0-22°C, pH 7.2-7.4, DO 9.2-9.6 mg l⁻¹, 60-1600 µS cm⁻¹, 8 NTU.

Comment: Distinguished from *Scaridium bostjani* Daems & Dumont (from Nepal) by larger size (>360 µm vs <288 µm) and wide tongue-shaped articulations of the manubria with the unci vs a pointed elongation in the Nepalese species. Detailed analysis of variants reported in the literature is lacking (Koste 1978), however it is likely that these represent more than ecotypic variations, i.e. a complex of species is involved.

Genus *Taphrocampa* Gosse

Taphrocampa Gosse, 1851, p. 199.

Type: *Taphrocampa annulosa* Gosse.

Type locality: Leamington, England.

Notommatid rotifers, cylindrical or fusiform body with more or less distinct transverse plicae; corona oblique on anterior surface of head, with lateral ciliated auricle; mastax virgate with asymmetric

trophi; fulcrum, long slender; rami approximately hemispherical; manubria long, slender with rudimentary basal plate; unci with 2-3 narrow teeth; well developed hypopharynx muscle; rami with large alulae. Two of the four species listed in Koste (1978) are known from Australia.

Key to species of *Taphrocampa* recorded from
Australian inland waters

1. Body generally <200 µm; toes <15 µm
..... *T. annulosa* Gosse (Fig. 28:2)
- Body >220 µm; toes >25 µm *T. selenura*
..... Gosse (Fig. 28:3)

Taphrocampa annulosa Gosse
FIG. 28:2

Taphrocampa annulosa Gosse, 1851, p. 199.

Type locality: Leamington, England.

Holotype: Not designated.

Description: Movement sluggish, creeping, gliding; body stocky may be thin when extended; three head "segments"; dorsum of same appearance as *T. selenura*; seen laterally more or less coarsely serrated; ciliary auricles rarely extended; short, indistinct, small tooth on inner margin of left ramus may be present; no basal apophyses.

Total length 130-230 µm; toes 11-15 µm; trophi 25-26 µm.

Ecology: Cosmopolitan in detritus rich periphyton (littoral). N.S.W., N.T., Qld, Vic.

Literature: Koste 1978, 1981; Shiel & Koste 1979.

Taphrocampa selenura Gosse
FIG. 28:3

Taphrocampa selenura Gosse, 1851, p. 1, Fig. 1:1

Type locality: England, not specified. Lacustrine.

Holotype: Not designated.

Description: Body elongate, cylindrical, tapering to foot; integument "leathery". Dorsally with transverse plications usually 10-12; ventral surface less distinctly plicate; tail separated from abdomen by transverse groove; toes long, tapering, decurved, form semicircle (viewed dorsally); left side of trophi more developed than right; piston muscle attached to end of fulcrum; left ramus with blunt tooth on inner edge, lamellar plate behind this, then two large teeth (Fig. 22:3c), right ramus with eight rudimentary teeth, left unci with large ventral tooth and smaller second tooth; right unci one large and two small; manubria have subsquare basal plates with straight posterior branch and terminal expansions.

Total length 220-290 µm; toes 25-33 µm; trophi 36 µm.

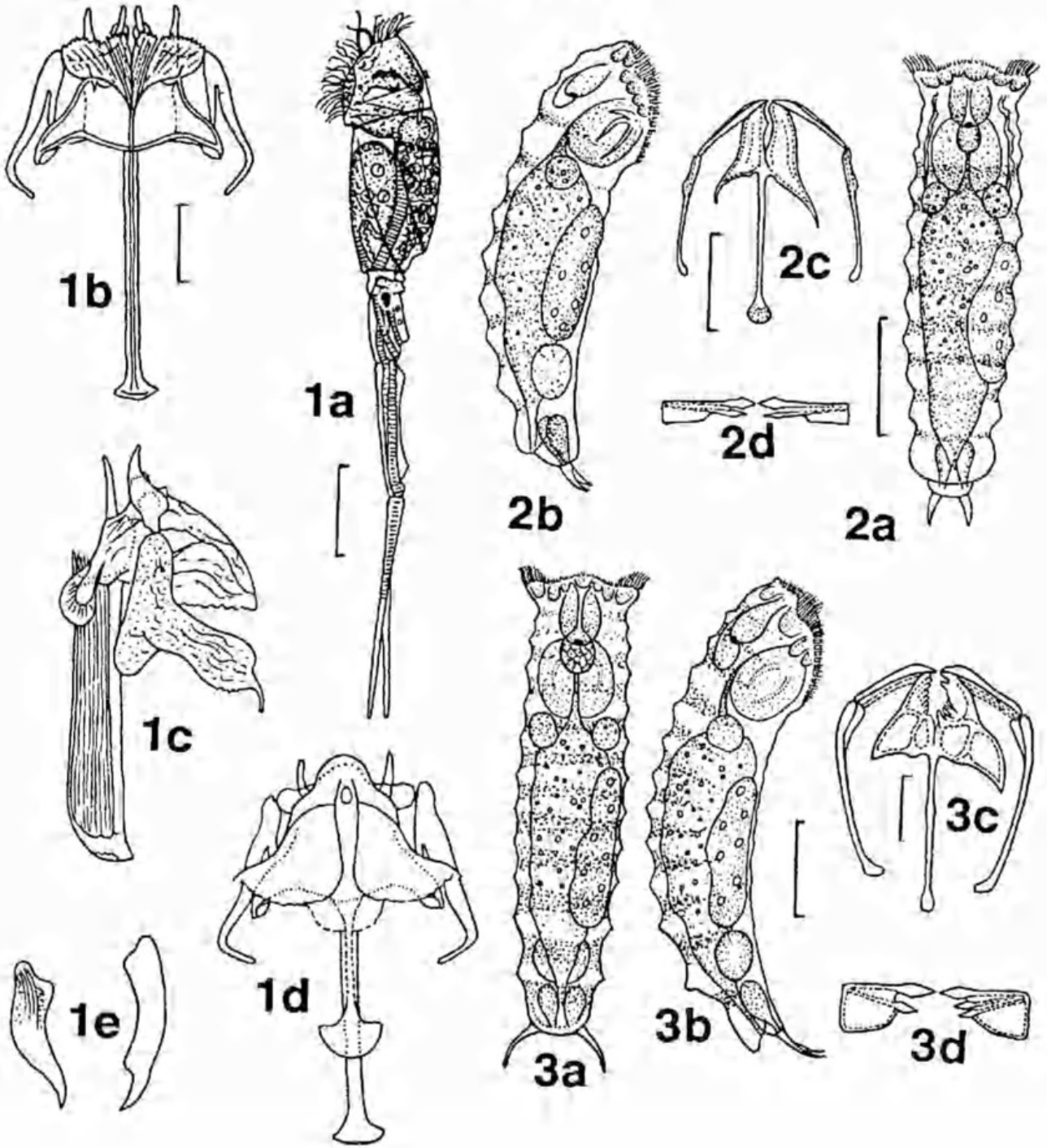


Fig. 28. 1, *Scaridium longicaudum* (Müller): (a) lateral; (b) trophi, ventral; (c) trophi, lateral; (d) trophi, dorsal; (e) two views of uncus. 2, *Taphrocampa unguiculosa* Gosse: (a) dorsal; (b) lateral; (c) trophi, ventral; (d) uncus. 3, *T. selenura* Gosse: (a) dorsal; (b) lateral; (c) trophi, ventral; (d) uncus. 1 after Donner (1943); 2, 3 after Harring & Myers (1924). Scale lines: adult 50 μ m; trophi 10 μ m.

Ecology: Cosmopolitan in detritus rich periphyton and eutrophic decomposition areas. Rare, N.S.W., N.T.

Literature: Shiel & Koste 1979, Koste 1981.

Genus *Rousseletia* Harring

Rousseletia Harring, 1914, p. 393.

Type: *Rousseletia corniculata* Harring, 1914 (Fig. 29).

Type locality: Kenilworth, DC, U.S.A.

Small stout illoricate body; slight constriction between head and abdomen; tail large, collar-like, projects over long foot; foot has dorsal seta, may be broken off; two short conical toes on ventral side of foot tip; corona terminal with circumapical ciliation; two papillae project from unciliated apical plate; buccal field semicircular, ciliated, with mouth near ventral edge; mastax disproportionately large (ca. $\frac{1}{2}$ body length), of specialized virgate type; fulcrum spatulate distally; rami large, domed, without marginal denticulation; manubria simple curved rods with ventral spur; unci absent; rod shaped epipharynx present; eyespot large, cervical; retrocerebral sac large, filled with highly refractive granules; large stomach extending to blind sacs on either side of mastax; no intestine; gastric glands small; foot glands club-shaped.

Rousseletia is not positively identified from Australia. Sudzuki & Timms (1977) listed a rotifer identified as *Russelletia* [sic] *parroti* Russell from Myall Lake, N.S.W. No description or figures were provided. If this is the rotifer described by Russell (1947), it was referred to the genus *Lindia* (Lindiidae) (see Koste & Shiel 1990b). We regard the record as *incertae sedis*, but include the generic description should the Myall Lake rotifer be encountered again.

Acknowledgments

Collectors acknowledged in earlier parts also contributed material included here. The Deutschen

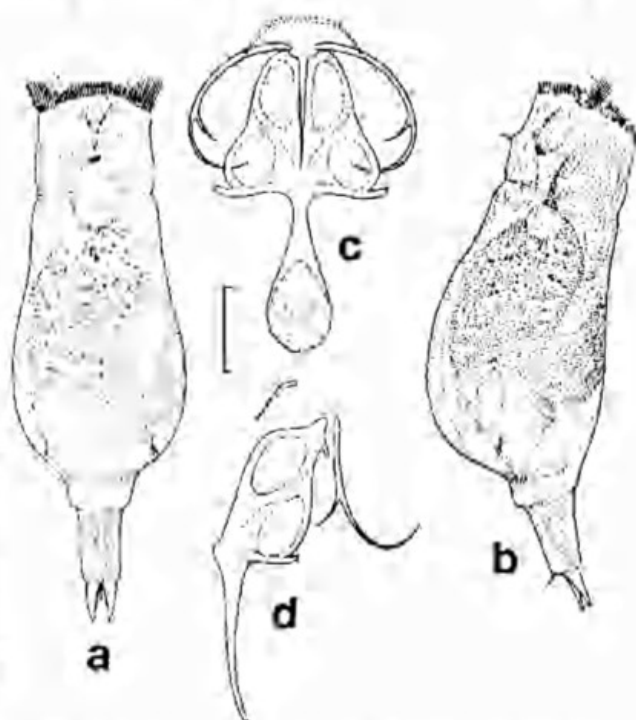


Fig. 29. *Rousseletia corniculata* Harring: (a) dorsal; (b) lateral; (c) trophi, ventral; (d) trophi, lateral. After Harring & Myers (1924). Scale lines: adult 50 μ m; trophi 10 μ m.

Forschungsgemeinschaft continues to support WK with microscope and photographic facilities. The support of the Murray-Darling Freshwater Research Centre, particularly the Director, Dr David Mitchell, in funding a six-week visit to the Centre by WK and assistant C. Leutbecher is gratefully acknowledged. The patience of Lor-Wai Tan in converting a part-pencilled/part-bilingual draft manuscript to final form on a word-processor, and her continued field assistance, has been invaluable. The systematic expertise of Dr Alice Wells, similarly patient, made our task somewhat easier for this paper and the remaining papers of the series. For technical and field assistance respectively, Garth Watson and Fiona Dunn are thanked.

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Note added in proof

The status of *Lindia parrotti* Russell (see Koste & Shiel 1990b: 141) = *Russelletia parrotti* (Russell) in Sudzuki & Timms (1977) was resolved after this paper was completed. Mr Phil Parr of Levin, N.Z., sent us the photograph of Russell's *Lindia parrotti* missing from our copies of the original description. Mr Jordi De Manuel, University of Barcelona, sent a copy of the description of *Russelletia* Sudzuki (1959), erected to accommodate *L. parrotti*.

Mrs La-orsri Sanoamuang, Department of Zoology, University of Canterbury, Christchurch, collected at the type locality (Lake Victoria) a population resembling *parrotti* as figured by Russell, and checked the type collection of the

Canterbury Museum for Russell's material. We thank these people for their efforts.

The type material could not be located, but from trophi analysis and comparative photographs of the Lake Victoria rotifers, we consider *Lindia parrotti* a junior synonym of *Proalides tentaculatus* De Beauchamp, 1907.

References

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