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A Guide to Nicothoid Parasites of British Amphipods, Cumaceans and Isopods

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The Nicothoidae is a family of variously transformed copepods which parasitize a wide variety of other crustaceans. The family, as amended by Boxsnall & Lincoln (1983), includes all copepods previously referred to the family Choniostomatidae as well as the genus *Rhizorhina* erroneously included among the Herpyllobiidae by some earlier authors. The family is divided into three broad groups:

(i) **Nicothoe Group** Little transformed: parasites among the egg-masses of Decapods (13 Species altogether)
(ii) **Rhizorhina Group** Highly transformed parasites of Amphipods, Isopods, Tanaids, and Leptostracans (7 species. See Gotto, 1984)
(iii) **Sphaeronella Group** moderately transformed: parasites usually occurring in the brood pouch or branchial chamber of Amphipods, Cumaceans, Isopods, Ostracods, Decapods and Mysidaceans. This is by far the largest group with 8 genera and 92 species, 76 species alone in the genus *Sphaeronella*.

Nicothoids are generally rather rarely recorded, largely due to their small size and clandestine habits. They are very easily overlooked, even the larger ovigerous females living in the brood pouches of the hosts can, at first glance, be mistaken for the eggs of their hosts which they mimic in size. Many species still remain unrecorded since their original descriptions in Hansen's monograph almost a hundred years ago.
Species determination of such small forms may be difficult, requiring close examination of mounted specimens and may be further complicated by the inadequacy of available descriptions and illustrations. Nevertheless these problems are being rectified as new material is found with some older species being redescribed or synonymized (see Green, 1958). Undoubtedly, as the family becomes better known, new species will be discovered even in British waters. This family, among others, is to be included in a Linn. See Synopsis of British Parasitic Copepods currently in preparation (Kabata and Gotto).

Only those species occurring, or likely to occur, on British Amphipods, Cumaceans or Isopods are discussed further here.

(i) **Nicothoe Group** – Restricted to Decapods.
(ii) **Rhizorhina Group** – Only one species of this group, *Rhizorhina ampelisae* Hansen, 1892, is likely to be found in British Waters, being recorded from Guernsey and the Clyde Estuary (Green, 1958), and the Firth of Forth (Scott, 1902) attached to the amphipods *Ampelisca diadema* or *A. brevicornis*. The female body is spherical, about 1mm long and devoid of any appendages. Anteriorly there is a small oral cone which attaches to the host and is connected to a network of rooting filaments which ramify the host's tissue. Small sac-like males, which remain within the shed copepodite skin, may be found attached to the female between the ovisacs. Elsewhere the species has only been recorded from Norway and Denmark by Hansen, 1892

(iii) **Sphaeronella Group** – Of the 8 known genera, *Aspidoecia* and *Mysidion* are restricted to Mysidacean shrimps, *Sphaeronellopsis* and *Sphaeronelloides* occur in Ostracods and *Choniostoma* parasitizes Decapods. The three remaining genera cover a wide host spectrum and are keyed out below, based on female anatomy.

1a A small unsegmented abdomen is present, protruding from the trunk (=thorax) region.....***Stenothocheres***

1b Abdomen absent, replaced by 2 small caudal rami, also protruding from the trunk region.....**2**

2a Trunk legs and caudal rami consist of a small, short basal part which tapers into a long conical branch, without setae.....***Homoeoscelis***

2b Trunk legs and caudal rami, when present, are short and cylindrical usually with terminal setae.....***Sphaeronella***

Genus *Stenothocheres*

Live in the marsupium of Stenothoid Amphipods. Only two species known, *St. egregius* and *St. sarsii*. The former was firs described by Hansen (1897) parasitizing *Metopa bruzelii* off West Greenland. Since then it has been recorded only once, by Scott (1904) in Aberdeen Bay where it parasitized *Metopa borealis*. *Stenothocheres sarsii* was also described by Hansen (1897) but from Norwegian waters where it parasitized *Stenothoe marina*. As this amphipod host also has a British distribution, this species might also be expected to turn up in British waters.

Genus *Homoeoscelis*

Live in the branchial cavity of Cumacea. Only two species known, *H minuta* & *H. mediterranea* parasitizing *Diastylis lucifera* & *Iphinoe trispinosa* respectively. Recorded originally by Hansen (1897) from Denmark & Sicily respectively. However both these copepods have since been discovered in British waters; *H. mediterranea* from the Plymouth area (1957) and *H. minuta* from the Firth of Forth. (M. O'Reilly, unpublished data).

Genus *Sphaeronella*

The largest genus in the family having a wide host spectrum including Amphipoda (42 species), Cumacea (9 species), Isopoda (8 species) as well as Ostracoda (18 species). *Sphaeronella* normally inhabits the marsupium of its host. The female trunk region becomes enormously distended on maturation, such that the whole body takes in a globular appearance with a small head surmounted. Relatively large ovisacs are repeatedly deposited in the host's marsupium, each ovisac approximately mimicking the size of a single egg of the host which unwittingly broods them as its own. The presence of the copepod appears to inhibit any egg production by its host.

The copepods eggs hatch directly into the single copepodid stage which, provided with well developed natatory legs, leaves the marsupium and disperses in search of a new host. It normally selects an immature pre-ovigerous female host, avoiding any competition for space with host eggs in the marsupium. Those copepodids that occasionally infect male hosts are unlikely to mature successfully. Without the protection afforded in a proper marsupium, as they grow in size, they are increasingly in danger of being removed by their host as a "foreign particle" during cleaning activities. The newly arrived copepodids attach to the bases of the hosts legs, gills or marsupial plates.

One or both sexes may then transform into pupal stage which remains attached by a short frontal thread. These pupae later moult into miniature adults, both sexes of which are initially about the

same size. The males however are distinguished by their more fully developed legs, with an inner and often small outer ramus and provided with long setae. Details of various stages of growth and development seem to vary from one species to another, further research being required in this area.

Infected hosts generally contain only mature female, with numerous ovisacs, and usually accompanied by one or two smaller males. Occasionally other juvenile females, male or female pupae or copepodids which may be either newly hatched in the marsupium or just arriving from elsewhere, may also be found.

Most *Sphaeronella* species still appear to be restricted to one or two closely related host species though this may be partly due to the paucity of records. Recent data on *S. leuckartii*, for instance, shows it to infest at least five Amphipod species from four different genera, representing three different families. Alternatively one species may act as host to more than one species of *Sphaeronella* parasite. *Ampelisca tenuicornis*, for example, may harbour either *S. longipes* or *S. frontalis* though not both simultaneously. Some information on the biology of the host parasite relationship as well as seasonal variation in the incidence of parasitism has been supplied by Ladle, (1975), Sheader, (1977) and Costello & Myers, (1989).

***Sphaeronella* in British Waters**

Fourteen species of *Sphaeronella* have been recorded from British waters (see table 1), with seven species having British type localities. One or two species may perhaps be synonymous, the type descriptions by Scott (1904 & 1905), for instance, being less than adequate such that new material is required for proper redescriptions. Only one species is described from a British Cumacean, *Pseudocuma similis* (see Scott; 1904) though Scott (1905) does mention a further *Sphaeronella* parasite infesting *Hemilamprops rosea*. More recently a *Sphaeronella* species, not yet examined in detail, has been found in the marsupium of *Bodotria pulchella* in the Firth of Forth by M.O'Reilly. (unpublished data).

Hansen (1897) however, described five Cumacean infesting *Sphaeronella* parasites all of which have hosts occurring in British waters (see Table 2) and any of these might be expected to turn up in Britain.

Similarly about twelve Amphipod and one Isopod species all of which occur in British waters are known to harbour *Sphaeronella* parasites elsewhere in North Atlantic waters (see Table 2) and it is quite probable that any of these will be discovered here eventually.

Provisional keys for identifying female *Sphaeronella* occurring, or likely to occur, in British waters for both Amphipod and Cumacean infesting species are given. It should be borne in mind that some species are so poorly described that their position in the key is at best tentative, until they receive full redescriptions. Proper orientation of the mounted specimens is essential if some of the finer details are to be observed. The awkward shape of gravid females sometimes necessitates mounting and carefully examining several specimens if all the key features are to be clearly determined. Identification of the host species can of course be helpful in suggesting the most probable parasite species.

Though the small males are often simply assigned to the identity of the female which they accompany, they themselves have a less modified morphology which may in fact retain more diagnostic features than that of the more reduced females. Indeed in the *S. leuckartii* sub-group, with about eight very similar species, the males are much more easily distinguished than the females. However the males of many species still remain either unknown or undescribed and more material is needed in order to facilitate the construction of accurate and comprehensive keys for males and also females of the genus.

Table 1 British Records of *Sphaeronella* associated with Amphipods and Cumacea.

Amphipod Parasite	Host	Location & Reference
S.frontalis Hansen, 1897	*Ampelisca macrocephala*	Clyde (Green, 1958)
	Ampelisca tenuicornis	Clyde (Green, 1958)
S.longipes Hansen, 1897	*Ampelisca tenuicornis*	Jersey (Green, 1958)
		Tyne & Wear (Sheader,1977)
		Galway Bay (Gotto & McGrath, 1980)
		Forth (M.O'Reilly, unpubl.)
S.amphilochi Hansen,1897	*Paramphilochoides Odontonyx*	Scotland (Scott, 1904)
S.sp. (not yet identified)	*Amphilochus neapolitanus*	Forth (M.OReilly, unpubl.)
S.leuckartii Salensky, 1868	*Aora gracilis*	Dornoch Firth (Scott, 1905)
		Guernsey (Green, 1958)
		Lough Hyne (Holmes, 1985)
	Lembos longipes	Clyde (Moore, 1984)
	Cheirocratus sundevalii	Clyde (Green, 1958)
	Corophium bonnellii & *C.volutator*	Norfolk (Hammond, 1973)
S.atyli Hansen, 1897	*Atylus swammerdami*	Galway Bay (Gotto & McGrath, 1980)
S.danica Hansen,1897	*Corophium crassicorne*	Geurnsey (Green, 1958)
		Forth (M.O'Reilly, unpubl.)
	Ericthonius punctatus	Plymouth (Green, 1958)
		Kilkeiran (Gotto & McGrath, 1980)
	Apherusa bispinosa	Clyde (Moore, 1984)
S.paradoxa Hansen, 1897	*Bathyporeia pelagica*	Moray Firth (Scott, 1904)
	B.pelagica & *B.sarsi*	Norfolk (Hamond, 1973)
		Northumberland (Ladle, 1975)
	Bathyporeia elegans	Wexford (Gotto & McGrath, 1980)
S.valida Scott, 1905	*Megamphopus cornutus*	Forth (Scott, 1905)
		Norfolk (Green, 1958)
S.callisomae Scott, 1904	*Scopelocheirus hopei*	Clyde (Scott, 1904)
S.vararensis Scott, 1905	*Megaluropus agilis*	Moray Firth (Scott, 1905)
S.cluthae Scott, 1904	*Harpinia pectinata*	Clyde (Scott, 1904)
S.minuta Scott, 1904	*Perioculodes longimanus*	Dornoch Firth (Scott, 1904)
		Moray Firth (Scott.1905)
S.pikei Green, 1958	*Pontocrates arenarius*	Guernsey (Green, 1958)

Recently M.O'Reilly has collected *Sphaeronella* material from *Perioculodes longimanus* in the Firth of Forth which suggests that *S.pikei* might be synonymous with *S.minuta*.

Cumacean Parasite	Host	Location & Reference
S.pygmaea Scott, 1904	*Pseudocuma similis*	Scotland (Scott, 1904)
S.sp. (single copepodid)	*Pseudocuma similis*	Forth (M.O'Reilly, unpubl.)
S,sp. (large female)	*Hemilamprops rosea*	Loch Fyne (Scott, 1905)
S,sp. (not yet examined)	*Bodotria pulchella*	Forth (M.O'Reilly, unpubl.)
S.dispar Hansen, 1897	*Eudorella truncatula*	Denmark (Hansen, 1897)
		Plymouth (Marine Fauna. 1957)

Table 2 Sphaeronella species not yet recorded in British waters but with British hosts.

Amphipod Parasite	Host	Location
S.microcephala G.&B.1893	*Ampelisca typica*	Denmark
S.argissae Hansen, 1897	*Argissa hamatipes*	Greenland
S.ecaudata Stock & De Vos, 1960	*Corophium arenarium*	Holland
S.devosae Stock & De Vos, 1960	*Corophium arenarium*	Holland
S.vestita Hansen, 1897	*Microprotopus maculatus*	Denmark
S.photidis Blake, 1929	*Photis reinhardi*	Maine, New England
S.pilosae Blake, 1929	*Photis reinhardi*	Maine, New England
S.giardii Hansen, 1897	*Protomedeia fasciata*	Denmark
S.bonnieri Hansen, 1897	*Protomedeia fasciata*	Greenland
S.norvegica Hansen, 1904	*Tmetonyx similis*	Norway
S.dulichiae Hansen, 1897	*Dyopedos monacanthus*	Denmark
S.metopae Hansen, 1897	*Metopa bruzelii*	Greenland
S.irregularis Hansen, 1897	*Stenula rubrovittata*	Denmark?
S.intermedia Hansen, 1897	*Bruzellia typica*	Norway
S,caprellae Blake, 1929	*Caprella linearis*	Maine, New England

Cumacean Parasite	Host	Location
S.modesta Hansen, 1897	*Eudorella emarginata*	Denmark
S.marginata Hansen, 1897	*Iphinoe trispinosa*	Sicily
S.decorata Hansen, 1897	*Diastylis rathkei*	Greenland
S.insignis Hansen, 1897	*Diastylis laevis* & *D.cornuta*	Denmark

Isopod Parasite	Host	Location
S.affinis Hansen, 1897	*Janira maculosa*	Norway

Hansen, (1923) also describes two species of *Sphaeronella* infesting Isopods of the genera *Munna* and *Pleurogonium*.

Provisional key to Amphipod infesting Sphaeronella females occurring or likely to occur in British waters.

1a Head with distinct frontal border and lateral borders, Antennule (A.1.) with several segments.....2

1b Head without distinct frontal and lateral borders;
A.1. reduced, uniarticulate, A.2. absent.....*S.microcephala*
A.1. & A.2. apparently absent?.....*S.cluthae*

2a Head relatively small with rounded frontal border.....3

2b Head relatively large with truncate frontal border.....*S.vararensis*

3a Antennae (A.2.) absent. Tufts of hair at base of Maxillulae (Mx.1)
(*S.leuckartii* Group – females very similar).....16

3b Antennae (A.2.) present. Usually no tufts of hair at base of Maxillulae.....4

4a Frontal margin with median cup-shaped expansion, though this may become reflexed dorsally making it less obvious.....*S.frontalis*

4b Frontal margin without any median expansion.....5

5a Trunk entirely naked or with only a few scattered, simple hairs.....6

5b Trunk partly or mostly hairy;
Trunk covered throughout, with simple hairs.....*S.norvegica*
Trunk hairy anteriorly, but naked posteriorly.....*S.callisomae*
Trunk covered with short 2 or 3 branched hairs.....*S.irregularis*

6a Trunk always attached to host by ventral thread.....*S.paradoxa*

6b Trunk never attached to host.....7

7a Maxillipeds small, their basal joint little longer than that of the maxillae (Mx.2)...*S.dulichiae*

7b Maxillipeds well developed, their basal joint much longer than that of maxillae (Mx.2)..... 8

8a Trunk legs, if found, with short setae little longer than the leg.....11

8b One of the setae on trunk legs, 2 or 3 times length of leg.....9

9a Distinct fringe of hairs on frontal border.....*S.pikei* (=*S.minuta*?)

9b No hair fringe on frontal border.....10

10a Strong skeletal bar behind maxillipeds, one leg seta twice the length of the other seta.....
.....*S.valida*

10b No skeletal bar behind maxillipeds, one leg seta nearly three times length of the other seta.....*S.longipes*

11a No skeletal bars behind the maxillipeds.....*S.argissae*

11b One or more skeletal bars behind the maxillipeds.....12

12a Genital area forming a solid heart-shaped plate.....*S.intermedia*

12b Genital area mostly thin-skinned, solid chitin forming an incomplete ring.....13

13a Head with naked lateral margins.....*S.metopae*

13b Head with hairy lateral margin.....14

14a Lateral margin hairs long, basal joint of maxilliped long and slender.....*S.amphilochi*

14b Lateral margin hairs short, basal joint of maxilliped short and stout.....15

15a Caudal rami behind or on the posterior margin of the ring of the genital area.....*S.giardii*

15b Caudal rami some distance in front of the posterior margin of the genital area...*S.bonnieri*

16a Maxillulae (Mx.1) with all 3 branches directed forwards.....*S.danica*

16b Maxillulae (Mx.1) with one branch directed backwards.....17

Sphaeronella – Amphipod Key – Contd.

17a Hairs at the base of the Maxillulae (Mx.1), base of Maxillae (Mx.2) and at the articulation of the maxillipeds.....18
17b Hairs at base of Maxillulae (Mx.1) only.....*S.atylae*
18a Trunk mostly naked, except for a few hairs around the genital area..... *S.leuckartii*
18b Trunk densely covered with scale-like modified hairs.....*S.vestita*

Key to Cumacean infesting female Sphaeronella of British waters.
(slightly modified from Hansen, 1897)

1a Maxillae (Mx.2) well developed.....2
1b Maxillae (mx.2) tiny vestigial remnants.....*S.marginata*
2a Conspicuous protuberance between bases of maxillipeds.....*S.decorata*
2b No such protuberance between maxillipeds.....3
3a Head with clear frontal and lateral borders.....*S.modesta*
3b Head not defined from trunk, no clear frontal or lateral borders.....4
4a Chitin ring of genital area open anteriorly.....*S.dispar*
4b Chitin ring of gential area complete.....*S.insignis*
4c *S.pygmaea*, Scott, 1904 – perhaps similar but insufficiently described.

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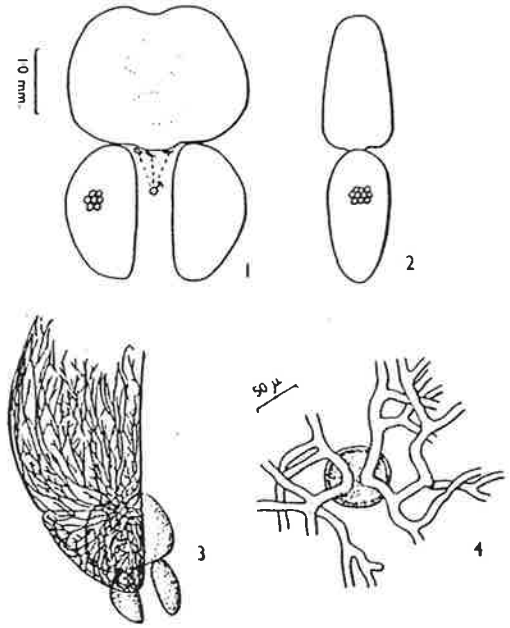
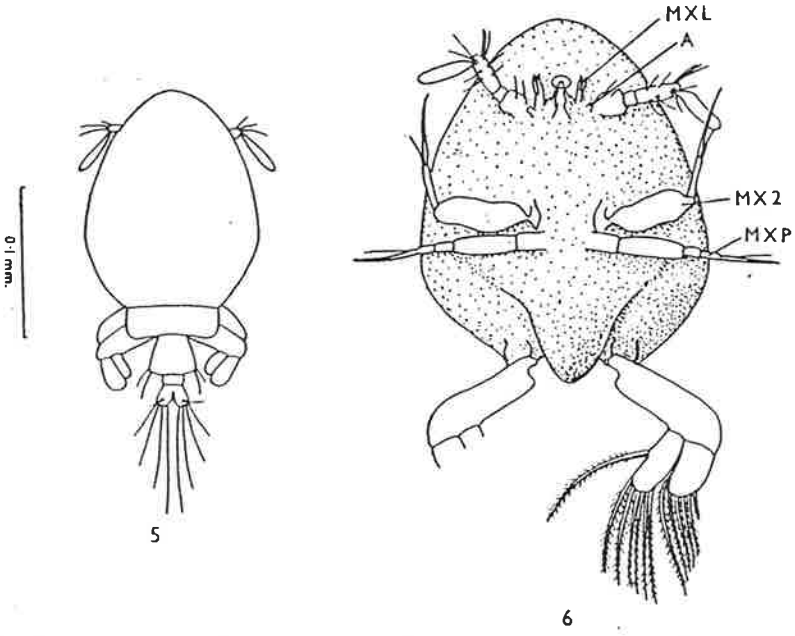
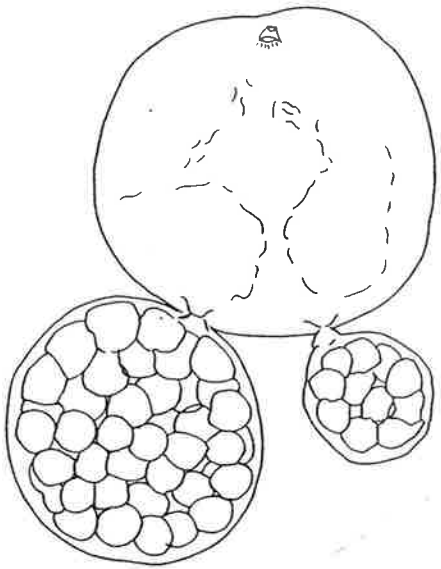
PLATE 1 Figures from GREEN(1959),GOTTO(1984),SCOTT(1904),HANSEN(1897)



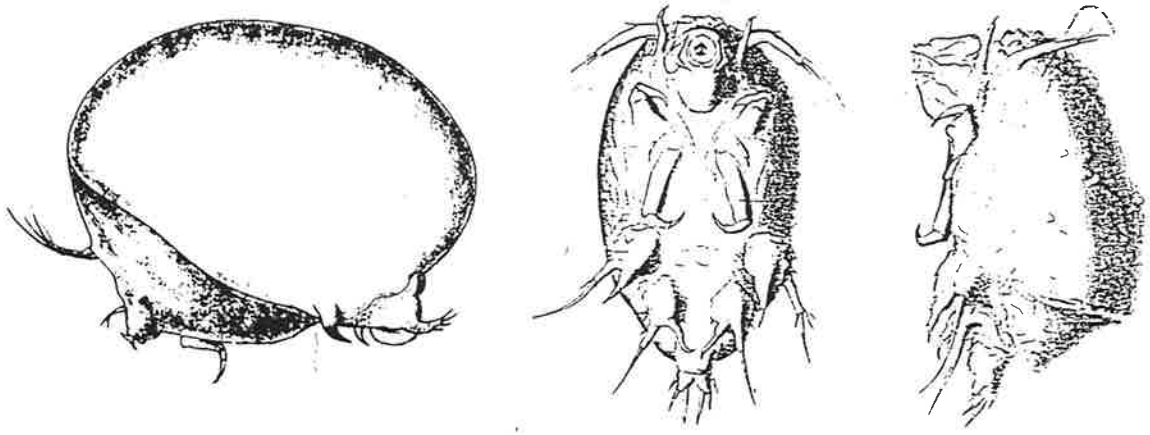
Figs. 1–4.—*Rhizorhina serolis*. 1, female, dorsal view. 2, female, lateral view. 3, pleopod of *Serolis bromleyana* with female attached, showing the extent of the rooting system from the mouth. 4, detail of the rooting system near the mouth.



Figs. 5–6.—*Rhizorhina serolis*. 5, male, dorsal view, the setae on the swimming legs have been omitted. 6, thorax and head of male, ventral view. A—antenna ; MXL—maxillule ; MX2—maxilla ; MXP—maxilliped.



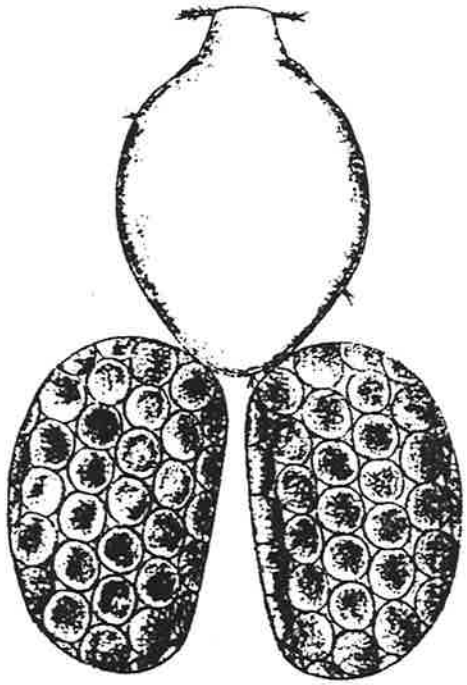
Female *Rhizorhina leptostracae* sp. nov., carrying two egg-sacs, ventral view.

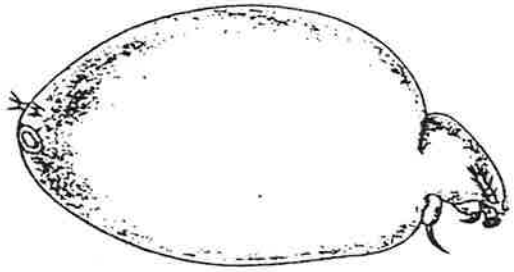


Stenothocheres egregius - female,left & male,centre and right.

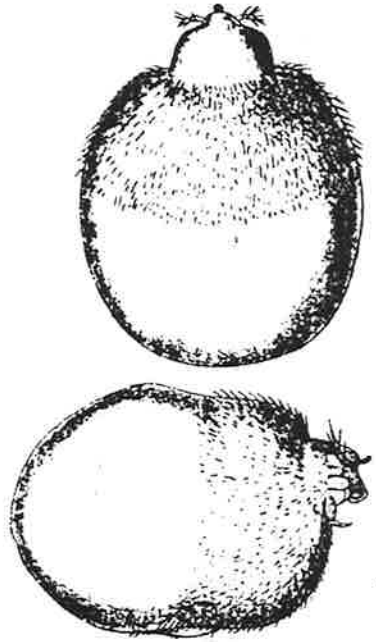
PLATE 2 Figures from SCOTT (1904 & 1905)

Sphaeronella minuta
Ovig. female from Perioculodes

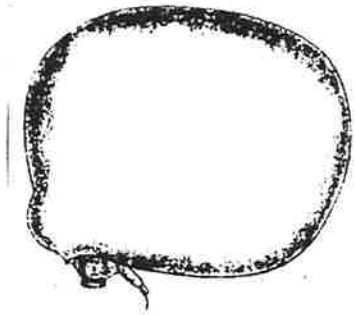




Sphaeronella vararensis
Ovig. female ,dorsal.
Female lateral.

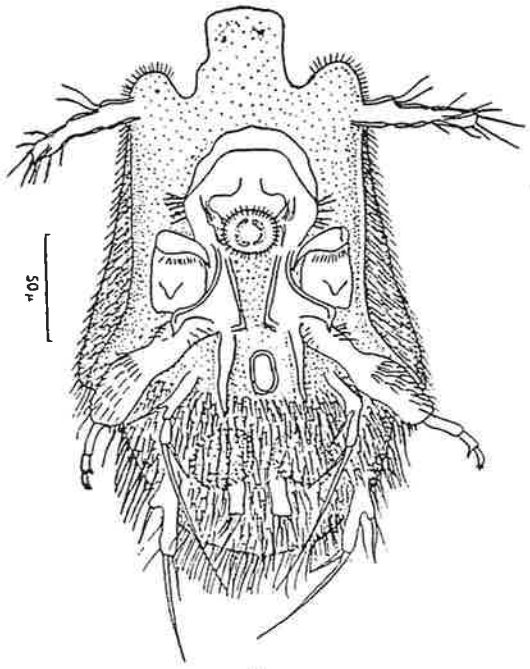


Sphaeronella callisomae



Sphaeronella cluthae

PLATE 3 Figures from GREEN(1958)



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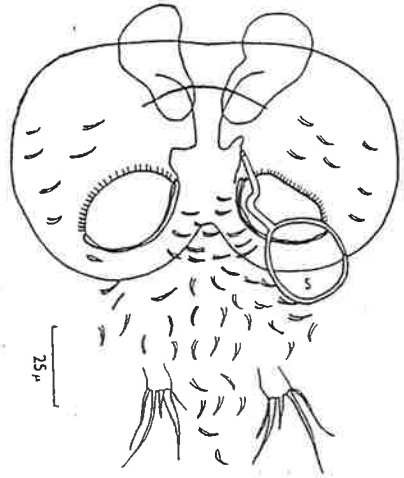

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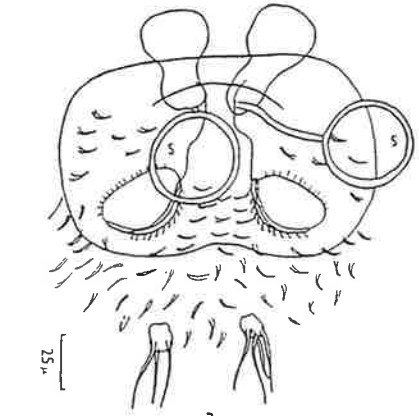
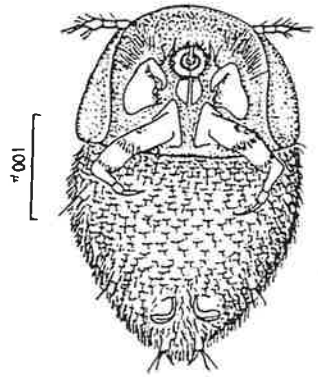


3

Figs. 1–3.—*Sphaeronella leuckarti*. 1, male, ventral view. 2, genital area of female from *Aora typica*. 3, genital area of female from *Cheirocratus sundevalli*. s–spermatophores.



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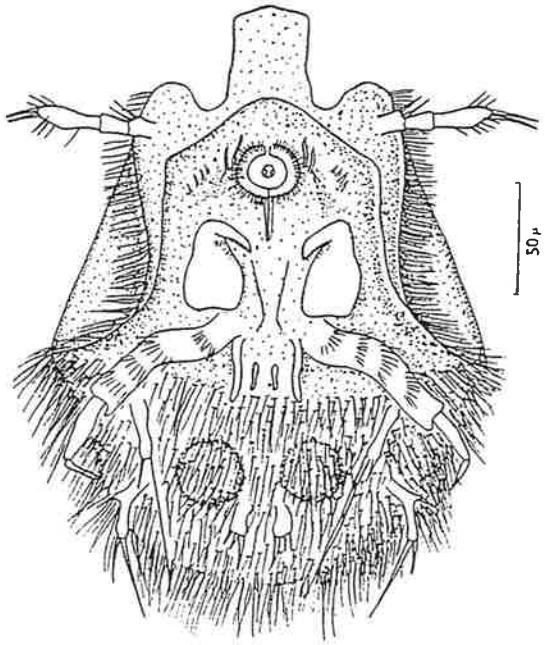

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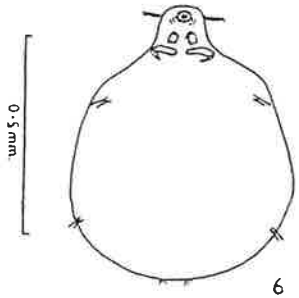

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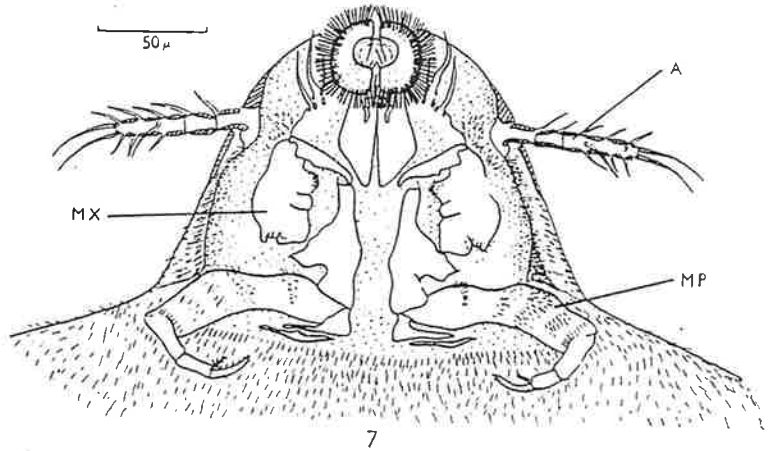
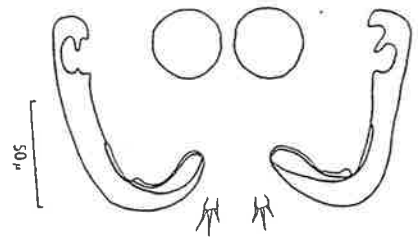


7

Figs. 4–7.—*Sphaeronella danica*.—4, young female, ventral view. 5, male, ventral view. 6, female, ventral view. 7, head of female, ventral view, A–antennule ; MX–maxilla ; MP–maxillipede.

PLATE 4 Figures from GREEN(1958)



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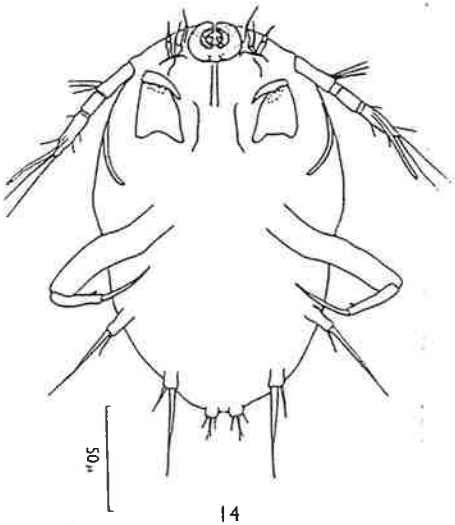

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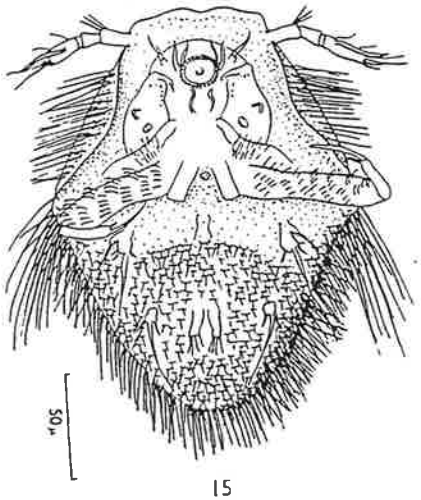
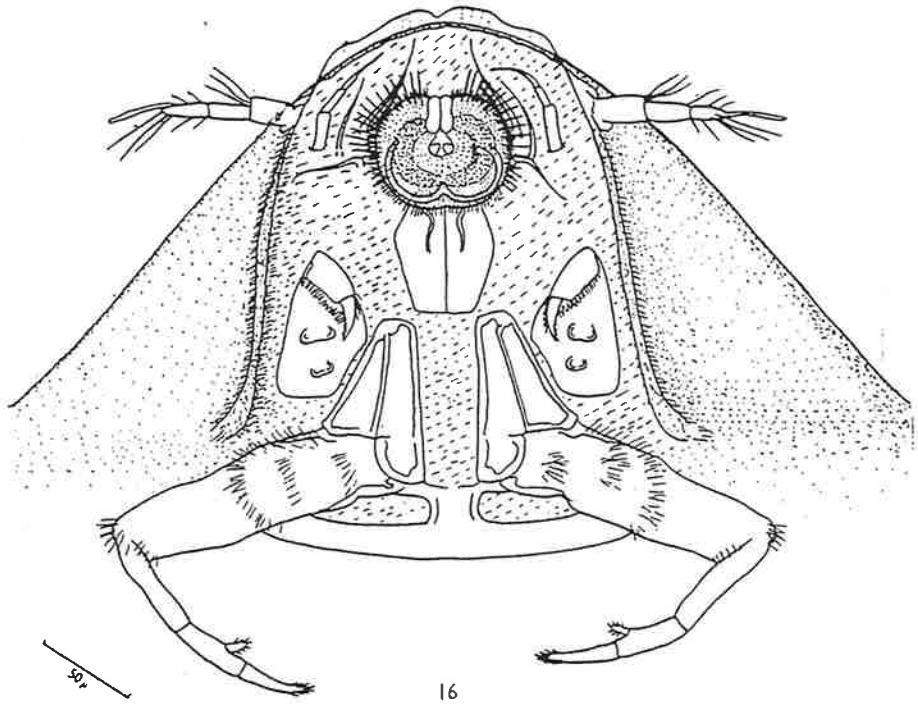


15

Figs. 13–15.—*Sphaeronella longipes*. 13, genital area of female. 14, very young female, ventral view. 15, male, ventral view.



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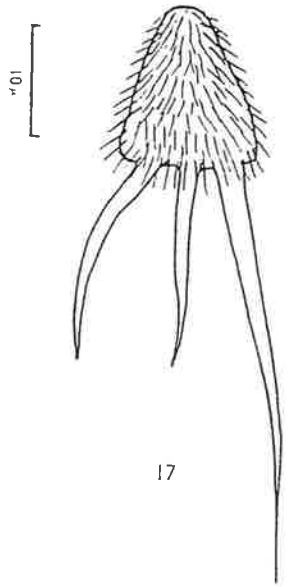

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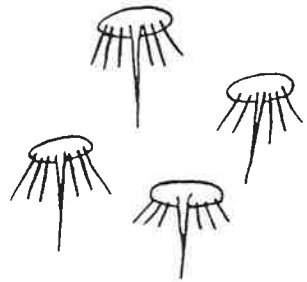
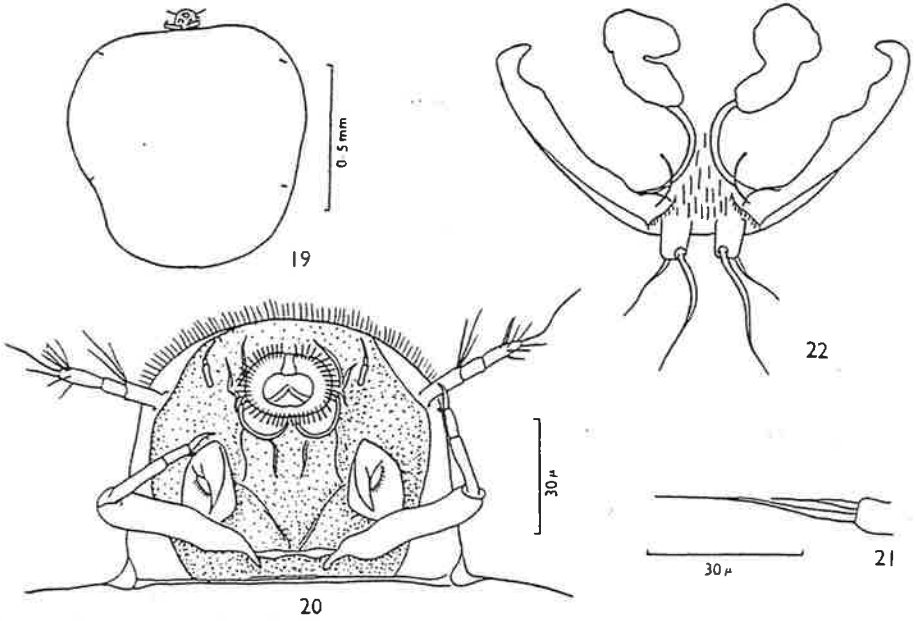


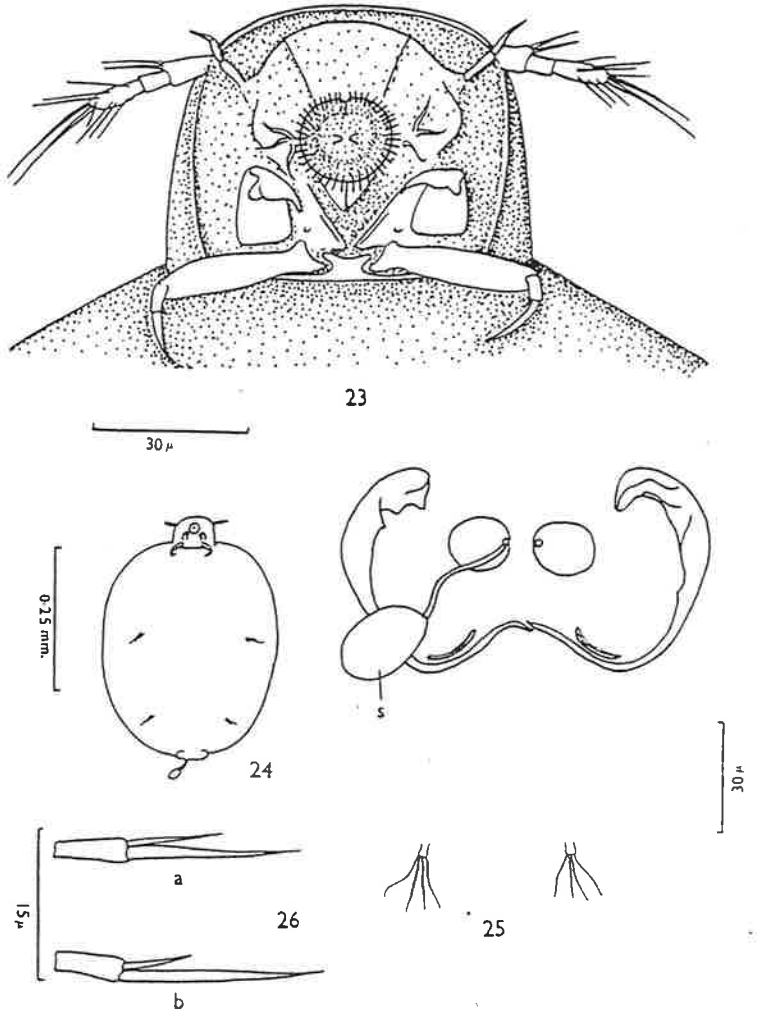
18

Figs. 16–18.—*Sphaeronella frontalis*. 16. head of a large female, ventral view, showing appearance when the frontal cup is reflected dorsally. 17, first trunk limb. 18, detail of body hairs of male.

PLATE 5 Figures from GREEN(1958)



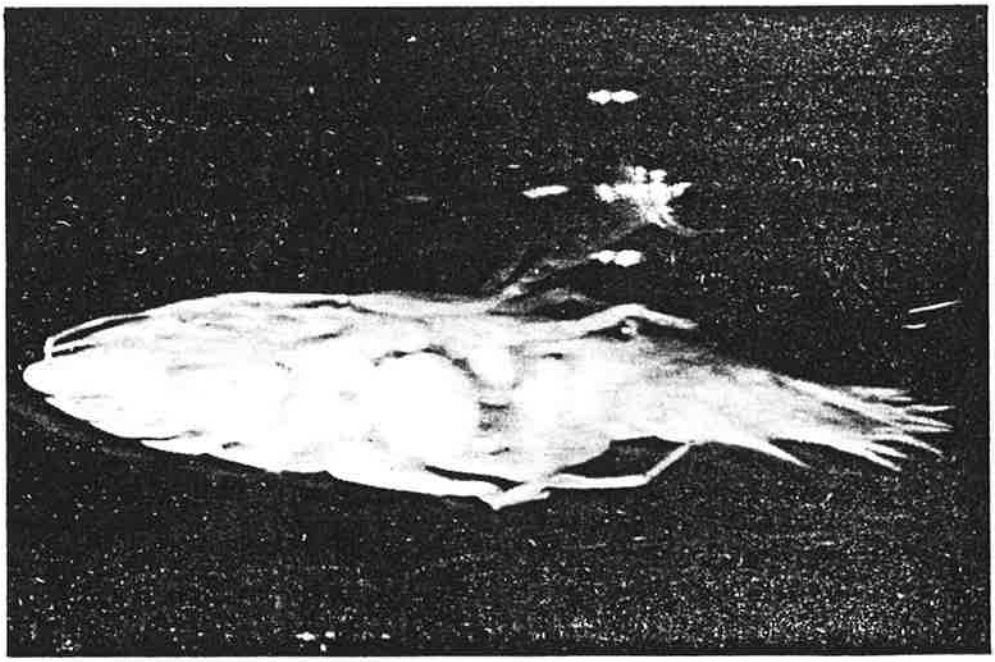
Figs. 19–22.—*Sphaeronella pikei* sp. n. 19, female, ventral view. 20, female, ventral view of head. 21, second trunk limb of female. 22, genital area of female.



Figs. 23–26.—*Sphaeronella valida*. 23, head of female, ventral view. 24, female, ventral view. 25, genital area and caudal rami of female ; s–spermatophore attached to entrance of spermatheca. 26, trunk limbs of female ; a–first, b–second.

PLATE 6 From GOTTO & McGRATH (1980)

(a) *Atylus swammerdami*, lateral view, with a female *Sphaeronella atyli* (large dark sphere) in the brood pouch. The smaller dark sphere is a deposited egg mass. Diameter of copepod approximately 1mm.



(b) *Ampelisca tenuicornis*, ventral view, with a female *Sphaeronella longipes* (large pale sphere) *in situ*. Diameter of copepod approximately 1mm.