

EPIZOIC AND ECTOPARASITIC PROTOZOANS FROM PLANKTONIC COPEPODS OF THE SOUTHWEST AND SOUTHEAST COASTS OF INDIA WITH THE DESCRIPTION OF A NEW SPECIES

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ABSTRACT

The epizoic and the ectoparasitic protozoans were studied from the planktonic copepods of the southwest and southeast coasts of India. The species of protozoans viz. *Trochiloides trivialis* Fenchel, *Zoothamnium adamsi* Stokes; *Ephelota gemmipara* Hertwig, *Acineta euchaeta* Sewell, *Acineta sajirae* sp. nov., *Paracineta pleuromammae* Steuer, *Paracineta gaetani* Sewell, *Hallezia scottocalani* Sewell, *Ellobiopsis chattoni* Caullery, *Ellobiopsis elongata* Steuer and a few cysts, are described with illustrations.

T. trivialis and *P. pleuromammae* are new records from the Indian Ocean. *E. gemmipara* as epizoic on copepods is recorded for the first time. *A. sajirae* is a new species belonging to the family Acinetidae.

The epizoids and the ectoparasites were found infesting the appendages and the body proper of different species of planktonic copepods collected from four sectors, off Tuticorin, off Cape Comorin, off Karwar and off Ratnagiri.

The nature of association, host, associate relationship and the rate of infestation are discussed.

INTRODUCTION

STUDIES on the epizoic and the ectoparasitic protozoans from copepods have been made by several authors (Canu, 1892; Sand, 1895, 1901; Caullery, 1910; Collin, 1911, 1912; With, 1915; Marshall *et al.*, 1934; Chatton and Lwoff, 1935; Steuer, 1932; Jepps, 1937, Boschma, 1948; Sewell, 1951; Wickstead, 1963; Santhakumari, 1985; Santhakumari and Saraswathy, 1979). Nevertheless very few studies are there about these forms from Indian Ocean (Sewell, 1951, Santhakumari, 1985; Santhakumari and Saraswathy, 1979).

The epizoids and the ectoparasites are important in the sense that they injure the host. The host, copepods are not only the major group both volumetrically and numerically, in most of the cases in Zooplankton, but also are economically important as they directly form the food of small fishes.

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MATERIAL AND METHODS

Zooplankton samples were collected with Bongo 60, made of nylon material of 0.5 mm mesh, width (60 cm ring diameter) with calibrated flowmeter, from sections off Tuticorin, off Cape Comorin, off Karwar and off Ratnagiri, southwest and east coasts of India. The samples were preserved in 4% formaldehyde solution in sea water. Copepods were examined under the microscope for associates and were separated for further study. The infected specimens were studied in detail. Drawings were made with the aid of camera lucida.

Details of collection, associate, host, place of attachment etc. are given in Table 1.

TABLE 1. Details of collection, host, associate, place of attachment, etc.

Sl. No.	Lat. N	Long. E	Date	Depth	Host	No.	Sex	Associates	No.	Place of attachment
16	14°29'	73°13'	17- 1-74	50	<i>Euchaeta marina</i>	1	Female	<i>Acineta euchaeta</i>	20	13 on caudal cirri, 3 on urosomal segments and 4 on the egg sac
38	7°53.5'	77°33'	15- 2-74	40	<i>Calanopia elliptica</i>	1	Male	<i>A. euchaeta</i>	4	2 on postero dorsal side of Cephalothorax, 2 on urosome
43	7°03.5'	77°33'	16 -2-74	125	<i>Euchaeta wolfendeni</i>	1	Male	<i>Paracheta gaetani</i>	5	Postero-dorsal side of dophalothorax
43	7°03.5'	77°33'	16- 2-74	125	<i>Rhin calanus sp.</i>	1	Female	<i>Hallezia scottocalani</i>	1	2nd antenna
43	7°03.5'	77°33'	16- 2-74	125	<i>E. wolfendeni</i>	1	Female	<i>P. gaetani</i>	2	on urosome
63	16°28'	71°56'	3- 3-74	150	<i>E. marina</i>	1	Female	<i>A. euchaeta</i>	5	2 on last leg, 2 on postero-dorsal side of cephalothorax, 1 on anal cirri
65	16°33.8'	72°10'	3- 3-74	150	<i>E. marina</i>	1	Female	<i>A. euchaeta</i>	16	5 on postero dorsal region of cephalothorax 11 on caudal cirri
67	16°45'	72°35'	4- 3-74	65	<i>E. wolfendeni</i>	1	Female	<i>Paracheta Pleuromannae</i>	4	postero dorsal region of cephalothorax
67	16°45'	72°35'	4- 3-74	65	<i>E. wolfendeni</i>	1	Female	<i>P. gaetani</i>	1	1 on caudal cirri
67	16°45'	72°35'	4- 3-74	65	<i>C. elliptica</i>	1	Female	<i>Acineta sajirae</i>	4	4 on urosome
109	80°36'	77°33'	3- 4-74	20	<i>Pontella investigoris</i>	1	Male	<i>Ephelota gemmipara</i>	5	1 on postero dorsal region of cephalothorax, 4 on urosome
181	7°12'	77°33'	25- 5-74	75	<i>Eucalanus Sp.</i>	1	Male	<i>A. euchaeta</i>	9	on urosome
184	8°38'	78°27'	27- 5-74	50	<i>C. elliptica</i>	1	Male	<i>A. euchaeta</i>	3	on urosome
186	8°10'	78°50'	27- 5-74	75	<i>Labidocira acuta</i>	1	Male	<i>P. gaetani</i>	8	on caudal cirri
209	14°33'	73°23'	12- 7-74	100	<i>L. acuta</i>	2	Female & Male	<i>A. sajirae</i>	4	on urosome
209	14°33'	73°23'	12- 7-74	100	<i>L. acuta</i>	1	Female & Male	<i>E. gemmipara</i>	2	on caudal cirri
211	14°26'	74°57'	14- 7-74	100	<i>E. marina</i>	1	Female	<i>P. gaetani</i>	2	on postero-dorsal side of urosome
211	14°26'	74°57'	14- 7-74	100	<i>E. marina</i>	1	Female	<i>A. sajirae</i>	5	on caudal cirri
213	12°26'	74°57'	14- 7-74	100	<i>L. acuta</i>	1	Female	<i>A. euchaeta</i>	2	on postero-dorsal side of cephalothorax
213	12°26'	74°57'	14- 7-74	100	<i>E. concinna</i>	1	Female	<i>A. euchaeta</i>	1	on postero-dorsal side of cephalothorax
233	8°24'	79°03.4'	11- 8-74	75	<i>E. marina</i>	1	Female	<i>P. pleuromannae</i>	1	on anterior end of the body
234	8°03'	77°33'	11- 8-74	15	<i>Centropages remicornis</i>	1	Female	<i>A. euchaeta</i>	8	3 on postero dorsal side of cephalothorax, 4 on urosome, 1 caudal cirri
239	7°13'	77°82.8'	11- 8-74	100	<i>L. minuta</i>	1	Female	<i>Ephelota gemmipara</i>	12	8 legs, 4 urosome

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245	16°48'	72°45'	19- 8-74	225	<i>E. wolfendeni</i>	2	Female	<i>A. euclhaeta</i>	4	3 on urosome, 1 caudal cirri
248	16°36'	92°16'	19- 8-74	85	<i>E. marina</i>	1	Female	<i>A. euclhaeta</i>	5	2 on postero dorsal side of cephalothorax, 3 on caudal cirri
256	14°37'	73°33'	22- 8-74	90	<i>E. marina</i>	1	Female	<i>A. sajiirae</i>	2	on caudal cirri
260	14°18'	72°45'	22- 8-74	100	<i>Undinula vulgaris</i>	1	Female	<i>Epilobopsis elongata</i>	3	on second antenna
314	38°09.6'	78°55.6'	15-10-74	110	<i>Candacea tuberculata</i>	1	Male	<i>Epilobota gemmipara</i>	10	8 on urosome, 2 on caudal cirri
317	16°55'	72°04'	1-11-74	30	<i>L. acuta</i>	1	Male	<i>E. gemmipara</i>	2	on postero-dorsal side of cephalothorax
324	16°31'	72°04'	3-11-74	25	<i>E. wolfendeni</i>	1	Female	<i>A. sajiirae</i>	5	on caudal cirri
331	14°33'	73°23'	3-11-74	95	<i>E. wolfendeni</i>	1	Female	<i>P. pleuromannae</i>	3	3 on postero-dorsal region of cephalothorax, 1 caudal cirri
363	7°53.5'	77°33'	19-11-74	40	<i>Eucalanus</i> sp.	1		<i>Zoothamnium adamsi</i>	1	one colony on the postero-dorsal region of cephalothorax
365	7°33.5'	77°33'	19-11-74	75	<i>Eucalanus</i> sp.	2	Female	<i>Z. adamsi</i>	1	one on mid dorsal region of cephalothorax
365	7°33.5'	77°33'	19-11-74	75	<i>Eucalanus</i> sp.	2	Female	<i>Z. adamsi</i>	1	one on postero-dorsal region of cephalothorax
365	7°33.5'	77°33'	19-11-74	75	<i>Eucalanus</i> sp.	2	Female	<i>Z. adamsi</i>	5	postero-dorsal region cephalothorax
365	7°33.5'	77°33'	19-11-74	75	<i>Eucalanus</i> sp.	2	Female	<i>Z. adamsi</i>	4	on urosome postero-dorsal region cephalothorax
365	7°33.5'	77°33'	19-11-74	75	<i>Eucalanus</i> sp.	2	Female	<i>Z. adamsi</i>	1	one postero-dorsal region cephalothorax
365	7°33.5'	77°33'	19-11-74	75	<i>Eucalanus</i> sp.	2	Female	<i>Z. adamsi</i>	1	one on last leg
367	7°13.5'	77°33'	19-11-74	120	<i>E. marina</i>	1	Female	<i>A. euclhaeta</i>	1	on postero-dorsal region of the cephalothorax
367	7°13.5'	77°33'	19-11-74	120	<i>Eucalanus</i> sp.	1	—	<i>Z. adamsi</i>	7	5 on cephalothorax
368	7°03.5'	77°38'	19-11-74	125	<i>Eucalanus</i> sp.	1	—	<i>Z. adamsi</i>	4	2 on urosome
368	7°03.5'	77°38'	19-11-74	125	<i>L. acuta</i>	1	Male	<i>Trichitoides Trivialis</i>	30	on the postero-dorsal region of cephalothorax
368	7°03.5'	77°38'	19-11-74	125	<i>L. acuta</i>	1	Male	<i>A. euclhaeta</i>	1	on the antero ventral side of cephalothorax
370	16°59'	74°13'	4-12-74	15	<i>E. marina</i>	1	Female	<i>Z. adamsi</i>	9	on the postero region cephalothorax
378	16°31'	72°04'	5-12-74	25	<i>E. marina</i>	1	Female	<i>A. sajiirae</i>	13	1 one colony on the urosome dorsal side of cephalothorax
391	14°18'	72°43'	8-12-74	100	<i>E. marina</i>	1	Female	<i>A. euclhaeta</i>	3	6 on urosome, 7 on caudal cirri

OBSERVATIONS

Class : Ciliata

Order : Holotricha

Family : Dysteriidae

Genus : *Trochiloides* Kahl***Trochiloides trivialis* Fenchel**

Body oblong; measures 45-60 μ by 30-40 μ ; two contractile vacuoles. Lateral edges of the animal are kept vertically and inwards, especially on the left side where the rim nearly reaches the middle of the animal. The macronucleus is situated in the left side of the body (Fig. 1).

This ciliate was noticed from the ventral side of *Eucalanus* sp. from off Cape Comorin.

30 specimens were found on the same host. It is a herbivore, feeding on algal remnants.

Fenchel (1965) described this species from *Gammarus* sp. from Scandinavian waters.

Order : Peritrichida

Family : Vorticellidae

Genus : *Zoothamnium* Bory***Zoothamnium adamsi* Stokes**

Primary stalk of colony varies in length from 150-175 μ . The mode of bifurcation appears to be dichotomous and each ultimate end bears a single zooid. The zooid is inverted bell-shaped and in preserved condition it is almost pyriform in outline and measures 40-60 μ in length.

In the largest colony the stalk appears to have undergone about five bifurcations and carries upto 14 individuals. Five colonies were noticed from a single host specimen. The zooids were all of the same size and no single zooids were seen.

This species was found on seven specimens of *Eucalanus* sp. The colonies were attached on the postero-dorsal side of cephalothorax and urosomal segments.

Steuer (1982) described a *Zoothamnium* sp. from *Pleuromamma gracilis* and Sewell (1951) from *Euchaeta marina*.

Class : Suctorina

Family : Ephelotidae

Genus : *Ephelota* Wright***Ephelota gemmipara* Hertwig**

Body almost cup-shaped with a diameter of 40-70 μ , stalk very long transparent and measures 400-1300 μ in length. It is transparent and the proximal end attached to host by means of disc. Tentacles arise from the projections of the tip of the cup as shown in Fig. 3. The protoplasm is finely granular.

This species infesting copepods, is recorded for the first time from the Indian Ocean. Nevertheless, Santhakumari (1985) observed this species epizotic on crab larvae from Arabian Sea.

During the present study *E. gemmipara* was observed from copepods, *Pontella investigoris*, *Euchaeta marina*, *Candacia tuberculata*, *Labidocera acuta*, *L. minima* and *Undinula vulgaris*. This suctorian was found infesting chiefly the postero-dorsal region of cephalothorax (Pl. I A). A maximum of 12 specimens were observed from a single host.

In certain cases only the stalks were found on the host. The zooid portion might have nipped off from the stalk (Pl. I A).

Even though large number of specimens were examined, only six species of copepods were noticed infected by this species. The hosts were collected from off Tuticorin, off Cape Comorin, off Karwar and off Ratnagiri.

Steuer (1932) recorded this species from end of stalk little constructed, striated portion *Pleuromamma borealis* and *P. gracilis* from expanding into a basal plate. At the distal Labrador stream.

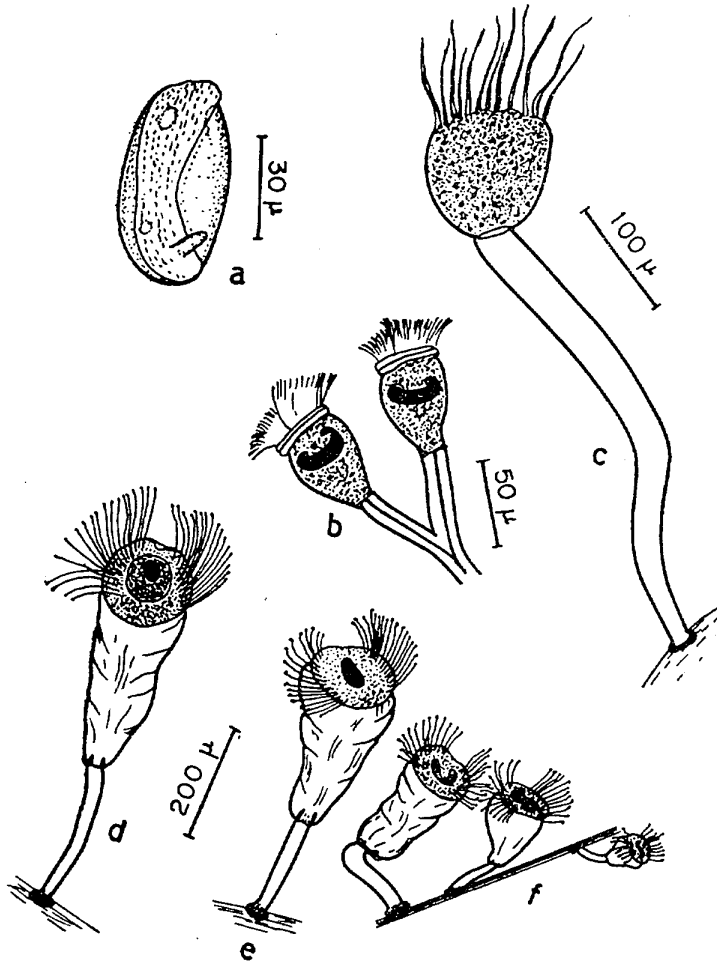


Fig. 1. a. *Trochilodes trivialis* from *Eucalanus* sp., b. *Zoothaminiium adamsi*, part of the colony shown, c. *Ephelota gemnipara* showing body structure, d, e and f. *Acineta euchaeta* showing body structure of different stages.

Family : Acinetidae

Genus : *Acineta* Ehrenberg, emend, Collin

Acineta euchaeta Sewell (Fig. 1 d-f)

In fully matured *A. euchaeta*, stalk measures about 225 μ in length by 25 μ in width, proximal

end of which is folded back over the end of stalk like a cuff. Theca delicate and wrinkled, theca ranges from 275 to 300 μ . The animal (body) measures 150 μ in diameter, tentacles numerous in the fully matured animal arranged in two fasciculi. Protoplasm finely granular (Fig. 1 d).

Inside body there is an oval mass, the embryo. An oval shaped nucleus inside the embryo. A distal margin of body, is a notch that represents birth pore, through which embryo passes out from parent. In this stage nucleus of parent not visible.

In young specimen, stalk measures 100 μ to 125 μ in length, body measures 80 μ in diameter. At this stage nucleus is spiral. Number of tentacles vary from 65 to 70 in each fasciculus. In further developed specimens nucleus oval and the protoplasm granular. In young specimens theca not so wrinkled as that of the matured specimens (Fig. 1 c, f).

A. euchaeta specimens of the present study are little bigger than that of Sewell's. The stalk of the matured specimen of Sewell varied from 210 to 250 μ . The body measured upto 125 μ in diameter. Except for the small size all the characters are similar. He observed it from *Euchaeta marina* and *E. wolfendeni*.

During the present study the *A. euchaeta* was observed from *E. marina*, *E. wolfendeni*, *Calanopia elliptica*, *Labidocera acuta* Eucalarnus sp. and *Acineta sajirae* sp. nov.

Body is elongated cup-shaped with extensions of two arms as shown in Fig. 2 a-c, arms equal in height. Body measures upto 58 μ in diameter. Tentacles arranged in two fasciculi at end of each arm. Number of tentacles vary from 8 to 10 in each arm. Each tentacle ends in knob. Protoplasm finely granular, intermingled with coarser granules. Body is straw coloured. Shape of macro-nucleus vary from oval to globular.

Stalk visible in all specimen even in very small individuals, transparent and measures from 30 to 75 μ in length, proximal end of stalk constricted and ends in a basal disc with which animal attaches to host.

Inside body of the developed, mature specimen, embryos could be seen, embedded in a cover as seen in Fig. 2a.

Several specimens of *A. sajirae* were observed from the caudal cirri and the urosome (Pl. I B, II A). Upto 13 specimens were noticed from a single host.

This species shows some resemblance to *A. tuberosa* Ehrenberg in shape of the body. But the presence of two well developed arms is a marked difference. More over the present specimen is larger in size than *A. tuberosa*. This species was observed from *Labidocera acuta*, *Euchaeta marina*, *E. wolfendeni* and *Calanopia elliptica*. Type specimens on copepod host were deposited in the reference collection of the Indian Ocean Biological Centre with the Catalogue numbers 10 BC 0393-02-15-1986.

Family : Podophryidae

Genus : *Paracineta* Collin

Paracineta pleuromamma Steuer (Fig. 2 d, e)

Body somewhat rounded and measures 30-45 μ in diameter. Protoplasm granular with rounded structures. An outer membranous cover which varies from 50-110 μ in length. Stalk is always smaller than outer cover. Tentacles arise from plasma conc. Macronucleus rounded.

Steuer (1932) described this species from *Pleuromamma xiphias*, *P. abnormalis*, *P. gracilis* and *P. borealis*. All of them were from the area of Bengula current.

The present finding is a new record from the Arabian Sea and also from the hosts *Euchaeta marina* and *E. wolfendeni*.

Paracineta gaetani Sewell (Fig. 2f, g)

Body usually spherical having a diameter of 30-42 μ . Protoplasm of the body frequently includes a number of refractile particles as well as coarse granules. Macronucleus rounded or oval. Tentacles in some cases are as long or longer than diameter of body and



PLATE I. A. *Ephelota gemmipara* on the cephalothorax, stalks without zooid can be seen and B. *Acineta sajira* sp. nov. attached on caudal cirri of copepods.



PLATE I. A. *Ephelota gemmipara* on the cephalothorax, stalks without zooid can be seen and B. *Acineta sajira* sp. nov. attached on caudal cirri of copepods.

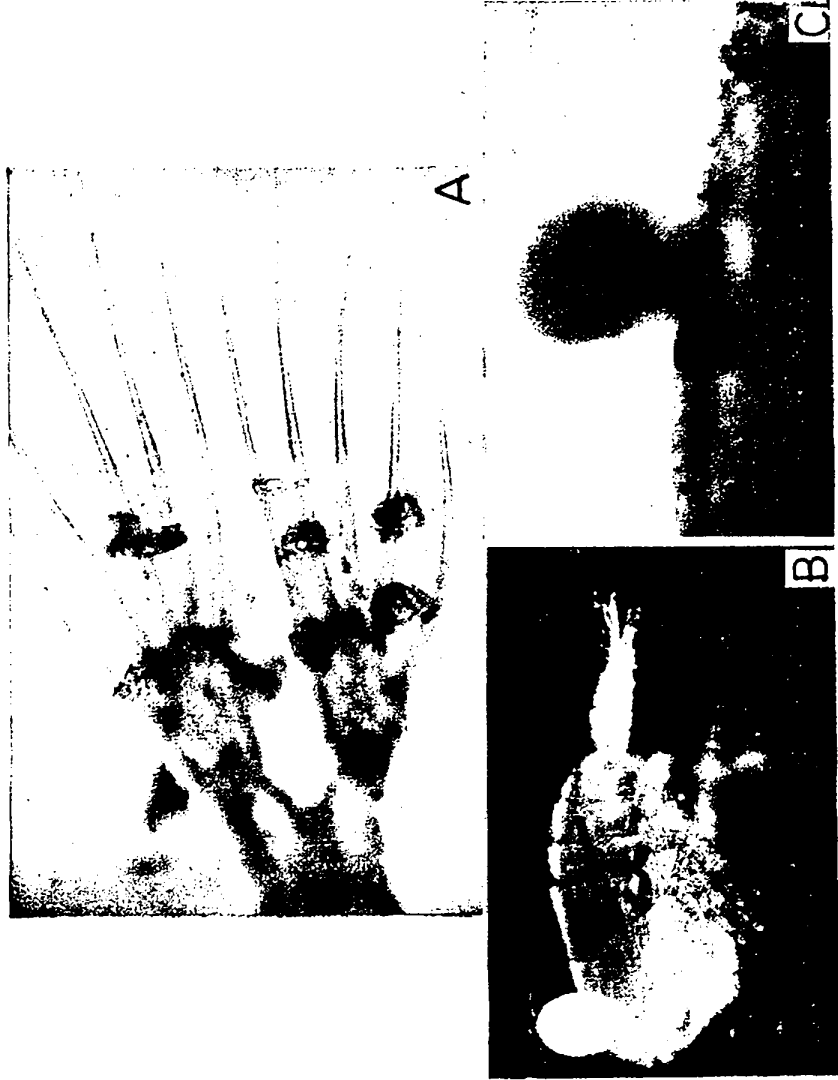


PLATE II. A. *Acinetia sajinae* sp. nov., attached on caudal cirri of copepod. B. *Elkibiopsis chuttoni* on the antenna of copepod and C. A cyst on the body of a copepod.

arranged on one side only. Each tentacle appears to be minute knob.

Cover of the cup very delicate and in most specimens smooth. But in some cases irregu-

P. gaetani is observed from the urosome of *Euchaeta wolfendeni*, *E. marina* and *Labidocera acuta*.

Sewell (1951) described this species from the

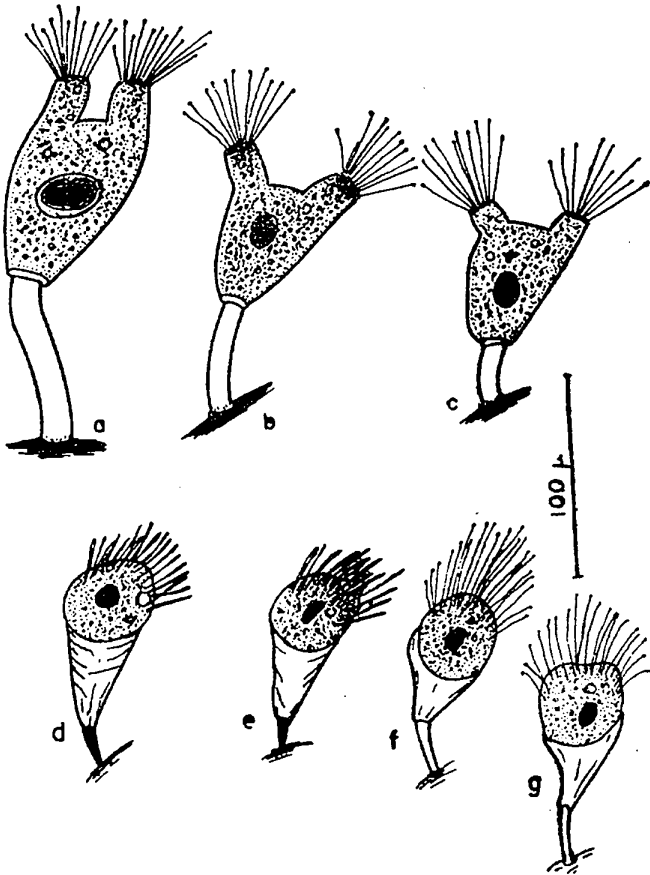


Fig. 2. a, b & c. *Acineta sajirae* n. sp. showing different stages; d, e. *Paracineta pleuromammiae* two stages f and g. *Paracineta gaetani*, two stages.

larly crenulated on sides. Length of cup measures about 38μ , length of stalk varied from 23μ to 30μ , stalk attached by a basal plate.

anterior appendages of *Gaetanus antarcticus* and on the posterior thoracic margin of *G. curvicornis*.

Genus : *Hallezia* Sand

Hallezia scottocalani Sewell (Fig. 3 a, b)

Body pyriform, body diameter $31\ \mu$ in antero-posterior axis and 25 in transeverse. Macronucleus oval. Tentacles arranged in two fasciculi on almost opposite sides of body and 14-18 in each fasciculus. Protoplasm granular with coarse particles. In stalk also protoplasmic granules found as that of body.

At distal end of body there a slight notch and probably through this pore embryo may escape.

Staked specimens of *H. scottocalani* were noticed on the second antenna of the female of *Rhincalanus* sp.

Sewell described several stages including very small without having a stalk.

Class : Flagellata

Family : Ellobiopsidae

Genus : *Ellobiopsis* Caullery

Ellobiopsis chattoni Caullery (Pl. II B)

E. chattoni is an ectoparasite living on appendages of Copepods. Body pyriform in shape and largest specimen measures $700\ \mu$ in length and $350\ \mu$ in diameter. It absorbs nourishment from host through 'root'. This species was described in detail by Santhakumari and Saraswathy (1979).

The species was observed in large numbers from copepods *Undinula vulgaris*, *Euchaeta marina* and *Cosmocalanus darwini*.

Ellobiopsis elongata Steuer (Fig. 36)

Body elongate and cylindrical, measuring $196\ \mu$ in length by $79\ \mu$ in breadth. Pellicle clearly wrinkled transverse in its distal two-thirds. Stalk $155\ \mu$ in length.

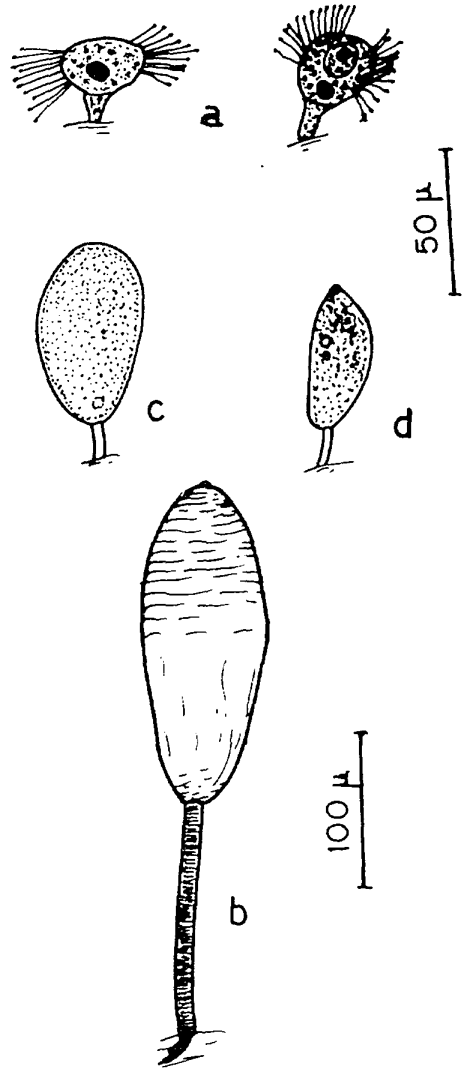


Fig. 3. a. *Hallezia scottocalani*, two stages ; b. *Ellobiopsis elongata* showing structure, c. Cyst from *Undinula vulgaris* and d. Cyst from *Rhincalanus* sp.

E. elongata is smaller than *E. chattoni*. This parasite also absorbs nourishment from the host.

It was noticed from the second antenna of *Undinula vulgaris*.

Cysts

A number of copepods were recorded with cysts on their appendages (With, 1915; Steuer 1932; Chatton and Lwoff, 1935; Sewell, 1951).

During the present study a few cysts were observed from *Euchaeta marina*, *Undinula vulgaris* and *Rhincalanus* sp.

Cyst No. 1

Globular cysts were noticed from the dorsal side of Cephalothorax of *E. marina* (Pl. II C). Cyst wall thick and protoplasm granular and dense. Body measures 105 μ in diameter.

Cyst No. 2 (Fig. 3C)

Cyst wall very thin delicate and completely filled by body of cell. Cell protoplasm finely granular. Stalk stout and not too long. Body measures 65 μ in length and stalk not too long. Body measures 65 μ in length and 38 μ in breadth and stalk 10 μ long. It is found from *U. vulgaris*.

Cyst No. 3 (Fig. 3d)

Body of cyst an elongate oval; protoplasm finely granular and vacuolated. A number of

refractile granules in protoplasm. It measures 46 μ in length and 23 μ in width. Stalk of moderate length, 14 μ . It was found attached on *Rhincalanus* sp.

It could be seen from the Table that *Euchaeta marina* and *E. wolfendeni* were infected by more number of associates. Perhaps it may be due to the presence of their long cirri and other appendages which facilitate the easy attachment of these associates.

Acineta euchaeta rank first among epizoids in infesting more number of hosts and also in rate of infestation. *E. gemmipara* comes next to *A. euchaeta*.

E. chattoni stands first in the case of number of specimens.

Deterioration of exoskeleton due to overcrowding of associates might serve as portals for other harmful organisms such as bacteria and fungi capable of causing serious shell diseases as has been observed by Rosen (1970). In the case of ectoparasitic forms like *E. chattoni* and *E. elongata* their 'roots' not only penetrate into the appendages of the host serving as an organ of attachment, but also as an organ of absorption and hence the harmful effects are much more than that of an epibiont.

REFERENCES

- BOSCHMA, H. 1948. Sur les organelles d'absorption chez une espèce d'*Amalocystis* (Protozoa, Ellobiopsidae), *Proc. Kon. Neder. Akad. Wetensch. Amsterdam*, 51: 446-449.
- CANU, E. 1892. *Les Copepodes du Boulonnaise* Lille.
- CAULLERY, M. 1910. *Ellobiopsis chattoni* n.g., n. sp. parasite de *Calanus helgolandicus* Claus, appartenant probablement aux Peridinicus. *Bull. Sci. France Belg.*, 44: 201-214.
- CHATTON, E. AND A. LWOFF 1935. Prostitologica L. Les Cilies. Apostomes. *Arch. Zool. Exp. et Gen.* 77.
- COLLIN, B. 1911. Etude monographique Sur les Acinetiens. *Arch. Zool. Exp. et Gen.*, (5): B.
- 1912. Etude monographique sur les Acinetiens. *Arch. Zool. Exp. et Gen.*, 51: 1-457.
- JEPPS, M. W. 1937. On the protozoan parasites of *Calanus finmarchicus* in the Clyde Sea area. *Q. J. Micr. Soc.*, 79: 589-658.
- MARSHALL, S. M., A. G. NICHOLLS AND A. P. ORR 1934. On the biology of *Calanus finmarchicus* V. Seasonal distribution, size, weight and chemical composition in Loch Striven in 1933, and their relationship to the phytoplankton. *J. mar. Biol. Ass. U.K.* (new series), 19: 793-828.

- SAND, R. 1895. Les Acinetins. *Ann. Soc. Belg. Micr.*, 19.
- SAND, R. 1901. Etude Monographique sue le Groupe des Infusoires tentaculiferes. *Ann. Soc. Belg. Micr.*, 24, 25 and 26.
- SANTHAKUMARI, V. 1986. Epizoic and ectoparasitic protozoans from crab larvae. *Mahasagar-Bull. nat. Inst. Oceanogr.*, 19 : 65-67.
- SANTHAKUMARI, V. AND M. SARASWATHY 1979. On the Ellobiopsidae, Parasitic Protozoa, from Zooplankton. *Mahasagar. Bull. nat. Inst. Oceanogr.*, 12 : 83-92.
- SEWELL, S. 1951. Epibionts and parasites of the planktonic copepoda of the Arabian Sea. *John Murray Exp. Re.*, 9 : 225-294.
- STEUER, A. 1932. Copepoda 6. *Pleuromamma* Giesbr. 1898. der Deutschen Tiefsee Exp. *Valdivia*, 1898-1899, 24 : 1-119.
- WICKSTEAD, J. H. 1963. A new record of *Ellobiopsis Chattoni* (Flagellate incertae sedis) and its incidence in a population of *Undinula vulgaris* var Major (Crustacea, Copepoda). *Coll. Repr. Internat. Indian Ocean Exp.*, 3 : 236-296.
- WITH, C. 1915. *Copepoda*. The Danish Ingolf-Exp. III.