PART I

SYSTEMATICS
A SYSTEMATIC ACCOUNT OF THE OLIGochaetes OF SOUTHERN KERALA

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INTRODUCTION

Stephenson (1930) defined oligochaetes as "worms with internal segmentation and a usually corresponding external annulation; possessing setae, usually segmentally arranged throughout the greater part of the body, but not situated on parapodia; hermaphrodite, the male and female gonads being few in number (one or two pairs) situated in the anterior part of the body the male anterior to the female, the genital products discharged by special ducts, a clitellum present at sexual maturity, the eggs deposited in a cocoon, without a free larval stage in development".

Oligochaetes have a wide distribution from sandy to muddy substratum in streams, rivers and ponds. A reasonable number of oligochaetes are found in estuaries and on sea shore and some are even found beyond the continental shelf (Brinkhurst and Jamieson, 1971; Cook, 1971a). Recent studies by Brinkhurst (1972) suggested that competition is avoided by selective digestion of the bacteria within the sediment which leads to a degree of collaboration as the faeces of one species of worm become the preferred food of another species and this leads to the very close clumping of individuals.

Studies on the systematic part of this group have recently acquired momentum owing to the growing interest in
biological methods of detecting and assessing water pollution and this resulted during the last three decades in a wide array of publications from all over the world and hence the taxonomy of this group is now in a well advanced state. Geographical distribution of several species has also been studied by various authors and these publications are provided with regional keys also.

A review of early literature shows that the studies of these interesting group of animals started from the early part of the 19th century. Early pioneers in this field are Gruithuisen (1823, 1828), Blainville (1825, 1828), Baer (1827), Gervais (1838), Gould (1841), Gay (1849), Grube (1851), Houghton (1860), Claparede (1862, 1863), Eisen (1878, 1879, 1886, 1900), Calus (1880), Levinsen (1884), Vejdovsky (1884), Bousfield (1886a, b, 1887), Horst (1889, 1891a,b, 1892), Forbes (1890a,b), Garbini (1895, 1898), Friend (1896, 1897a,b,c, 1898a,b, 1911, 1912a,b,c,d, 1913), Ferronnière (1899) and Galloway (1899, 1911).

Inspite of the wide array of publications, the three most outstanding contributions in this field during the period are Vejdovsky's System und Morphologie der Oligochaetaen (1884) which is an account of his own observations, Beddard's 'Monograph of the Order Oligochaeta' (1895) and Michaelsen's 'Oligochaeta' (1900) in the series Das Tierreich (Berlin). Beddard (op. cit.) has not dealt with embryology, ecology and regeneration and his
scheme of classification has been largely superseded. Michaelson (op. cit.) made a systematic survey consisting only of family, generic and specific diagnosis with localities. Michaelson recognised thirty one families. This increase in number was mainly due to the advancement of subfamilies of Megascolecididae and Glossoscolecididae to family rank.

The first major review of the Oligochaeta during the present century was produced by Stephenson (1930), but here the taxonomic section is very small dealing only up to the generic level. The second major review dealing with all of the families and subfamilies that are completely aquatic was undertaken by Brinkhurst and Jamieson (1971).

A great volume of information has been published during the last three decades. Pollution of our environment has made us aware of the need to study the intricate mechanism determining the distribution and abundance of animals, which in turn naturally leads to the imperative need to identify species with accuracy. Aquatic oligochaetes, particularly the tubificids become an all too obvious feature of organically polluted waters as this group of animals is clearly one which proves useful to biologists in surveying inland and estuarine waters for signs of pollution of various types.
The taxonomy of the tubificids was almost chaotic till the publication of workable keys by Brinkhurst (1963a, 1965a) and Brinkhurst et al. (1968). Studies on the family Tubificidae were made by Brinkhurst (1960, 1962b,c, 1963a, 1964b, 1965a, 1966c,d, 1970, 1979a,b), Loden (1977) and Holmquist (1978). Studies on the components of the bottom fauna of the St. Lawrence Great Lakes have been made by Brinkhurst et al. (1968) and Cook and Hiltunen (1975). The aquatic oligochaetes of Australia, New Zealand, Tasmania and the adjacent islands were studied by Brinkhurst in 1971, and in 1976 (unpublished manuscript) he listed the aquatic Oligochaeta recorded from Canada and the St. Lawrence Great Lakes.

Our information regarding the distribution of marine oligochaetes is of comparatively recent origin. "The recognition of Oligochaeta, mainly Tubificidae as regular components of the marine benthic community, has occurred only with the last decade" (Cook, 1974). The study of Brinkhurst in 1963d on the brackish water and marine species of Tubificidae and those of Hrade in the year 1966, 1967, 1971b and c have demonstrated the distribution of a number of marine tubificids including the deep sea forms. Cook (1969a,b) studied the tubificid population of Cape Cod Bay and north-west Atlantic respectively. The marine tubificids of Cape Cod Bay was studied by the same author in
1971\textsuperscript{a} and in 1974 reported five new species of Tubificidae from the Bahia De San Quintin, Baja California. Brinkhurst and Baker (1979) reviewed the distribution of marine tubificids in North America and listed a total of thirty nine species from this area.

The existence of a diverse oligochaete fauna, especially Lumbriculidae in the Subterranean waters of Europe was well documented by Hrabe, 1932, 1937b, 1958b, 1960, 1963a, Michaelson, 1933c and Cernosvitov, 1939a. Cook (1975) reported \textit{Trichodrilus allegheniensis} a new species from Round Mountain Cave, Tennessee.

Cave dwelling aquatic oligochaetes from the eastern United States have been studied by Cook in 1975. Ten taxa of aquatic Oligochaeta have been identified from eight Appalachian caves, including one new genus and three new species of Haplotaxidae.


In India, studies on oligochaetes have been comparatively few and our knowledge of this particular group from the tropics is chiefly taxonomical and even this area has been quite neglected. In 1909b and 1910 Michaelsen listed almost all of the Indian species of *Pheretima* as pregerine or of doubtful status. "Systematic collection and study of earthworms have been carried out hitherto only in the Punjab, and in Travancore" (Aiyer, 1929a). "We are still far from a complete acquaintance with the distribution of Indian earthworms, and ... any conclusion based on the absence of any forms from this or that region is liable to be upset at any time (Stephenson, 1915c). Stephenson in 1907b described two freshwater oligochaetes from the Punjab and in 1909 dealt with the anatomy of some aquatic oligochaetes of the Punjab and in 1911 made some further contributions. Other studies on Indian oligochaetes were made by Stephenson in 1912a,b, 1914, 1920, 1921, 1922a,b,c, 1925a,b and 1926a,b. Recently Rao and Ganapati (1968) recorded eight species of oligochaetes from the Andhra coast.

The earliest account of oligochaetes from Kerala comprising the Travancore region was by Fedarb (1898) and the
recent important papers to appear from South India being those of Naidu (1962a,b,c, 1963, 1965b). Up to 1929, forty-nine species of terrestrial oligochaetes have been recorded from India (Aiyer, 1929a) and till 1958 the acolosomatids and naidids known from the Indian sub-continent were twenty-seven and thirty-six species respectively (Naidu, 1963). Record of eighteen new species by Aiyer (1929a) from the Southern region (including seven new species and eleven new records from the Southern region, inclusive of two new records from the Indian sub-continent) has established forty-five species for the region and fifty-four species for the sub-continent.

Only scanty informations are available regarding the oligochaete fauna inhabiting the brackish waters of India. "The Oligochaeta of the brackish water are few and do not form independent ethological group" (Stephenson, 1915d). Oligochaetes inhabiting the Chilka lake have been reported by Stephenson (1915d, 1923). Panikkar and Aiyer (1937) recorded one species from the brackish regions of Madras. Azis (1976) reported a few oligochaetes from the Edava-Nadayara and Paravur backwaters (South India), the former comprising the retting zone and the latter representing a typical non-retting zone and according to him "oligochaete population of the benthic community constitutes an important meiofaunal component at the two stations". Bearing these facts in mind, a survey of the aquatic oligochaetes inhabiting various regions of the southern part of Kerala was undertaken during the present investigation.
LIST OF SPECIES DESCRIBED

Order Haplotaxida
Suborder Tubificina
Superfamily Tubificoidea
Family Naididae
Genus Dero Oken, 1815
Subgenus Aulophorus Schmarda, 1861
  1. Aulophorus carteri Stephenson, 1931
  2. Aulophorus tonkinensis (Vejdovsky, 1894)
  3. Aulophorus furcatus (Müller, 1773)

Subgenus Dero Oken, 1815
  4. Dero dorsalis Ferronière, 1899
  5. Dero nivea Aiyer, 1929
  6. Dero zeylanica Stephenson, 1913
  7. Dero digitata (Müller, 1773)

Genus Brachiodrilus Michaelson, 1900
  8. Brachiodrilus semperi (Bourne, 1890)
  9. Brachiodrilus hortensis (Stephenson, 1910)

Genus Pristina Ehrenberg, 1828
  10. Pristina proboscidea Beddard, 1896
  11. Pristina longiseta longiseta Ehrenberg, 1828

Genus Stephensoniana (Cernosvitov, 1938)
  12. Stephensoniana trivandrana (Aiyer, 1926)

Genus Stylaria Lamarek, 1816
  13. Stylaria fossularis Leidy, 1852
Genus Nais Müller, 1773

14. Nais communis Pignut, 1908

Family Tubificidae

Subfamily Tubificinae Eisen, 1879

Genus Limnodrilus Claparède, 1862

15. Limnodrilus hoffmeisteri Claparède

Genus Tubifex Lamarck, 1816

16. Tubifex tubifex (blanchardi form)

17. Tubifex tubifex (bergi form)

Suborder Lumbricina

Super family Lumbricoidea

Family Glossoscolecidae

Subfamily Alminae Duboscq, 1902

Tribe Almini Nov.

Genus Glyphidrilus Horst, 1889

18. Glyphidrilus annandalei Michaelson, 1910
TAXONOMIC DESCRIPTIONS

Order Haplotaxida
Suborder Tubificina
Superfamily Tubificoidea
Family Naididae
Genus Dero OKEN, 1815

No eyes. Dorsal setae from IV, V or VI onwards, hairs and double-pronged, pectinate or palmate needles; ventral setae of II–V usually of a shape different from those of the rest, with upper tooth longer than lower, and equally thick, compared with equally long or shorter, and thinner, in the latter. Pharynx in II–IV, with pharyngeal glands; often septal glands; stomachal dilatation slow, beginning in VIII, IX or X or inconspicuous. Anus opening into a ciliated branchial fossa, usually containing gills; angles of posterior border of the fossa in one subgenus projecting as palps. A pharyngeal vascular plexus; contractile transverse vessels in a number of segments from VI onwards, dorsal vessel situated ventrally to the left, blood reddish. Coelomocytes present or absent. Nephridia often invested with bladder-like peritoneal cells. Clitellum absent between male pores; vasa deferentia joining atria anteriorly or on top; usually no prostate gland cells; ejaculatory duct surrounded by gland cells; penial setae present or absent. Asexual reproduction by budding or fragmentation. Usually living in tubes of secreted mucus and foreign matter. Cosmopolitan.
Subgenus *Aulophorus* SCHMARDA, 1861

Dorsal setae present from IV, V or VI onwards; ventral setae of II-V different or not different in shape from those of the following segments. Stomachal dilatation present or absent. Posterior border of the branchial fossa projecting into two palps. Coelomocytes present or absent. Spermathecae rarely absent; vasa deferentia joining atria at anterior side; no prostate glands; usually no penial setae. Budding or fragmentation. Usually living in portable tubes. Cosmopolitan.

1. *Aulophorus carteri* Stephenson, 1931

(P1. I, figs. 1-4)

*Aulophorus carteri* STEPHENSON, 1931b : 303, Pl. XVII,
Figs. 2-3.

*Aulophorus carteri* Stephenson. MARCUS, 1943 : 60, Pl. X,
Figs. 43-46, Pl. XI, XII, XIII, XIV, Figs. 60,

Material examined

Three specimens were collected from the floating fern *Salvinia molesta* Mitchell on 7.3.'77 from the Veli lake. Of the three specimens two were entire with one budding zone. The third got fragmented during collection, and therefore this was not taken for systematic study. A second lot of eleven specimens
was also obtained from two *Salvinia* samples collected from the same area on 14-3-'77. These specimens were all fragmented and therefore, were not used for the present taxonomic study.

**TABLE I**

Length, diameter and number of segments of the body in *Amelophorus carteri* Stephenson

<table>
<thead>
<tr>
<th>No.</th>
<th>Length (mm)</th>
<th>Diameter (mm)</th>
<th>No. of segments ahead of the unsegmented posterior region</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.5</td>
<td>0.30</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>2.8</td>
<td>0.22</td>
<td>26</td>
</tr>
</tbody>
</table>

**Description**

Worms almost transparent and whitish in colour. Prostomium bluntly conical and has a more or less rounded margin. Sensory hairs and eyes absent. No stomachal dilatation of the alimentary canal.

Dorsal setae commence from the VI segment with one hair and one needle per bundle. Presence of dorsal setae was noticed only up to the XV segment. Length of hair setae varies from
160.2 to 231.4 μ and needles 65.0 to 72.2 μ (Table II).

Hair setae smooth, long and straight and without any ornamentation. The prongs of the needles are minute and needles rather straight (Pl. I, fig. 2). Ventralcs begin from the second segment. They are four per bundle in the anterior two segments (II and III segments), then five per bundle in the next two segments (IV and V) followed by four per bundle up to the XV segments. These setae are somewhat sickle-shaped in the anterior bundles (Pl. I, fig. 4), but become more erect in the posterior bundles. Their length exhibited considerable variation. Thus the anterior sickle-shaped ones in segments II-V measured 87.5 μ, those in VI 62.5 μ while those of the XIV and XV measured only 60.0 μ. The setae are double-pronged with distal prong longer than the proximal. This difference in the length of the prongs is discernible in all the setae throughout the body length. The setae have medially placed nodulus.

The hinder end is expanded to form the branchial fossa (Pl. I, fig. 3). From the floor of the fossa arises a pair of small almost rounded gills which are placed dorsally and in the preserved specimens they closely adhere to walls of the branchial fossa. The margin of the branchial fossa is extended to form two non-vascular palps. Even though the palps seem to be parallel at the point of origin, they diverge a little toward the distal region. They are wider at the base than at the tip.
In the preserved specimens, the palps measured 0.11 to 0.13 mm in length with a diameter of about 0.040 to 0.045 mm at the base and 0.014 mm at the tip. The gills have a length of 0.060 mm and a diameter of 0.045 mm at the base and 0.030 mm at the tip.

Habitat

The present specimens are found attached to the 'roots' of *Salvinia*.

Distribution

Mukthlawaiya, in the Chaco, the Swampy region of north west Paraguay (Stephenson, 1931b); South America (Brinkhurst and Jamieson, 1971); Argentina (Di Persia, 1980).

Remarks

The present specimens differ from that described by Stephenson (1931b) in size, number and length of both dorsal and ventral setae and also in the nature of the needle setae. Naidu (1962c) in his key to various species of *Aulophorus* considers the presence of three pairs of short gills and one pair of palp as the diagnostic character of the species. Brinkhurst and Jamieson (1971) also stresses the importance of
the three pairs of short gills and one pair of palp as important distinguishing characters of the species.

Even though the ventral setae show general resemblance to those described by Stephenson (op. cit.), they differ in size, in number and in arrangement. Here they are most often four per bundle. The disparity noticed in the number of ventral setae of Stephenson's material is not discernible in the present material. Except in segments four and five, where the ventrals number five each, the rest of the anterior region have consistently four setae per bundle. The pattern of distribution of the ventral setae shows an interesting feature in segments II-V where setae are of identical size (87.5 µ) followed by much smaller ones in the following segments (62.0-62.5 µ). This trend is continued till segment XIV when a further reduction is noticeable in the size of the setae (60.0 µ).

The dorsal setae, as in Stephenson's material commences from the VI segment, but here they differ widely from his material in the number per bundle and also in the structure of the needle setae. A peculiar feature noticed here of the needle setae is the absence of the transparent web between the two prongs described by Stephenson. As in Stephenson's specimens, the hairs here also are smooth without any serration, but it was not possible to trace out more than one hair and one needle
per bundle as mentioned by him. The needles here are comparatively smaller having a range of 65.0-72.2 μ. Up to the X segment they show a range between 72.0 and 72.3 μ in length. On the XI segment they show a sudden decrease to 65.4 μ and this length is maintained in the XII segment also.

In the nature of body length also the present specimens depart slightly from that of Stephenson's. Present specimens having only a single budding zone measuring as much as 2.5 to 2.8 mm whereas Stephenson's specimens with a single budding zone and one without a budding zone measure only 2.0 mm in length.

It is found that in all the specimens described so far, the dorsal setae commences from the VI segment. In the absence of stomachal dilatation and also in the difference in shape of the ventral setae noticed in II-V segments these specimens agree with the diagnostic characters enumerated by Stephenson (1931b) and Brinkhurst and Jamieson (1971). The major difference noticeable in the present specimen from that of Naidu (1962c) and Brinkhurst & Jamieson (1971) is the number of gills present in the branchial region. A variation in the number of gills has been reported by Brinkhurst & Jamieson (op. cit.) in A. furcatus (3 or 4 pairs); in A. vagus (1 to (27) pairs) and in A. flabelliger (2-3 pairs) and also by Naidu (1962c). Therefore, following the description of Stephenson (1931b) the present
specimens are assigned to *Aulephorus carteri* Stephenson.
This seems to be the first record of this species from this region.
**TABLE II**

Number and length of the setae in the ventral and dorsal bundles in different segments of *Aulophorus carteri* Stephenson

<table>
<thead>
<tr>
<th>Segments</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>XIII</th>
<th>XIV</th>
<th>XV</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of setae in each ventral bundle</td>
<td>-</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Length of the ventral seta in microns</td>
<td>-</td>
<td>87.5</td>
<td>87.5</td>
<td>87.5</td>
<td>87.5</td>
<td>62.5</td>
<td>62.0</td>
<td>62.1</td>
<td>62.5</td>
<td>62.5</td>
<td>62.5</td>
<td>62.4</td>
<td>60.0</td>
<td>60.0</td>
<td>60.0</td>
</tr>
<tr>
<td>Length of the hair seta in microns</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>231.4</td>
<td>173.0</td>
<td>195.3</td>
<td>213.6</td>
<td>160.2</td>
<td>165.4</td>
<td>180.0</td>
<td>180.5</td>
</tr>
<tr>
<td>Length of the needle seta in microns</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>72.2</td>
<td>72.2</td>
<td>72.0</td>
<td>72.2</td>
<td>65.4</td>
<td>65.4</td>
<td>65.0</td>
<td>65.0</td>
</tr>
</tbody>
</table>
2. *Aulophorus tonkinensis* (Vejdovsky, 1894)

(Pl. I, figs. 5-9)

(?) *Aulophorus oxycephalus* SCHMARDA, 1861: 9, Pl. XVII, Fig. 152.

(?) *Dero (?) oxycephala* (Schmarda) VAILLANT, 1890: 387.

(?) *Dero sp.*, STUHLMANN, 1891: 925.

(?) *Dero stuhlmanni* STIEREN, 1892: 123.

*Dero tonkinensis* VEJDOVSKY, 1894: 244.

*Dero tonkinensis* Vejdovsky. MICHAELSEN, 1900: 30;

1905b: 353.

*Aulophorus tonkinensis* (Vejdovsky). MICHAELSEN,

1909b: 132. STEPHENSON, 1911: 212; 1923: 91;

1931c: 43; 1932: 236. AIYER, 1925: 35, Fig. 3.

MICHAELSEN and BOLDT, 1932: 596. SPERBER, 1948:

1958: 49, Figs. 8-9. NAIDU, 1962c: 911,

Figs. 24a-h; 1965a: 18. BRINKHURST, 1964a: 215;

1966d: 139. BRINKHURST and JAMIESON, 1971: 380,

Figs. 7-18 F-I.


CUMMINGTON, 1920: 574.

*Aulophorus oxycephalus* Schmarda. CHEN, 1940: 62,

Fig. 20.

Material examined

Five full specimens were collected from the floating fern, *Salvinia molesta* Mitchell on 7-3-'77 from the Veli Lake near Trivandrum. All these worms were entire and found to be living inside tubes. The two ends of the tubes were open and through these openings, the anterior and posterior ends projected outwards.
Description

Worms pale white and transparent. Length of the animal varies from 1.8 mm to 2.0 mm and diameter from 0.19 mm to 0.20 mm. Number of segments varied from 28 to 32 with an undifferentiated posterior region. Of the total eleven specimens observed, five showed the presence of a single budding zone and 'n' found to be XVII (twice) and XVIII (thrice). The head is swollen and bulbous with a small conical prostomium at the anterior end.

Dorsal setae commencing from the VI segment onwards. Only one hair seta and one needle seta per segment. Hair seta of VI segment measures 130.5 μ. VII segment shows a slightly shorter hair seta (130.0 μ). Setae of the VIII and IX segments are of uniform length (122.5 μ) and those of the X segment still shorter (119.0 μ) (Table III). Hair setae long and smooth with a slight bent at the proximal region (Pl. I, fig. 6). Needles straight with distal nodulus (Pl. I, fig. 7). The bifurcated nature of the needle is not visible owing to the presence of a transparent web between the two prongs. The presence of this web gives the needle seta the appearance of an ear. The span of the web is 4-5 μ. Needles vary from 55-65 μ.

Ventrals begin from second segment. They have a constant arrangement of four setae per bundle from II to XVIII segment. Their length exhibit considerable variation. The setae of
anterior II-V segments are of identical length (99.5 μ), VI measures 87.5 μ, those of the VII and VIII segments are much shorter (57.5 μ) and from here a gradual reduction in length is discernible. Anterior setae have slightly proximal nodulus with distal prong slightly longer and thinner than the proximal (Pl. I, fig. 8). Toward the posterior region, the nodulus are distally placed with prongs of equal length and width (Pl. I, fig. 9).

Branchial organ with one pair of palp and two pairs of gills. Palps extend backwards, 0.20 mm in length and 0.09 mm in diameter. The ends of the palps are rounded. Gills two pairs with curly margin and rounded tip. They are shorter than palps and the two pairs are of equal size.

Mouth ventral, no special stomachal dilatation. IX segment enlarged to form the intestine. Intestine saccular and narrows toward the posterior region. Budding zone single.

Habitat

Tubicolous form. Tubes made out of sand particles covered by mucilaginous substance. The two ends protrude out from the tube which are attached to the roots of the aquatic fern, Salvinia molesta Mitchell.
Distribution

South and East Asia, Africa (Brinkhurst and Jamieson, 1971).

Indian sub-continent: Trivandrum (Aiyer, 1925).

Remarks

It is not difficult to determine the identity of this species as all the distinctive characters that are available for the species from the former literature are shown by the present specimens except for minor variations in the setal characters. When the body length is taken (2 mm), the present worm agrees well with the earlier observations made by Stephenson (1931c) and Naidu (1962c). A slight departure from the observations of Naidu (1962c) and Stephenson (1931c) is noticeable in the position of 'n'. 'n' in the present specimens being XVII or XVIII segment. Naidu (1962c) observed 'n' in the XV and Stephenson (1931c) in the XIV-XVII segments, XV being common.

Regarding the dorsal bundle, only one needle seta and one hair seta could be noticed in the present specimen. Naidu (1962c) found the occasional presence of two needles and two hair setae. Brinkhurst and Jamieson (1971) reported the occurrence of one to two needle setae in each bundle. Stephenson (1931c) noted the presence of two hairs in his specimens only.
twice. The needles here also are found to be palmate, but no ribs could be seen. The hair setae are comparatively longer than those in Naidu's specimens. Hair setae of VI segment measures 130.5 μ, VII 130.0 μ and VIII 122.5 μ. Naidu observed hair setae having equal length (122.5 μ) in VI, VII and VIII segments. But coming to the IX segment, this trend is lost in Naidu's specimens and a reduction in length of hair setae (119.0 μ) occurs whereas in the present specimens the length of the hair setae is quite constant until the X segment where a further reduction to 119.0 μ occurs.

Needle setae also show much disparity. In the present specimens, a decline in length of the needle setae is noticeable from the anterior to the posterior segments, but in Naidu's specimens even though the length shows a constant value of 63 μ in the VI, VII and VIII segments, in the IX segment an increase to 66.5 μ occurs and this length is maintained up to the XI segment. Further back, the measurements are not given by him.

The constant occurrence of only four setae could be noticed in the ventral bundle of the present specimens. Naidu (1962c) observed 4-5 setae, Stephenson (1931c) up to seven setae and Brinkhurst and Jamieson (1971) 3-9 per bundle in the anterior II-V segments. Anterior setae (II-V) are comparatively longer than Naidu's specimen (91-98 μ), but smaller than those
of Stephenson's (110–117 μ) and have a constant length (99.5 μ). This is followed by comparatively smaller setae in the VI segment (87.5μ). Despite these minor variations, probably of an ecotypical nature the specimens described here closely resemble the descriptions of Naidu (1962c) and Brinkhurst and Jamieson (1971) in having two pairs of short gills and presence of one pair of palp, beginning of dorsal setae from VI segment with needle setae having a transparent web between the two prongs, ventral setae having proximal nodulus in the anterior region, distal prong longer and thinner than the proximal, posterior setae with distal nodulus and also in the tubicolous mode of living, and hence these specimens are designated as Aulophorus tonkinensis (Vejdovsky).
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3. Aulophorus furcatus (Müller, 1773)
(Pl. I, figs. 10-15)

Nais furcata MÜLLER, 1773 : 23.
(non) Nais (Dero) furcata, florifera OKEN, 1815 : 363.

Uronais furcata (Roesel). GERVAIS, 1838 : 18.


VAILLANT, 1890 : 381.

Dero Rodriguezi SEMPER, 1877 : 106, Pl. IV, Figs. 15-16.


STIEREN, 1892 : 119. BEDDARD, 1895 : 299.

MICHAELSEN, 1900 : 29; 1903b : 184. PIGUET, 1906a : 278.

GALLOWAY, 1911 : 304.

Dero palpigera Grabnitzky. VAILLANT, 1890 : 382.

Aulophorus furcatus (Oken). MICHAELSEN, 1905d : 308;

1909a : 25, Fig. 40. PIGUET and BRETSCHER, 1913 : 45.

STEPHENSON, 1914 : 332; 1916 : 306, Pl. XXX, Fig. 31.

1923 : 92, Fig. 34. SMITH, 1918 : 639. UDE, 1929 : 33.

Fig. 34. AIYER, 1929a : 43. MICHAELSEN and BOLDT,

Figs. 16-20. CHEN, 1940 : 61. MARCUS, 1943 : 87.

Pl. XIV, Fig. 61, Pl. XV, Figs. 66-69, Pl. XVI; 1944 : 50.


Fig. 1. BRINKHURST, 1962a : 320; 1963b : 21.

Fig. 4c; 1963c : 144; 1964a : 214, Fig. 5a; 1966d : 139;
1971 : 120, Fig. 4a. BRINKHURST and JAMIESON,
1971 : 376, Fig. 7-17 A-D. CHEKANOWSKAYA, 1962 : 175.

Fig. 93. MOSZYNSKA, 1962 : 15. NAIDU, 1962c : 899.

Figs. 20a-g. DI PERSIA, 1980 : 93.

(? ) Aulophorus palustris MICHAELSEN, 1905d : 308.

(? ) Aulophorus furcatus var. brevipalpus GOLANSKI, 1911.

Aulophorus stephensoni MICHAELSEN, 1912b : 116

(?) Aulophorus palustris Michaelsen. STEPHENSON, 1913a : 285, Pl. I, Fig. 5; 1916 : 306.
Material examined

Eighteen specimens were obtained from the African fern Salvinia molesta Mitchell collected on 7.3.77 from the Veli Lake near Trivandrum. None of these specimens were entire. Out of these eighteen, two had three budding zones but the anterior and the posterior extremities were missing. Two plankton collections were also made on the same day, one near the bar mouth and the other one kilometre away from the bar mouth, the former yielded two fragmented specimens and the latter eighteen specimens of which six were entire with only one budding zone. On 18-7-78 another lot of three specimens were collected from the Chackai canal. The nine entire specimens mentioned above formed the basis of the present systematic study.

Description

Worms small, transparent and yellowish-brown in colour. Formalin preserved material measured 3.0-3.5 mm with a diameter 0.20 mm with 32-38 segments. Prostomium distinct and somewhat triangular, bearing marginal sensory hairs.
Dorsal setae commencing from the V segment onwards, each bundle bearing one hair seta (Pl. I, fig. 12) and one needle seta a feature maintained throughout the length of the body. Hair setae showed no uniformity in their length. In the V and VI segments they measured 200 μ, in the VII 195 μ, in the VIII and IX segments they were worn out partially while in the X segment they measured only 160 μ (Table IV). From here onwards a gradual reduction in the length of the setae was noticed. Needles bifid with slightly longer proximal prong (Pl. I, fig. 13). In the V, VI and VII segments they showed a range between 59.5-60.0 μ and from the VIII segment onwards a uniformity in the length of the needle setae has been noticed (52.5 μ) up to the XV segment. The setae are with distally placed nodulus.

Ventrals four per bundle up to the XI segment. In the XII, XIII and XIV segments they are three per bundle and further back they are only two per bundle. The setae of segments II-IV showed a uniform length of 87.5 μ. From V to the XII segments, they showed much variation in length. From XIII segment again a constancy in length has been maintained (50 μ) (Table IV). The anterior setae have median nodulus (Pl. I, fig. 11) with the distal prong one and a half times longer than the proximal. The posterior setae have median nodulus and the length of the proximal prong also decreases toward the posterior region.
Mouth ventro-lateral in position. Pharynx begins from the second segment and ceases in the middle of the V segment. A well defined stomachal dilatation absent.

Branchial organ (Pl. I, figs. 14 & 15) with two thin palps. Palps long, filiform, rounded tips and have a length of 0.17-0.22 mm and having a diameter of 0.03-0.04 mm at the base and 0.02 mm at the tip. The distal end is curled upwards in preserved specimens and they diverge at an obtuse angle toward the distal end. Gills three pairs, finger-like structures arising from the branchial fossa.

Habitat

Majority of the specimens were found to be living within tubes made up of small sand particles mingled with other organic debris and intertwined by a mucilaginous substance secreted by the worm itself. The anterior and posterior extremity usually project outwards from the tube. Worms collected from the Chackai canal were seen in association with Branchiura sowerbyi and Limnodrilus hoffmeisteri. Specimens freed from the tubes normally swim near the bottom mud often coming up to the surface.

Distribution

U.S.S.R (Chekanovskaya, 1962); South Africa (Brinkhurst, 1966d); Europe, Africa, Asia, North America and Neotropical America, Argentina (Dipersia, 1980).
Indian sub-continent:— Trivandrum (Aiyer, 1929a; Bugga stream, Cuddapah, Madras, Lahore (Pakistan) (Naidu, 1962c).

Remarks

The occurrence of a shorter distal prong in the needle of the dorsal bundle is a character, which according to Brinkhurst and Jamieson (1971) distinguishes Aulophorus fureatus from Aulophorus hymanae having a slightly longer distal prong and also from Aulophorus borellii having needles with equally long prongs. In all these three species it is found that the dorsal setae begin in the V segment. Even though the dorsal setae of the present specimens show a close resemblance in number and arrangement with those of Naidu (1962c); Brinkhurst (1966d; 1971) and also Brinkhurst and Jamieson (1971), they differ from Naidu's description in having comparatively longer hairs and needles. Brinkhurst (1966d) reported the presence of one or more, rarely a few intermediate teeth in the needles. This was not found in any of the present specimens nor has this been reported by Naidu (1962c), Chekanovskaya (1962), Brinkhurst (1971) and Brinkhurst and Jamieson (1971).

Naidu (1962c) separated Aulophorus michaelseni from Aulophorus fureatus on the basis of thinner and longer distal prong in the former. But his description of the needle is
contradictory to his illustration where the distal prong is shown as slightly shorter than the proximal. Brinkhurst and Jamieson (1971) believed that the separation of *Aulophorus michaelsoni* was not on a satisfactory basis and merged it with *Aulophorus furcatus* on the basis that when the illustrations of the needle setae of the two are compared, it does little to clarify the issue except that the upper tooth is slightly less shorter than the lower in *Aulophorus michaelsoni* than in *Aulophorus furcatus*.

In the case of ventral setae also the present specimens show a general resemblance to those described by Naidu (1962c) in the number, arrangement and shape. Here also the ventral setae present an uniform arrangement of four setae per bundle up to the XI segment and further posteriorwards i.e. from XII to XIV the setae are three per bundle and still posterior two per bundle. Chekanovskaya (1962) observed 2-5 setae in each bundle. But when compared with that of Naidu's specimen, the ventral setae of the present specimens are comparatively longer and having a special peculiarity of setae of identical size in II-IV segments.

In the possession of three pairs of gills the branchial region also shows a close similarity with the description furnished by Naidu (1962c). Chekanovskaya (1962), Brinkhurst and Jamieson (1971) and Brinkhurst (1971) mentioned the occurrence
of three to four pairs of gills. But all specimens before me are with three pairs of gills. From a comparison with the available literature, it would appear that except for minor variations exhibited in setal length, the present specimens exhibit all the distinguishing characters of *Aulophorus furcatus*. The difference noticed in the setal length is not of much importance from a specific standpoint and therefore, the present specimens are treated as *Aulophorus furcatus* (Müller).
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Subgenus Dero OKEN, 1815

Dorsal setae from IV or VI; ventral setae of II-V as a rule sharply differentiated from those following. Stomachal dilatation present. No palps. No coelomocytes. Prostate gland cells sometimes present on atria; as a rule no penial setae. Budding present. Usually live in fixed tubes.

4. Dero dorsalis Ferronnière, 1899
   (Pl. I, figs. 23-27)

(?) Uronais decapoda (Dutrochet). GERVAIS, 1838 : 18.
(?) Dero? decapoda (Dutrochet). VAILLANT, 1890 : 386.

Dero dorsale FERRONNIÈRE. 1899 : 255.
Dero tubicola POINTNER, 1911 : 274, Pl. XXVIII, Figs. 4-5.
Dero tubicola Pointner. SCHUSTER, 1915 : 18, Figs. 10-14.
MALEVICH, 1929 : 47. UDE, 1929 : 36, Fig. 41.
Dero australina STEPHENSON, 1925a : 882, Pl. I, Fig. 1.
Dero australina Stephenson. AIYER, 1929a : 34, Figs. 10-11.
STEPHENSON, 1931a : 269. MICHAELSEN, 1933a : 334.
CHEN, 1940 : 57, Figs. 18-19.
Dero dorsalis Ferronnière. MICHAELSEN, 1933a : 334.
CHEKANOVSKAIA, 1962 : 171, Fig. 90. NAIDU, 1962b
529, Figs. 12a-h. TIMM, 1962 : 200, Fig. 5a.
BRINKHURST, 1971 : 119, Fig. 3K. BRINKHURST and
JAMIESON, 1971 : 364, Figs. 7. 3A-C.
Material examined

The material used for the present study was collected from the Veli Lake near Trivandrum. Three full specimens and two anterior fragments were picked up from the plankton collection taken from the bar mouth on 7.2. '77. A second lot of eleven specimens was obtained from the floating fern, Salvinia molesta Mitchell on the same day. Out of these eleven specimens two got fragmented during fixation in formalin and were not used for the present systematic study. Of the remaining nine worms six were with a single budding zone, two were with two budding zones and one without any budding zone.

Description

The longest individual of the present collection with only a single budding zone measured 3.1 mm. Of the two worms with two budding zones, one measured 2.8 mm and the other 3.0 mm.

The worms are of indefinite light yellowish hue and are fairly transparent under the microscope. Those with only a single budding zone have a total number of 40-60 segments. Segments gradually diminish in size toward the posterior region and in the posteriormost portion they are rather indistinct.

Prostomium is short, slightly extensible, slightly conical and bears sensory hairs.
Ventral setae occur in all segments from II onwards. They are four per bundle till the XIV segment where the number shows a reduction to three per bundle. Setae of II, III, IV and V segments differ slightly from those of the rest in having comparatively longer setae with medially placed nodulus and also with the distal prong longer and thinner than the proximal (Pl. I, fig. 24). Toward the posterior region, the nodulus is distally placed and the prongs are of about the same length and width (Pl. I, fig. 25). Regarding the size of the setae also they can be divided into two classes; anterior and posterior, the former comprising the setae of II–V segments, all of identical length (75.0 μ) and the latter exhibiting considerable variation in length (65.0–73.0 μ) (Table V).

Dorsal setae commencing from IV segment with one hair and one needle per bundle. There is considerable variation in the length of the hair setae but they show a range in between 150–180 μ (Table V). Hairs straight and smooth without any ornamentation (Pl. I, fig. 26). Needles are rather straight with distinct, distally placed nodulus (Pl. I, fig. 27). Prongs are of about equal width at the base with the distal prong slightly longer than the proximal.

Chloragogen cells begin from the VI segment. Intestine saccular, wider at the anterior region. The sacculation corresponds to the external segmentation.
Branchial region with five pairs of foliate gills. Gills are very small and in preserved specimens, they are fully retracted into the fossa so that the tip of each gill alone slightly projects outwards. The wall of the branchial fossa forms two projections posteriorly on each side.

Habitat

Found attached to the 'roots' of *Salvinia molesta* Mitchell. They occur at times in the plankton collections, probably detached from their moorings on *Salvinia*.

Distribution

U.S.S.R (Chekanovskaya, 1962), Europe, South and East Asia (Brinkhurst and Jamieson, 1971).

Indian sub-continent: Madras (Stephenson, 1925a), Trivandrum (Aiyer, 1929a), Cuddapah and Kakinada (Naidu, 1962b).

Remarks

Brinkhurst and Jamieson (1971) synonymised *Dero australina* STEPHENSON (1925a) and *Dero australina* Stephenson, AIYER (1929a) with *Dero dorsalis* FERRONNIÈRE. The diagnostic characters enumerated by Naidu (1962b), Chekanovskaya (1962) and Brinkhurst and Jamieson (1971) are the presence of five pairs of gills with
two divergent processes from postero-lateral border of branchial fossa and the regular occurrence of dorsal setae from IV segment onwards with one hair seta and one needle seta per bundle. In the present specimens also there are five pairs of gills with dorsal bundle beginning from IV segment with one hair seta and one needle seta per bundle. Stephenson (1925a, 1931a) described only three pairs of true gills and one pair of accessory gills (secondary gill) but he was not sure of his observations as he says that "observations on fixed material are liable to error however carefully made". But in spite of this fact, his specimens showed the presence of dorsal setae from IV segment onwards and this character is very important as in no other species under this genus, the dorsal setae commence from IV segment.

Ventral setae of the present specimens are of the type found in Naididae having an arrangement of four setae in the anterior bundles reducing to three toward the posterior region. Stephenson (1925a) noted the occurrence of five setae in the II and III segments, in IV and V there were six, further back the number diminishes to four per bundle. Chekanovskaya (1962) observed 5-7 setae in the anterior II-V segments, the number of setae decreasing in successive segments and in the posterior most bundles only three setae per bundle. As described by Naidu
(1962b) and Chekanovskaya (1962), here also the nodulus of the anterior setae are medially placed with the distal prong longer than the proximal. Stephenson (1925a) described all setae having distally placed nodulus and noted (1931a) the incidence of medially placed nodulus in one of his specimens and this he accounted as a divergence from the original description. Brinkhurst (1971) and Brinkhurst and Jamieson (1971) described the nodulus of the anterior setae as slightly proximal or distal. A disparity noticed from Naidu's specimen is in the relative thickness of prongs. The distal prong of the anterior setae of the present specimens are found to be thinner than the proximal. Stephenson (1925a) also described anterior setae with distal prong thinner and longer than the proximal, but noted (1931a) the occurrence of equally thick prongs and this he considered as a variation from the usually observed pattern. No sudden change in the character of the setae is discernible backward. A gradual shift in the position of the nodulus toward the distal region and a gradual reduction in length of the outer prong of the setae occur, so that at the X segment, the setae have distally placed nodulus with prongs having equal length. Dorsal bundle agrees perfectly with that of Stephenson (1925a, 1931a), Chekanovskaya (1962), Naidu (1962b), Brinkhurst (1971) and Brinkhurst and Jamieson (1971) in having its beginning from the
IV segment. The disparity noticed is in the number of setae per bundle. The rare occurrence of two hair setae or needle setae could not be noticed in the present specimens as suggested by Naidu (1962b). The shaft of the needle setae are rather straight with distal prong slightly longer than the proximal. Stephenson (1925a), Chekanovskaya (1962), Naidu (1962b), Brinkhurst (1971) and Brinkhurst and Jamieson (1971) have made the same observation regarding the length of the prongs. Prongs of the present specimens have equal width at the base. Stephenson (op.cit.) noticed the distal prong slightly thinner than the proximal while Naidu (op. cit.) observed the outer prong as thicker than the inner.

Regarding size also, the present specimens are comparatively smaller, the longer individual with a single budding zone measures only up to 3.1 mm. Stephenson (op. cit.) gave the length of the complete individual as 16 mm. Aiyer (1929a) has given the range as 10-18 mm, Chekanovskaya (1962) as 10-30 mm for chain of individuals and Brinkhurst and Jamieson (1971) as 10-30 mm.

Inspite of these small variations the present specimens are designated as Dero dorsalis Ferronnière on account of the two main diagnostic characters such as the presence of five pairs of gills in the branchial region and beginning of dorsal setae from IV segment onwards.
### TABLE V

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</tr>
<tr>
<td>Length of the ventral seta in microns</td>
<td>-</td>
<td>75.0</td>
<td>75.0</td>
<td>75.0</td>
<td>75.0</td>
<td>71.0</td>
<td>68.0</td>
<td>68.0</td>
<td>67.5</td>
<td>65.0</td>
<td>65.0</td>
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<td>65.0</td>
<td>65.0</td>
<td>65.0</td>
<td>65.0</td>
</tr>
<tr>
<td>Length of the hair seta of the dorsal bundle in microns</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>160.0</td>
<td>160.0</td>
<td>179.0</td>
<td>179.5</td>
<td>171.0</td>
<td>160.0</td>
<td>160.0</td>
<td>165.0</td>
<td>165.0</td>
<td>165.0</td>
<td>165.0</td>
<td>165.0</td>
<td>150.0</td>
</tr>
</tbody>
</table>
5. Dero nivea Aiyer, 1929  
(Pl. I, figs. 16-21)

**Dero niveum** Aiyer, 1929a: 40, Figs. 16-17.  
**Dero palestinica** CernosvitoV, 1938a: 541, Figs. 5-10.  
(?) **Dero obtusa** d'udekem. Chen, 1940: 55, Fig. 16A.  
**Dero nivea** Aiyer. Sperber, 1948: 184, Fig. 19g, Pl. XVIII,  
Fig. 4; 1950: 72, Fig. 23d, Pl. III, Fig. 4; 1958: 49, Figs. 5-7. Chekansvskaya, 1962: 173. Naidu,  
1962b: 540, Figs. 17a-c; 1965a: 17. Brinkhurst,  
1966d: 138; 1971: 120, Fig. 3M; 1976: 9.  
Brinkhurst and Jamieson, 1971: 370, Figs. 14 J-M.  

**Material examined**  
Five full specimens, with only one budding zone were collected from the floating weeds (*Salvinia molesta*) on 5.1.'79 in the Veli Lake. A second lot of eleven specimens was obtained from the plankton taken from the bar mouth on 7.2.'79. Of these eleven, two specimens showed two budding zones each. Specimens collected from *Salvinia molesta* were used for the present systematic study.

**Description**  
Worms small, body transparent with a light yellowish tinge. Prostomium more or less rounded. Individuals with only a single budding zone measured 2.0-2.5 mm in length and 0.10-0.12 mm in diameter. Worms having two budding zones showed signs of slight
degeneration at the anterior and posterior regions. Total number of segments varies from 40 to 45 and 'n' XX-XXV.

On each segment, the setae are distributed in four bundles, two ventro-lateral and two dorso-lateral. Dorsal setae begin in segment VI and consist of one needle seta (Pl. I, fig. 21) and one hair seta (Pl. I, fig. 20) per bundle. No uniformity could be noticed in length of hair setae or needle setae. The length of hair setae range from 94.0 to 102.5 μ and that of needles range from 50.0 to 55.0 μ (Table VI). The shaft of the needle is straight with distal nodulus beyond which is a slight sickle-shaped curve. The tip is bifid and the prongs are of about equal length and width.

Ventrals begin from the II segment and have four setae per bundle in the anterior II-V segments. In the VI and VII segments, there are three setae per bundle and then again four per bundle in the two succeeding segments (VIII and IX). From the X segment onwards, the setae have a constant arrangement of three per bundle. Ventral bundles also show another peculiarity in having setae of identical length in II-V segments (83.5 μ). This is followed by setae of 85.0 μ in the VI segment. Setae of VII, VIII and IX segments measure 72.5 μ and the rest of the setae have a length of 72.0 μ (Table VI). The setae of II-V are
less curved than those of the succeeding segments. The setae on the anterior segments have median nodulus and distal prong longer than the proximal (Pl. I, fig. 17). Toward the posterior region, the prongs are of equal length with distally placed nodulus (Pl. I, figs. 18, 19).

Branchial organ (Pl. I, fig. 22) has three pairs of foliate gills of the same length and diameter with rounded posterior tips. They can be completely retracted into the fossa which then get closed.

Budding zone present and 'n' found to be between XX and XXV segments.

Habitat

Noted in the plankton collection and also attached to the 'roots' of Salvinia molesta Mitchell.

Distribution

U.S.S.R (Chekanovskaya, 1962); Europe, Asia, America, Africa and Australia (Brinkhurst and Jamieson, 1971); Gatineau River in Chelsea of Quebec (Brinkhurst, 1976); Argentina (Dipersia, 1980).

Indian sub-continent:- Trivandrum (Aiyer, 1929a); Bugga stream in Cuddapah (Naidu, 1962b).
Remarks

The present specimens exhibit the typical diagnostic characters enumerated by Aiyer (1929a), Naidu (1962b), Chekanovskaya (1962) and Brinkhurst and Jamieson (1971) such as having three pairs of gills in the branchial region, beginning of the dorsal bundle from VI segment with only one hair and one needle having prongs of equal length per bundle and also presence of stomachal dilatation in VIII segment. The difference noticed is in the position of the budding zone, 'n' in the present specimens being placed in between XX-XXV segments. Aiyer (1929a) observed 'n' between XIV-XVII (usually XVI) and Naidu (1962b) between XIV-XV segments.

As described by Aiyer (1929a), Naidu (1962b), Chekanovskaya (1962) and Brinkhurst (1966d) the dorsal setae here also begin from VI segment. When the needle setae of the present specimens are compared with the figures given by Aiyer (1929a) and Naidu (1962b), no difference has been noticed in the nature of the prongs.

Ventrals in the present specimens also are four per bundle in the anterior segments decreasing to three toward the posterior region. One peculiarity noticed is that the setae of segments II-V are of identical length (83.5μ). Aiyer (1929a) had given the range of length of the ventral setae of II-V segments as
81–84 μ and Naidu (1962b) noticed a gradual reduction in length of the setae from II–V segments. Chekanovskaya (1962) noted the setae of II–V segments longer than the others. When the structure of the ventral setae is taken, the present specimens have medially placed nodulus in the anterior II–V segments instead of the proximal nodulus described by Aiyer (1929a), Naidu (1962b), Chekanovskaya (1962) and Brinkhurst and Jamieson (1971). As mentioned by Aiyer (op.cit.), Chekanovskaya (op.cit.) the setae of these segments are longer and less curved than the others, with distal prong longer than the proximal and the posterior setae are with distal nodulus having equally long prongs. Except for these small variations cited above, the present specimens described here agree well in all other characters of the species and hence this is considered as *Dero nivea* Aiyer.
<table>
<thead>
<tr>
<th>No. of setae in each ventral bundle</th>
<th>Segments</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>XIII</th>
<th>XIV</th>
<th>XV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of the ventral setae in microns</td>
<td></td>
<td>53.5</td>
<td>83.5</td>
<td>83.5</td>
<td>83.5</td>
<td>85.0</td>
<td>72.5</td>
<td>72.5</td>
<td>72.5</td>
<td>72.0</td>
<td>72.0</td>
<td>72.0</td>
<td>72.0</td>
<td>72.0</td>
<td></td>
<td></td>
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<tr>
<td>Length of half seta of the dorsal bundle in microns</td>
<td></td>
<td>102.5</td>
<td>100.0</td>
<td>98.0</td>
<td>100.0</td>
<td>95.0</td>
<td>100.0</td>
<td>96.0</td>
<td>94.0</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of needle seta of the dorsal bundle in microns</td>
<td></td>
<td>55.0</td>
<td>55.0</td>
<td>53.0</td>
<td>54.0</td>
<td>54.0</td>
<td>55.0</td>
<td>55.0</td>
<td>55.0</td>
<td>52.0</td>
<td>50.0</td>
<td>50.0</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
6. *Dero zeylanica* Stephenson, 1913

(Pl. I, figs. 28-32)


*Dero zeylanica* Stephenson. STEPHENSON, 1923: 89, Fig. 33.

AIYER, 1929a: 30, Fig. 8. SPERBER, 1948: 178.
NAIDU, 1962b: 536, Figs. 15a-k. BRINKHURST and
JAMIESON, 1971: 368, Figs. 7. 13N-P, Fig. 7. 14A.

Material examined

Two worms were collected from the foul smelling bottom sediment of an old aquarium tank on 5-7-'79. A single specimen was obtained from a collection of tubifex worms brought to the aquarium on 7-7-'79 from the Chackai canal in Trivandrum city.

Several specimens were collected from a bunch of *Salvinia molesta* removed from the Veli Lake near Trivandrum on 5-5-'79. Five fragmented specimens were separated from the plankton sample taken from the Veli Lake on 11-3-'77.

Description

Worms in the living condition have a pale red colour with fairly transparent body wall, but when preserved in formalin, they tend to become rather opaque. When kept in tanks they move freely over the mud at the bottom with a sort of serpentine movement. When the worms are transferred to a small petri dish, they frequently come to the surface of water with darting
movements. The body has a mucilaginous coat to which sand particles invariably adhere.

Morphometric studies on four specimens showed that the length range is between 5.0 to 6.1 mm and diameter between 0.29 and 0.31 mm. The number of segments ahead of the short posterior unsegmented region ranges from 40-47.

**TABLE VII**

Data regarding the length, diameter and number of segments of the body in *Dero zeylanica* Stephenson

<table>
<thead>
<tr>
<th>No.</th>
<th>Length (mm)</th>
<th>Diameter of the body (mm)</th>
<th>No. of segments ahead of the short unsegmented posterior region</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>6.1</td>
<td>0.31</td>
<td>47</td>
</tr>
<tr>
<td>2</td>
<td>6.0</td>
<td>0.29</td>
<td>47</td>
</tr>
<tr>
<td>3</td>
<td>5.8</td>
<td>0.29</td>
<td>45</td>
</tr>
<tr>
<td>4</td>
<td>5.0</td>
<td>0.30</td>
<td>40</td>
</tr>
</tbody>
</table>

Prostomium having sensory hairs and with conical tip. Segmentation clear and the size of the segment tends to reduce toward the posterior region, so that in the posteriormost region the segmentation is indistinct.
Ventral setae occur in bundles of four to five in the anterior region reducing to three and two toward the posterior region. Associated with the anterior bundles occur fragmented setae also. In the anterior region, the setae of a bundle are of the same size, but in the posterior region where the bundle is composed of only two setae, the outer is much smaller without a distinct nodulus. The setae of II-V measure 127.0 μ and from VI to the IX they are of uniform length (126.0 μ). From here onwards a slight reduction in length of the setae is discernible, so that in the XV segment the seta measures only 125.0 μ (Table VIII). The reduction in length of the seta is more drastic toward the posterior region. Anterior setae are with distal nodulus and the distal prong is thinner and longer than the proximal (Pl. I, fig. 30). In the posterior region, the longer setae have distal nodulus with distal prong slightly longer and having prongs of about equal width at the base (Pl. I, fig. 29).

Dorsal setae commence from segment VI onwards and are of two kinds, hair setae and needle setae. In the VI, VII and VIII segments, three needle setae and three hair setae occur per bundle, further back each bundle consists of two hair setae and two needle setae and behind this a single seta from each type. Hairs and needles are arranged in pairs of one of each kind. Length of hair setae varies from 150 to 300 μ in the anterior
segments (Table VIII). Hairs are slightly bayonet-shaped and show no uniformity in their length (Pl. I, fig. 31). In the same bundle itself, they show much variation. Longest hair setae of VI and VII segments measure 250 µ and 220 µ respectively whereas the smaller ones of the same bundle measure only 120 µ and 85 µ respectively. Needles are fairly sickle-shaped and there is a nodulus at the junction of the straight and curved part i.e. slightly distal (Pl. I, fig. 32). Distal prong a little longer and thicker than the proximal.

The posterior end is expanded to form the branchial fossa. In the preserved specimens, all the four pairs of gills are completely retracted into the fossa. The fossa seems to open dorsally giving the posterior end, a cup-like appearance. A diverticulum is seen passing upwards dorsally from the posterior tip. The first pair of gills originates from the dorsal side of the branchial fossa, the second pair from its lateral walls, the third pair lateral to this while the fourth pair is ventrally placed.

Habitat

Worms are found living attached to the roots of aquatic plants and also on the foul smelling bottom sediment of small ditches and ponds. In the Chackal boat canal they are found associated with Branchiura sowerbyi and Limnodrilus helmeisteri.
Distribution

Brinkhurst and Jamieson (1971) have reported that this species occurs in Ceylon and Southern India.

Indian sub-continent:— Ceylon (Stephenson, 1913a); Cuddapah and Bangalore (S. India) (Naidu, 1962b).

Remarks

Regarding size of the body, the specimens described here are comparatively smaller than those reported earlier having a maximum length of only 6.1 mm and a diameter of 0.31 mm. Stephenson (1913a) recorded a maximum length of 7.5 mm and diameter of 0.35 mm and Aiyer (1929a) recorded the maximum length of 10 mm and that of chains, 14 mm.

A survey of the previous literature showed that in all specimens hitherto described, the dorsal setae commence from the VI segment. As described by Stephenson (1913a), there are only three hairs and three needles per bundle in the anterior segments reducing to two and one toward the posterior region. Aiyer (1929a), Naidu (1962b) and Brinkhurst and Jamieson (1971) reported the occasional presence of four hair setae and four needle setae per bundle. As described by Naidu (1962b), the hair setae of the present specimens also are somewhat bayonet-shaped and needles sickle-shaped with distal prong slightly
longer than the proximal. Stephenson (1913a) and Brinkhurst and Jamieson (1971) observed the forking of the needle setae as very minute only just visible with the ordinary high power microscope.

Even though the ventral setae show general resemblance to those described by Stephenson (1913a), Aiyer (1929a), Naidu (1962b) and Brinkhurst and Jamieson (1971), they differ in size, in number and in arrangement. The disparity noticed in the number of ventral setae by the above mentioned authors is also discernible in the present specimens. The maximum number of setae occurring in a bundle in the present specimens is five. Stephenson (1913a), Aiyer (1929a), Naidu (1962b) and Brinkhurst and Jamieson (1971) reported the maximum number as six. Another speciality noted in the present specimens is the presence of identical setae in II-V segments and having a uniform distribution of four setae per bundle. Stephenson (1913a), Aiyer (1929a) and Brinkhurst and Jamieson (1971) reported 4-5 setae in the anterior II-V segments where as Naidu (1962b) obtained 4-6 setae in the anterior II-V segments. Setae of the present specimens are found to be comparatively longer, all having distally placed nodulus. In the relative length of the two prongs also resemblance of the present specimen with those of Naidu (1962b) could be observed, but they differ widely from those of Aiyer (1929a).
in having distal prong thinner than the proximal in the anterior II-V segments. Stephenson (1913a) gives only a vague idea as he says "the prongs are about equal in thickness at their base or the proximal is perhaps a little thinner".

Inspite of these small variations the present specimens show remarkable similarity to the earlier descriptions, in the nature of the branchial region. All the diagnostic characters enumerated for this species are shown by the present specimens also. So the variations observed may be considered to be ecotypical which are not significant enough to justify the creation of a new species for the present specimens.
<table>
<thead>
<tr>
<th>Segments</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>XIII</th>
<th>XIV</th>
<th>XV</th>
</tr>
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<tbody>
<tr>
<td>No. of setae in each ventral bundle</td>
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<td>4</td>
<td>4</td>
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<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Length of the ventral seta in microns</td>
<td>-</td>
<td>127.0</td>
<td>127.0</td>
<td>127.0</td>
<td>126.0</td>
<td>126.0</td>
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<td>125.8</td>
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<td>125.5</td>
<td>125.4</td>
<td>125.4</td>
<td>125.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of hairs in each dorsal bundle</td>
<td>-</td>
<td></td>
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<td></td>
<td></td>
<td>3</td>
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<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>No. of needles in each dorsal bundle</td>
<td>-</td>
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<td></td>
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<td>3</td>
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<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Length of the longest hair seta of the dorsal bundle in microns</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
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<td>250</td>
<td>220</td>
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<td>300</td>
<td>250</td>
<td>250</td>
<td>150</td>
<td>175</td>
<td>160</td>
<td>160</td>
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</tbody>
</table>

TABLE VIII

Number and length of the setae in the ventral and dorsal bundles in different segments of Ptero asylanica Stephenson
7. Dero digitata (Müller, 1773)
   (Pl. I, figs. 33-37)

Nais digitata (Coeca) MÜLLER, 1773 : 2.


Dero digitata (Coeca) (Müller). Oken, 1815 : 363.

Nais (Dero) furcata, florifera. Oken, 1815 : 363.


   Piguet and Bretscher, 1913 : 42. Ude, 1929 : 35, Figs. 38-39. Sciacchitano, 1938 : 258, Sperber, 1948 : 165, Figs. 19a-c, 27a, Pl. XIV, Figs. 2-5, Pl. XV-XVIII, Figs. 1-3, 6; 1950 : 71, Fig. 23b, Pl. III, Figs. 1-2;

Dero limosa Leidy, 1852a : 266.

   Levinson, 1864 : 218. Vaillant, 1890 : 381, Pl. XXII, Figs. 21-22.

GALLOWAY, 1911: 304. PIERANTONI, 1911: 3.
STEPHENSON, 1914: 330, Fig. 6 (?); 1915a: 785; 1915b: 789, Pl. LXXX, Figs. 1-3; 1923: 88.
(? ) SCHUSTER, 1915: 16, Fig. 7. SMITH, 1918: 640.
WOLF, 1928: 389. UDE, 1929: 34, Figs. 38-39. AIYER, 1929a: 33, Fig. 9. KONDO, 1936: 385, Pl. XXIV,
Fig. 13. CERNOSVITOV, 1938b: 269, Figs. 1-2. BERG, 1938: 46, Figs. 27-32. SCIACCHITANO, 1938: 258.
CHEN, 1940: 52, Fig. 15.

VAILLANT, 1890: 386.
Dero acuta BOUSFIELD, 1886b: 1098.
( ? ) Dero mülleri Bousfield. BOUSFIELD, 1887: 104, Pl.IV,
Figs. 9-10.

BEDDARD, 1895: 298. STIEREN, 1892, 122. MICHAELSEN, 1900: 28.
( ? ) Dero intermedius CRANGIN, 1887: 32.
Dero (? ) obtusa d' Udeken. MICHAELSEN, 1903b: 181.
Dero incisa MICHAELSEN, 1903b: 182, Fig. 3.
Dero incisa Michaelsen, 1909a: 24, Fig. 37. SCHUSTER, 1915:
17, Figs. 8-9 (?). UDE, 1929: 35, Fig. 40. STEPHENSON,
1932: 234, Figs. 6,7 (?).
( ? ) Dero bonairiensis MICHAELSEN, 1933a: 336, Pl. I,
Figs. 3-6.
Dero kawamura KONDO, 1936: 385, Pl. XXIV, Fig. 14.
Dero tanimotoi KONDO, 1936: 386, Pl. XXIV, Fig. 15.
Material examined

Five specimens were obtained from tubifex collection taken from the Chackai canal on 3-5-80. Of these two were immature and the rest with a single budding zone.

Description

Worms transparent with a reddish tinge. Pigments concentrated more in the head region. Worms preserved in alcohol are colourless and up to 10-11 mm long and 0.60 mm diameter. The number of segments is 28-32. All segments are broader than long. The prostomium is a blunt cone, as broad at the base as it is high or long. Mouth ventral.

Ventral setae commence from the second segment onwards. II, III, IV and V bundles slightly longer than others, 117.5 μ in length (Table IX). Ventrals having three setae per bundle in the anterior segments reducing to two toward the posterior region. Nodulus proximal in the anterior bundles (Pl. I, fig. 34), but as the setae approach toward the posterior region, the nodulus is displaced more and more anteriorly and finally reaches a state when it is placed exactly in the distal region (Pl. I, fig. 35). The prongs do not diverge, instead the distal prong bends a little toward the proximal. The prongs are of equal width at the base. In the posterior region, the prongs are of equal length.
Dorsal bundle beginning from VI segment, one hair and
one needle per bundle. Hairs 139.5-175 μ long (Table IX). No
uniformity in length of hair setae could be noticed. Hairs
smooth without any ornamentation and are somewhat bayonet-shaped
(Pl. I, fig. 36). Needles bifid, nodulus distal, distal prong
slightly longer than the proximal (Pl. I, fig. 37).

Branchial organ (Pl. I, fig. 33) with four pairs of gills, all foliate, one dorsal and the other three ventral.

Habitat

Living in the muddy substratum of Chackai canal.

Distribution

U.S.S.R (Chekanovskaya, 1962); Cosmopolitan (Brinkhurst
and Jamieson, 1971); New Zealand and Australia (Brinkhurst, 1971);
Canada (Brinkhurst, 1976); Argentina (Di Persia, 1980).

Indian sub-continent:— Trivandrum and Kottayam (Aiyer, 1929a);
Bangalore, Cuddapah and Bellary (Naidu, 1962b).

Remarks

Naidu (1962b) distinguished D. digitata from D. cooperi,
D. indica and D. seyplanica (all having four pairs of gills) on
the basis of the relative length of the two prongs of the needle seta, former having needle teeth unequal with distal tooth longer than the proximal. Even though the present specimens resemble the three species (D. cooperi, D. indica and D. zeylanica) mentioned above in having four pairs of gills, they disagree in having needle teeth of unequal length, the distal prong being longer than the proximal. *Dero limosa* described by Aiyer (1929a) also has four pairs of gills but he did not mention any thing about the structure of the needle seta. Chekanovskaya (1962) noted the distal denticle (prong) twice as long as proximal.

Similar to the specimens of Naidu (1962b), Chekanovskaya (1962), Brinkhurst and Jamieson (1971), here also the dorsal setae begin from the VI segment with one hair seta and one needle seta per bundle and the hair seta agrees perfectly with that of Naidu's specimen in being bayonet-shaped.

Major difference noticed in the present specimen from that of Naidu (1962b) and Brinkhurst and Jamieson (1971) is in the number of setae occurring in the ventral bundle. Here a maximum of three setae occur per bundle. Naidu (1962b) noted the occurrence of 4-5 setae in the anterior II-V segments, four per bundle from VI onwards decreasing to three and two toward the posterior region. Chekanovskaya (1962) and Brinkhurst and
Jamieson (1971) observed 3–6 per bundle in the anterior II–V segments and 2–5 in the following segments. Anterior setae agree fully with those of Naidu's in having proximal modulus with equally thick prongs. Except for these minute variations no remarkable difference could be noticed in the present material. Even though the present specimens resemble *Dero zeylanica*, *Dero indica* and *Dero dorsalis* in having four pairs of gills, it differs from them in having needle teeth of unequal length and hence this is treated as *Dero digitata* (Müller).
### TABLE IX

Number and length of the setae in the ventral and dorsal bundles in different segments of *Dero digitata* (Miller)

<table>
<thead>
<tr>
<th>Segments</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
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<th>XVI</th>
<th>XVII</th>
<th>XVIII</th>
<th>XIX</th>
<th>XX</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of setae in each ventral bundle</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<td>3</td>
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<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
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<td>2</td>
<td>2</td>
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<td></td>
</tr>
<tr>
<td>Length of the ventral seta in microns</td>
<td>117.5</td>
<td>117.5</td>
<td>117.5</td>
<td>110.0</td>
<td>110.0</td>
<td>85.0</td>
<td>85.0</td>
<td>85.0</td>
<td>85.0</td>
<td>85.0</td>
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<td>85.0</td>
<td>85.0</td>
<td>85.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of the hair seta of the dorsal bundle in microns</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>162.5</td>
<td>139.5</td>
<td>169.5</td>
<td>175.0</td>
<td>169.0</td>
<td>170.0</td>
<td>169.0</td>
<td>160.0</td>
<td>153.0</td>
<td>150.0</td>
<td>153.0</td>
<td>150.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of the needle seta of the dorsal bundle in microns</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>92.0</td>
<td>92.0</td>
<td>75.0</td>
<td>75.0</td>
<td>73.0</td>
<td>73.0</td>
<td>73.0</td>
<td>73.0</td>
<td>73.0</td>
<td>73.0</td>
<td>73.0</td>
<td>70.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* includes one small seta without nodulus
Genus **Branchiodrilus** MICHAELSEN, 1900

No eyes. Transverse pigment stripes on anterior segments. Branchial processes from (IV or) VI onwards on a number of segments, enclosing dorsal setae. Dorsal setae beginning in (IV or) VI, hairs and except in a number of anterior segments, straight or curved, simple-pointed needles. No stomachal dilatation. Vascular system in I–V forming a plexus; in all other segments one pair of transverse loops, in the gill-bearing segments each giving off a branch into a gill, and other branches to the body wall; dorsal vessel situated ventrally. Coelomocytes present. Clitellum absent between the male pores; vasa deferentia entering atria towards their upper surface; no prostate; atrial duct surrounded by gland cells; penial setae present. Budding incomplete; 5 segments normally formed at anterior end.

8. **Branchiodrilus semperi** (Bourne, 1890)
   (Pl. II, figs. 1-5)

**Chaetobranchus semperi** BOURNE, 1890 : 83, Pl. XII.

**Chaetobranchus semperi** Bourne. BOURNE, 1891 : 355.

**Branchiodrilus semperi** (Bourne). MICHAELSEN, 1900 : 24.

**Branchiodrilus menoni** STEPHENSON, 1912a: 219, Figs. 1-3, Pl. XI.

**Branchiodrilus menoni** Stephenson. STEPHENSON, 1921: 752; 1923: 76, Fig. 25; 1925a: 882. AYER, 1929: 31.

Material examined

One specimen collected from the Sreevaraham temple tank located in Trivandrum city.

Description

Formalin preserved worms measured 15 mm in length with one hundred and twenty-five segments. External segmentation well marked. Body tapering toward the posterior region. Brown bands of pigment occur in the anterior twenty-five segments, being very clear up to the eighteenth segment. No eyes. Prostomium small and conical.

Gills beginning from the V segment, one pair per bundle. Forty-nine such pairs have been counted in the present specimen all being restricted to the anterior region. These structures arise as dorso-lateral projections of the body wall with slight constriction at the place of attachment. Anterior gills are longer having a range in length between 0.15-0.20 mm. Their length decreases toward the posterior region and at about the XL segment they become mere tubercles. Gills are highly vascularised, each gill with an afferent and efferent vessel,
both being connected by capillaries. In the anterior region, three hair setae occur per bundle; all being embedded inside the gill and thus forming a supporting framework for it. The number is reduced to two and one per bundle toward the posterior region. In the tubercles they project outside it. Hairs straight, smooth, 300-400 μ long in the anterior segments, but comparatively smaller and thicker toward the posterior region. Needles single pointed, anodulate and straight anteriorly (Pl. II, fig. 4), but curved distally toward the posterior region (Pl. II, fig. 5).

Ventral setae commencing from the second segment with four setae per bundle in the anterior region reducing to three and two toward the posterior region. Anterior setae have median nodulus with distal prong longer and thinner than the proximal (Pl. II, fig. 2). Toward the posterior region, the nodulus is distally placed with prongs of equal length (Pl. II, fig. 3).

Asexual reproduction is observed to take place by a slight constriction after the XXXVIII segment.

Habitat

Living in the bottom mud of the pond. Not tube dwelling.
Distribution

According to Brinkhurst (1966d) this species is known only from India.

Indian sub-continent:— Trivandrum (Aiyer, 1925); Cuddapah and Bellary in South India (Naidu, 1962b).

Remarks

Genus *Branchiodrilus* erected by Michaelsen (1900) is comprised of three species namely *Branchiodrilus semperi*, *Branchiodrilus hortensis* and *Branchiodrilus cleistochaeta* (Naidu, 1962b; Brinkhurst and Jamieson, 1971).

Naidu (1962b) has taken the occurrence of two types of needle setae; anterior setae with straight tips and posterior setae with distally curved tips; as the main criteria for the separation of *Branchiodrilus semperi* from the other two, having only one type of needle setae through out the body. In the present specimens also two types of needles could be noticed, anterior with straight tips and posterior with distally curved tips. Brinkhurst and Jamieson (1971) also described the same character of the needle seta, but they had taken the nature of distribution of gills as the basis for the identity of the species; *Branchiodrilus semperi* having gills restricted to the anterior region whereas in *Branchiodrilus hortensis* gills are represented in almost the entire length of the body.
When the needle setae of the present specimen are compared with the figures given by Naidu (1962b) no difference in the shape of the setae could be noticed. As reported by Brinkhurst and Jamieson (1971) here also a maximum number of three hairs and three needles occur in the anterior bundles.

Nevertheless, slight deviations are noticed from the description given by Naidu (op. cit.). He noticed that in the Bellary specimens, the gills begin from the V segment and in the Cuddapah specimens, they begin from the VI segment, and the dorsal setae beginning from V or VI. But the present description is based on a single specimen and here the dorsal bundle and gills are seen to be beginning from the same segment i.e. from the V.

Disparity is noticed in the number of ventral setae as well, occurring per bundle. Here a maximum number of four setae could be counted in the anterior bundles. Brinkhurst and Jamieson (1971) reported a maximum of six setae per bundle. In shape and form, ventral setae of the present specimens agree well with those of the specimens of Naidu (1962b); the only noticeable difference being in the relative size of the two prongs of the setae in the posterior region. In Naidu's specimens, the thinner nature of the distal prong is maintained throughout the body whereas in the present specimens, the two prongs become equally thick toward the posterior region.
Regarding size, the present specimens are comparatively smaller having a length of 15 mm. Stephenson (1925a) recorded 25 mm for his Branchiodrilus menoni with 175 segments. Chekanovskaya (1962) and Brinkhurst and Jamieson (1971) had given the range as 8-50 mm and segments 77-200. Despite these variations, the present specimens can be treated as Branchiodrilus semperi (Bourne) on account of the two main distinguishing characters namely the presence of gills only in the anterior region of the body and the occurrence of two types of needle setae in the dorsal bundle.
9. **Branchiodrilus hortensis** (Stephenson, 1910)
   (Pl. II, figs. 6–9)

**Laberia hortensis** STEPHENSON, 1910a : 59, Figs. 1–3, Pl. VIII.

**Branchiodrilus hortensis** (Stephenson). STEPHENSON, 1912a : 229; 1923 : 77, Fig. 26. MEHRA, 1920 : 463, Figs. 1B, 3. CHEN, 1940 : 65, Fig. 21. SPERBER, 1948 : 157, Fig. 28a. SOKOLSKAYA, 1961a : 65, Fig. 7. CHEKANOVSKAYA, 1962 : 177, Figs. 94, 95. NAIDU, 1962b : 525. BRINKHURST, 1966d : 137; 1971 : 122, Fig. 4D. BRINKHURST and JAMIESON, 1971 : 359.

**Branchiodrilus hortensis** (Stephenson) var. **japonicus**
YAMAGUCHI, 1938 : 530, Figs. 1–2, Pl. XIX.


Material examined

Two worms were collected from an unused tank in the aquarium campus on 5.9.'79, one from the foul smelling bottom sediments and the other from among various kinds of algae. One fragmented worm was obtained from *Salvinia molesta* collection taken from Veli Lake on 21.10.'79, but this was not taken for the present study.

Description

When the live worms were placed under a coverslip on a slide they are seen to be extremely contractile, rapidly altering their shape, now short and contracted, soon long and
extended. In the preserved condition, the first specimen having no budding region measured 15 mm in length and 0.5 mm in diameter and the second specimen with two budding regions (three individuals) measured 23 mm in length and 0.65 mm in diameter; the former having 45 segments and the latter having 95 segments preceding a short unsegmented posterior region. The body is light reddish brown in colour owing to the presence of dark brown pigments aggregated more toward the anterior region. Prostomium rounded in shape, margin of which is also pigmented.

Gills present nearly on all segments beginning from VI as paired cylindrical dorso-lateral structures. Longest gill measured 0.15 to 0.20 mm and shortest 0.02 to 0.05 mm in length. In some segments they are present only on one side and in some others they are completely absent. Smaller gills intercalate with the longer gills in the anterior region (Pl. II, figs. 6 & 7). In the posterior region however gills are entirely composed of smaller ones (Pl. II, fig. 8). They contain vascular loops composed of an afferent and efferent vessel, the two vessels being connected by capillaries.

Setae arranged in four bundles per segment, two ventral and two dorsal. Ventral bundles commence from the second
segment and bear four setae per bundle. Setae sigmoid, medulus distal with distal prong longer, thinner and a little bent toward the proximal (Pl. II, fig. 9).

Dorsal bundle beginning from the VI segment onwards and consists of hairs and needles. The hairs are smooth and straight divisible into two types namely ordinary hairs and enclosed hairs. The former is usually associated with shorter gills projecting out of it while the latter is associated with larger gills and do not project from the surface as they are situated within the gill as an internal support, the usual number of hairs being three in the present case. The three hairs arise as separate ones at the basal region and as they enter the gills, they unite giving the appearance of a single hair seta. Of these, the longest one reaches the tip of the gill. The needles are rather straight and single-pointed. In the posteriormost region where hair setae are absent, the dorsal bundle is composed of one needle seta alone.

Asexual reproduction was seen to be taking place in one individual, the first budding zone being noticed behind XXXVIII segment.

Habitat

This species inhabits foul smelling sediments at the bottom of tanks and also attached to the 'roots' of Salvinia.
Distribution

Lake Toro in Hokkaido, Japan (Yamaguchi, 1938); U.S.S.R. (Chekanovskaya, 1962); East and South Asia, Australia and Africa (Brinkhurst and Jamieson, 1971).

Remarks

The present specimens exhibit all the distinguishing characters of the species enumerated by Naidu (1962b) and Brinkhurst and Jamieson (1971). As given by Naidu (1962b) in his key to the various species of this genus, the present specimens also bear only one type of needle seta which distinguishes it from *Branchiodrilus semperi* having distally curved needles in the posterior region. Ventral bundle also is composed of only one type of seta having distally placed nodulus, the disparity being noticed only in the nature of prongs. Naidu (op. cit.) described the prongs as equally long, but here the distal prong is always longer and thinner than the proximal, a character observed also by Chekanovskaya (1962) and Brinkhurst and Jamieson (1971). Brinkhurst (1966a) had noted the same type of setae in the anterior bundles, but posteriorly the distal tooth was shorter in his specimens. When compared with the description given by Yamaguchi (1938), the present specimen agrees in the following points. The gills are present nearly on all segments of the body.
beginning from the VI. Dorsal hairs formed of enclosed and ordinary ones, ordinary hairs always projecting freely from the posterior region. Needles also agree in being single-pointed and anodulate. Ventral bundle commences from the second segment, with setae having cleft at the distal end. The point of disparity noticed is in the nature of prongs; the present specimens having the distal prong longer and thinner than the proximal whereas in Yamaguchi's specimens the prongs are of equal length even though proximal prong is twice as thick as the distal. Brinkhurst and Jamieson (1971) separated Branchiodrilus hortensis from Branchiodrilus semperi on the basis of the nature of distribution of gills, the former having gills present throughout the body while in the latter, gills are restricted to the anterior half of the body. In this respect also the present specimens can be treated as B. hortensis. Brinkhurst and Jamieson (1971) had described the prongs of ventral setae as equally long or distal prong longer than the proximal. On the basis of the details furnished above the present specimens are treated as Branchiodrilus hortensis.
Subfamily Pristininae LASTOCKIN, 1924

Prostomium often forming a proboscis. No eyes. Dorsal setae usually beginning in II, consisting of hairs and needles. Pharyngeal and septal glands present; stomach of special structure, with intra-cellular canals. Commissural vessels mostly only in preovarial segments. Coelomocytes present. Nephridia sometimes invested with bladder-like peritoneal cells. Testes and spermatotheca in VII, ovaria and atria in VIII. Seven segments formed at anterior end, by budding.

Genus Pristina EHRENBERG, 1828

Dorsal setae hairs and simple, bifid or trifid, needles with or without a nodulus. Dorsal vessel in the middle line; commissural transverse vessels simple, anastomosing, or forming a plexus. Stomach, beginning in VI, VII or VIII. Chloragogen beginning in IV or V. Vasa deferentia with or without prostate cells joining atria on top; atria without prostate, most often weak, tubular; genital setae of various shapes, often accompanied by special glands.

10. Pristina proboscidea Beddard, 1896
(Pl. II, figs. 10-13)

Pristina proboscidea Beddard, 1896 : 4, Fig. 18.
Pristan aequiseta Bourne. MICHAELSEN, 1900: 34 (partim);
1905d : 309 (partim).
**Pristina proboscidea** Beddard f. *typica* MICHAELSEN, 1905b : 359.

**Pristina proboscidea** Beddard var. *paraguayensis* MICHAELSEN, 1905b : 360.


(?) **Pristina serpentina** WALTON, 1906 : 701, Fig. 11.

**Pristina proboscidea** Beddard f. *typica* Michaelsen.  

**Pristina proboscidea** Beddard var. *paraguayensis* Michaelsen.  
1909b : 134. STEPHENSON, 1923 : 73. AIYER, 1929a : 26, Fig. 6. MICHAELSEN and BOLDT, 1932 : 596.


Material examined

Six specimens were collected from the floating fern, *Salvinia molesta* Mitchell on 7-5-79 from Veli Lake near Trivandrum. Of these six specimens, posterior part of three specimens fragmented during collection. Another lot of three specimens were collected from the plankton sample taken from Veli Lake on 7-2-79.

Description

Worms with a single budding zone measured 1.8–2.0 mm, with diameter 0.18–0.22 mm and having 20–22 segments ahead of the short unsegmented posterior region. Anterior end produced into a
proboscis (Pl. II, fig. 11) which is wider at the base and tapering toward the distal region. Septa well developed. Eyes absent.

Dorsal bundle (Pl. II, fig. 13) commencing from the second segment. No specially elongated hair setae could be noticed in any segment. Hairs smooth without any ornamentation. In the anterior seven segments (II-VIII), a general trend to accommodate more than one hair seta has been noticed, the maximum number being three occurring in the IV segment. Even though segments II, VI and VII have only one hair seta, presence of two needle setae in these bundles indicates the original presence of two hair setae. The hair setae may be roughly classified into long and intermediate according to their length. Their length is not uniform, showing variation in the same bundle and also from segment to segment. The length of the longest hair seta occurring in each bundle shows a range between 240 and 370 μ, hair seta of the second segment being the shortest having only 240 μ (Table X). Needles single-pointed, anodulate and straight and occur in couples with the hair setae.

Like the dorsal bundles the ventrals also have their origin in the second segment. In the anterior six segments (II-VII), they have a constant number of three setae per bundle. The number increases to four in the VIII segment, five in the IX and six in X, XI, XII, and XIII. From the XIV segment a
A reduction in number of setae has been noticed. Ventral setae also exhibit much variation in their length, setae of II segment being the longest (98.5 μ). Setae of III–VI show a range between 93 μ and 95.1 μ. A sudden decrease in length to 87.0 μ has been noticed in the VII segment. From here a gradual reduction in the length of the setae is noticed until the XIII segment from where the setae show a constant length of 85.0 μ (Table X). Ventral setae all bifid with median nodulus and distal prong longer than the proximal (Pl. II, fig. 12).

Mouth is ventral, pharynx occupies II–IV and oesophagus V–VII segments. Stomach pear-shaped lodged in the VIII segment, followed by the intestine.

Two specimens were undergoing asexual reproduction at the time of collection, the first sign being a slight constriction between the XVI and XVII segments.

Habitat

These specimens were found attached to the 'roots' of Salvinia molesta Mitchell and also along with other planktonic forms.

Distribution

South America, Zanzibar, South and East Asia, Australia (Brinkhurst and Jamieson, 1971); Argentina (Di Persia, 1980).
Indian sub-continent:— Trivandrum (Aiyer, 1929a).

Remarks

Absence of specially elongated hair setae in any of the segments is a character which according to Brinkhurst and Jamieson (1971) distinguishes Pristina proboscidea from Pristina longiseta having specially elongated seta in the third segment and also from Pristina biserrata having elongated setae at least from the VIII segment. Naidu (1963) also had taken the same character to identify Pristina proboscidea from Pristina longiseta longiseta, Pristina longiseta sinensis, Pristina longiseta leidyi and Pristina biserrata all having dorsal setae beginning from the second segment.

In the present specimens also, even though the length of the setae oscillate from segment to segment, no specially elongated hair seta could be noticed in any of the segment. As suggested by Brinkhurst (1966d, 1971) and Brinkhurst and Jamieson (1971) the dorsal bundle here also begins from the second segment with more than one hair seta and one needle seta per bundle, but the maximum number noticed is three instead of four suggested by Brinkhurst (1966d, 1971) and Brinkhurst and Jamieson (1971).

Ventral bundles of the present specimens also show a general tendency to bear more setae in the middle region, the maximum number recorded being six in the X, XI, XII and XIII
segments. This is quite small when compared with the fourteen reported by Brinkhurst (1966d) and Brinkhurst and Jamieson (1971). All setae here are of the same type, with median nodulus and distal prong longer than the proximal, setae of the II segment being the longest (98.5 µ). Since no measurements of the setae have been given by Brinkhurst (op. cit.) or Brinkhurst and Jamieson (op. cit.) a comparative study of their size is difficult. Except for these minute variations suggested above, no marked differences could be noticed in the present specimens from the description furnished by the previous authors.
TABLE X

Number and length of the setae in the ventral and dorsal bundles in different segments of *Pristina profossidea* Beddard

<table>
<thead>
<tr>
<th>Segments</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>XIII</th>
<th>XIV</th>
<th>XV</th>
<th>XVI</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of setae in each ventral bundle</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<td>4</td>
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<td>5</td>
<td>4</td>
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</tr>
<tr>
<td>Length of the ventral seta in microns</td>
<td>-</td>
<td>98.5</td>
<td>95.0</td>
<td>95.1</td>
<td>93.1</td>
<td>93.0</td>
<td>87.0</td>
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<td>2</td>
<td>3</td>
<td>2</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>No. of needles in each dorsal bundle</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
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<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>Length of the longest hair seta of the dorsal bundle in microns</td>
<td>-</td>
<td>240.0</td>
<td>230.0</td>
<td>250.0</td>
<td>255.0</td>
<td>240.0</td>
<td>250.0</td>
<td>247.0</td>
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<td>215.0</td>
<td>335.0</td>
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<td>370.0</td>
<td>325.0</td>
<td>350.7</td>
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</tr>
<tr>
<td>Length of the needle seta of the dorsal bundle in microns</td>
<td>-</td>
<td>55.0</td>
<td>55.0</td>
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<td>53.5</td>
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<td>53.5</td>
<td>53.5</td>
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</tbody>
</table>


11. **Pristina longiseta longiseta** Ehrenberg, 1828

*(Pl. II, figs. 14-17)*

**Pristina longiseta** EHRENBERG, 1828: 112.

**Pristina longiseta** (Ehrenberg). GRÉVAIN, 1838: 17.


**Stylaria longiseta** (Ehrenberg). TAUBER, 1879: 73.


UDE, 1929: 29, Figs. 25-26. STEPHENSON, 1931c: 41, Fig. 2. BERG, 1938: 45. CHEN, 1940: 46, Fig. 12a.


**Nais proboscidea** O.F. MüLL. LEVINSEN, 1884: 219 (Partim).

**Pristina leidyi** Smith. MICHAELSEN, 1905b: 357 (Partim).

**Pristina longiseta** Ehrenberg f. *typica* MICHAELSEN, 1905d: 308.

**Pristina longiseta** Ehrenberg f. *typica* Michaelson.

MICHAELSEN, 1909a: 25, Figs. 41-42. STEPHENSON, 1923: 70, Fig. 23. SVETLOV, 1924: 197. AYER, 1929a: 24, Fig. 4.

**Pristina longiseta** Ehrenberg. JACKSON, 1931: 74.

**Pristina longiseta** Ehrenberg f. *typica* Michaelson.

MICHAELSEN and BOLDT, 1932: 595.

**Pristina longiseta sinensis** SPERBER, 1948: 237.

**Pristina longiseta sinensis** Sperber. NAIDU, 1963: 204.

**Pristina longiseta longiseta** Ehrenberg. SPERBER, 1948: 236, Pl. XXI, Figs. 2, 6; 1950: 77, Fig. 28c, Pl. III, Fig. 9. NAIDU, 1963: 216, Figs. 34a-k. BRINKHURST, 1966d: 144. BRINKHURST and JAMESON, 1971: 402.
Material examined

Five entire specimens, all with a single budding zone, were obtained from the floating fern, *Salvinia molesta* Mitchell collected from the Veli Lake on 5.5.'79. A second lot of three specimens, one with mutilated posterior region was obtained from the plankton sample taken from the same area on 31.4.'79. The present description is based on these eight worms.

Description

Worms (Pl. II, fig. 14) small having an yellowish tinge in the body wall and quite transparent under the microscope. When placed under a cover glass for observation under the microscope, the body exhibited a sort of undulating movement, hairs become fully extended and proboscis frequently bending backwards as well as to the sides. Formalin preserved materials became white and opaque and measured 2-2.25 mm in length and 0.15-0.18 mm in diameter with 24-28 segments. Proboscis highly mobile and in the preserved condition measures 250-270 μ in length with a width of 40-50 μ at the basal region.

Dorsal bundle (Pl. II, fig. 17) commencing from the second segment with hairs and needles arranged in an alternating manner. II segment bears only one hair seta and one needle seta per bundle. The number shows an increase to two per bundle in the third segment and three per bundle in the IV and V segment, this being
the maximum number noted in the present material. A peculiar feature noticed in the VIII segment is that even though two needles are present here, only one hair seta has been noticed; presence of two needles in this segment indicates that the other hair seta may have fallen out, the cause of which is not clear. No uniformity in length of hair setae has been noticed, setae of third segment being the longest (750 μ) (Table XI). They are straight, non-serrated, highly mobile reaching beyond the tip of the proboscis when turned forward. Needles straight, anodulate, 50-53 μ in length.

Ventrals beginning with an arrangement of four setae per bundle from the second segment. They are five per bundle in the III segment followed by seven per bundle until the VIII segment where the number shows again a reduction to six per bundle. This condition is maintained only in the VIII and IX segments, segments X to XII again having seven setae per bundle. The maximum number of twelve setae occurs in the XIII, XIV and XV segments. Setae of second and third segment are comparatively longer (98 μ), IV segment shows a reduction to 55 μ and this is maintained until the VIII segment where again a reduction to 51 μ occurs. Setae of XI-XVIII shows an identical length of 50 μ (Table XI). Anterior setae are with comparatively straight shaft with median nodulus (Pl. II, fig. 15), prongs of equal width with distal twice as long and bent a little toward the proximal.
Posterior setae are more sickle-shaped with distal nodulus; difference between the two prongs also becomes lesser in this region (Pl. II, fig. 16).

Pharynx in II-III, a little bulged outwards; oesophagus in IV-VII and is narrow; stomach in VIII - 1/3 of IX, pear-shaped and this is followed by the intestine. Budding zone present in between XVII and XVIII segments.

Habitat

Found attached to the 'roots' of *Salvinia molesta* Mitchell and also along with other planktonic forms.

Distribution

Europe, Asia, Africa and Australia (Brinkhurst and Jamieson 1971).

Indian sub-continent: - Bugga stream, Cuddapah; Ulsoor tank, Bangalore (Naidu, 1963).

Remarks

Naidu (1963) had taken the relative length of the two prongs of the ventral setae as the basic character for distinguishing *Pristina longiseta longiseta* from *Pristina longiseta sinensis* and *Pristina longiseta leidyi*; former having distal tooth of the ventral setae of II and III nearly twice as long as the proximal whereas in the latter two the distal tooth of ventral setae
of II and III is thrice as long as the proximal. It is found that in all these three species the dorsal setae had its beginning from the second segment with hairs of segment III specially elongated.

As suggested by Stephenson (1909), Naidu (1963), Brinkhurst and Jamieson (1971), in the present material also one of the hair seta of the third segment is very long. When compared with those of Naidu's (1963) specimens, the dorsal setae do not exhibit much variation. The maximum number of setae in a bundle noticed in the present specimens is three and in the shape also the needles and hairs fully agree with the description given by Naidu (op. cit.) in being anodulate and single pointed. Brinkhurst (1966d) and Brinkhurst and Jamieson (1971) had noted the maximum occurrence of four hair setae and five needles per bundle. Stephenson (1909) recorded the number in the dorsal bundle as 2-5.

Though the ventral setae described here show a general resemblance to the description furnished by Stephenson (1909), Naidu (1963), Brinkhurst (1966d) and Brinkhurst and Jamieson (1971), they show slight differences in the number, shape and arrangement. A general trend for the ventral bundle to accommodate more setae toward the middle region has been noticed in the present specimens, the maximum number being twelve in
the XIII to XV segments. Naidu (1963) recorded the maximum number per bundle as six, Stephenson (1909) as 3-9, 5 being the common number, Brinkhurst (1966d) and Brinkhurst and Jamieson (1971) as 3-9. As stated by Naidu (1963) in his key to the various species of this genus, the distal tooth of the ventral setae of II and III is nearly twice as long as that of the proximal. Brinkhurst (1966d) described the ventral chaetae in II as slightly longer and thinner than the rest, in III as slightly longer and thicker than the rest with upper tooth twice as long as the lower. Brinkhurst and Jamieson (1971) also observed the same thing about the ventral setae of II and III segment with the upper tooth much longer than the lower. In the present specimens also it is seen that the setae of II and III segments are comparatively longer (98 μ). Regarding the position of nodulus, anterior ventral setae of the present specimens have median nodulus instead of the proximal nodulus described by Naidu (1963). Brinkhurst (1966d) and Brinkhurst and Jamieson (1971) did not mention anything about the position of the nodulus.

In spite of all these variations mentioned above it is seen that the present specimens exhibit all the diagnostic characters enumerated by Naidu (1963) and Brinkhurst and Jamieson (1971) and hence treated as Pristina longiseta longiseta Ehrenberg.
<table>
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</table>
Genus **Stephensoniana** CERNOSVITOV, 1938

No eyes. Dorsal setae from II onwards, hairs and straight, simple-pointed needles; ventral setae all of one type. No coelomocytes. Sexual organs one segment in front of the usual situation; atria provided with prostate gland cells; penial setae present. Four segments formed at anterior end on budding.

12. **Stephensoniana trivandrana** (Aiyer, 1926)
   (Pl.II, figs. 18-21)

**Naidium trivandranum** AYER, 1926 : 139, Pl. V, VI.
**Stephensonia trivandrana** (Aiyer). AYER, 1929a : 27, Fig. 7, Pl. 1, Figs. 2-4.
**Stephensoniana trivandrana** (Aiyer). CERNOSVITOV, 1938a : 539, Figs. 1-4.
SPERBER, 1948 : 208, Fig. 28c.
**NAIDU,** 1963 : 201, Figs. 28a-d.
**BRINKHURST,** 1966d : 142.
**BRINKHURST** and **JAMIESON,** 1971 : 389, Figs. 7.

Material examined

Two entire specimens were obtained from the bottom mud sample collected from an unused tank in the aquarium campus on 27.7.'79. A second lot of three specimens was collected from the floating fern, *Salvinia molesta* Mitchell on 7.3.'79 from the Veli Lake near Trivandrum. Of these three, one got fragmented during collection and hence not used for the present
systematic study. The present description is based on the remaining four specimens.

Description

Formalin preserved specimens measured 2.5-3.0 mm in length with a diameter of 0.18-0.20 mm and with 26-30 segments. Body whitish and opaque as a result of preservation. Prostomium semicircular and having a width of 35.0-37.5 µ at the middle region. Mouth ventral. Sand particles and other organic detritus adhere to the body wall owing to the mucilaginous secretion present around it.

Both dorsal and ventral bundles commence from the II segment. Ventral bundle of anterior six segments (II, III, IV, V, VI and VII) bears a constant number of four setae per bundle. Setae are with proximal nodulus and distal prong longer than the proximal (Pl. II, fig. 19). The difference between the two prongs becomes more pronounced toward the posterior region. Prongs have equal width at the base, a feature maintained throughout the length of the body. Setae of II-V segments are comparatively longer having a range of 83.0-85.4 µ, setae of II segment being the longest (85.4 µ). Coming to the VI segment, the setae show a sudden decline to 79.0 µ and this is followed by still smaller setae of 74.0 µ in the VII segment. VIII and IX segments have setae of identical length (73.5 µ), but in X segment again a reduction to 72.0 µ is discernible (Table XII).
Dorsal bundle bears hair setae and needle setae. Anterior six bundles (excluding VI segment) have three hair setae and three needle setae per bundle. In the VI segment, only one hair seta has been observed and since three needle setae have been present here, it is guessed that the other two hair setae may have fallen off the segment. The number is reduced to two and one toward the posterior region. Hairs bayonet-shaped ranging from 60-185 μ in length (Pl. II, fig. 20). Needles single-pointed, anodulate and distally curved (Pl. II, fig. 21).

Alimentary canal slightly widens in the third segment to form the pharynx. Oesophagus narrow in the fourth and fifth segments and widens again in the sixth segment to form the intestine.

Habitat

Worms live in the soft bottom mud of tanks covered with decaying organic matter and other vegetable debris. It is also found attached to the 'roots' of Salvinia molesta Mitchell.

Distribution

India, Palestine and Africa (Brinkhurst, 1966d, Brinkhurst and Jamieson, 1971); Argentina (Di Persia, 1980).
When Aiyer described this species for the first time in 1926, he was not sure about the systematic position and so, following Stephensons (1923) key he placed it under the genus Naidium. But an examination of the reproductive organs and their position in segments IV and V prompted Aiyer (1929a) to create a new genus Stephensonia to incorporate this particular species. Naidu (1963) separated this from Naidinae and created a new subfamily Stephensonianinae to accommodate this particular genus, on the criterion that the dorsal setae begin from the second segment onwards. According to Brinkhurst and Jamieson (1971), beginning of dorsal bundle from the second segment cannot be attributed as a reason because in Homochaeta also the dorsal setae begin from the second segment, but yet it is placed under Naidinae. According to them, the only difference between the genus Stephensonia and the rest of the Naidinae is the failure to develop a fifth segment at the front end, following asexual reproduction which places the gonads one segment forward of the position in other Naidinae and in the same position as in the Paranaidinae.
Even though the present specimens show a general resemblance to the description given by Aiyer (1926), Naidu (1963), Brinkhurst (1966d) and Brinkhurst and Jamieson (1971), they differ in the number and length of both dorsal and ventral setae and also in the position of 'n'.

Dorsal bundle begins from the second segment which is considered as the important diagnostic character of the species. When the diagrams of the needle setae and hair setae of the present specimens are compared with those of Naidu (1963) and Brinkhurst and Jamieson (1971), no disparity in the shape of setae could be noticed. The only variation observed being the number of setae occurring per bundle, the maximum number of hair setae and needle setae noted per bundle in the present specimens being three. Naidu (1963) obtained a maximum of five hair setae and five needle setae per bundle, but Aiyer (1926) and Brinkhurst and Jamieson (1971) observed a maximum of four setae per bundle. Brinkhurst (1966d) accounted a maximum of five setae per bundle.

In the number of setae per ventral bundle also, the present specimens agree well with the description given by Aiyer (1926), Naidu (1963) and Brinkhurst and Jamieson (1971) in having a maximum number of four setae per bundle in the anterior segments. But when the position of nodulus and nature of prongs are taken, the present specimens agree more to the description of
Brinkhurst and Jamieson's (1971) than to the description of either Aiyer (1926) or Naidu (1963). As described by Brinkhurst and Jamieson (1971), here the setae are all with proximal nodulus, with distal prong longer than the proximal, the difference between the two prongs becoming more pronounced toward the posterior region. Naidu (op. cit.) observed that the setae of posterior segments have distally placed nodulus and distal prong of the anterior segments thicker than the proximal whereas Aiyer (1929a) obtained setae all with distally placed nodulus.

Regarding the length of the body, the present specimens come within the range expected by Aiyer (1926), Brinkhurst (1966d) and Brinkhurst and Jamieson (1971), but 'n' in the present specimens is placed a little anterior (XVII-XVIII) than that noted by Aiyer (op. cit.) (XX) and a little posterior when compared with Naidu's (1968) specimens (XII-XIV).

Even though the present specimens show certain differences in the number of dorsal setae, in the setal characters of ventral bundle, in the position of 'n' etc. the general agreement on several other characters justifies the inclusion of them as Stephensoniana trivandrana (Aiyer).
<table>
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<tr>
<th>Segments</th>
<th>I</th>
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<th>VIII</th>
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<tr>
<td>No. of needle setae in each dorsal bundle</td>
<td>-</td>
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<td>3</td>
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</tr>
<tr>
<td>Length of the longest hair seta of the dorsal bundle in microns</td>
<td>-</td>
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<td>150.0</td>
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<td>90.0</td>
<td>90.0</td>
<td>85.0</td>
<td>60.0</td>
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</table>
Genus *Stylaria* LAMARCK, 1816

Eyes normally present. Pigment present. Prostomium forming a proboscis. Dorsal setae from VI, hairs and straight, simple-pointed needles without nodulus; ventral setae all with proximal tooth weak, nodulus proximal, distal part of setae straight, proximal part angularly bent. Pharyngeal and oesophageal glands present; stomach present. Simple transverse vessels in II-V; dorsal vessel in the middle line, coelomocytes present. Clitellum absent around the male pores; *vasa deferentia* with or without prostate glands on their hindmost part; atria with prostate glands; penial setae present.

13. *Stylaria fossularis* Leidy, 1852
   (Pl. II, figs. 22-26)

*Stylaria fossularis* Leidy, 1852b : 287.


*Stylaria lacustris* (L.). MICHAELSEN, 1900 : 33 (Partim).

WALTON, 1906 : 693, Fig. 6 (Partim). STEPHENSON, 1909 : 276, Pl. XIX, Fig. 46; 1911 : 209, Fig. 3; (?) 1920 : 200; 1923 : 85, Fig. 31 (Partim). GALLOWAY, 1911 : 303 (Partim). AYER, 1925 : 31. YOSHIZAWA, 1928 : 587, Fig. 1028. KONDO, 1936 : 384, Pl. XXIII, Fig. 9.
Material examined

Three specimens having a single budding zone were obtained from the floating fern, Salvinia molesta Mitchell collected from the Veli Lake near Trivandrum on 7.5. '79. Two specimens were collected from the same area on 10.6. '79. These five specimens were used for the present systematic study.

Description

Worms small with transparent yellowish body wall (Pl. II, fig. 22). Formalin preserved specimens whitish and opaque and measure 2-3 mm, with 0.16-0.19 mm in diameter and having 25-32 segments. Prostomium semicircular and from the anterior tip of it projects out the proboscis (Pl. II, fig. 26) which is very distinct, wider at the basal region and tapering toward the distal with rounded tip. In the preserved condition, length of the prostomium 500 μ, width at the tip 15 μ, middle 25 μ and base 50 μ. One pair of eyes present on either side in the dorsal region, crescentic in shape and blackish purple in colour.

Dorsal setae begins from the VI segment. VI and VII segment bears two setae per bundle. In the remaining segments
only one hair seta have been noticed in spite of the occurrence of two needle setae per bundle. Hair setae of VI-XV showed a range between 250.0 and 298.2 μ in length, those of the VI segment being the longest (298.2 μ) (Table XIII). Hairs simple, smooth and straight (Pl. II, fig. 25). Needles also begin from the VI segment; single-pointed, anodulate and straight (Pl. II, fig. 24). Setae of VI-IX showed a range between 94.0 μ in length. A decline in length to 78.0 μ is discernible in the X segment. From here a gradual reduction occurs so that in the XIV segment, they measure only 63.0 μ.

Ventrals have an arrangement of four setae per bundle in the II segment and five setae per bundle in III-V segments. A general trend to accommodate more setae in the ventral bundle has been noticed toward the posterior region; segments IX-XIV have six setae per bundle and XV-XX bear seven setae per bundle. Regarding size, setae of II-V are comparatively longer having a range of 118.0-120.3 μ, VI-VIII measure 113.5 μ, IX-XIV, 112.0 μ, XV-XVI, 110.5 μ and still posteriorly they measure only 100.0 μ (Table XIII). The shaft of the setae is rather straight with proximal nodulus, prongs having equal width at the base but the distal is longer and a little bent toward the proximal (Pl. II, fig. 23).
All the five specimens were undergoing asexual reproduction at the time of collection and 'n' XVII-XX.

Habitat

Found attached to the 'roots' of *Salvinia molesta*.

Distribution

U.S.S.R (Chekanovskaya, 1962); East and South Asia, North America, Europe (Britain), Africa (Brinkhurst and Jamieson, 1971).

Indian sub-continent:— Punjab (Stephenson, 1909); Trivandrum (Aiyer, 1925); Bugga stream in Cuddaph (Naidu, 1962b).

Remarks

According to Chekanovskaya (1962), Brinkhurst and Jamieson (1971), genus *Stylaria* is composed of two species, *Stylaria lacustris* and *Stylaria fossularis*. The main distinction between the two as pointed out by the above mentioned authors is in the form of the prostomium at the point of origin of the proboscis; the proboscis in *Stylaria lacustris* projects from a notch between two lateral lobes while at projects from the pointed tip of the prostomium in *S. fossularis*. According to Brinkhurst (1964a) the separation of *S. fossularis* from
S. lacustris is invalid as he found both species occurring in the same locality in Britain and in 1976 opined that S. fossularis is not more than a form of S. lacustris, both forms being found together in many habitats in Europe and N. America. Even though Michaelsen (1900) merged S. fossularis with S. lacustris, Chen (1940) bifurcated these two species and in the present study also the two species are treated separately.

As pointed out by Stephenson (1909), Naidu (1962b), Brinkhurst (1966d) and Brinkhurst and Jamieson (1971), the proboscis in the present specimens also project out from the pointed tip of the prostomium and no variation in the shape of the prostomium or proboscis could be noticed. Dorsal setae here also begin from the VI segment and in shape also they fully agree with the earlier descriptions even though they are comparatively shorter than those of Naidu's (op. cit.) specimens. A major difference noticed is in the number of hair setae occurring per dorsal bundle. Except in VI and VII segments, only one hair seta has been noticed. Stephenson (1909) noticed a maximum of three hair setae per bundle whereas Naidu (1962b), Chakanovskaya (1962), Brinkhurst (1966d) and Brinkhurst and Jamieson (1971) found only 1–2 hairs per bundle. In Naidu's specimens, needle setae showed an identical length of 63.0 μ, but here no such uniformity in the length of the needle setae could be noticed. Instead the setae showed a decrease in length from the anterior to the posterior region.
Ventral bundles of the present specimens showed a general trend to accommodate more setae toward the posterior region, the maximum number recorded being seven (XV-XX). Stephenson (1909) noticed a maximum of 5 or 6 in each bundle, Naidu (1962b) 6-10 per bundle while Chekanovskaya (1962), Brinkhurst (1966d) and Brinkhurst and Jamieson (1971) observed 5-14 per bundle. In the position of the nodulus and in the nature of prongs also, the present specimens fully agree with the description furnished by Naidu (op. cit.). But when the diagram of the ventral seta of the present specimen is compared with that of Naidu, a slight difference could be noticed in the shape of the seta. In Naidu's figure, the proximal part of the ventral seta shows a sharp bent, which is not present in any of the present specimens.

It is seen that all the general characters exhibited by *S. fossularis* such as the presence of a proboscis at the anterior end, presence of a pair of eyes, dorsal bundle with more than one hair seta and one needle seta per bundle and ventral bundle with an increased number of setae are shown by *S. lacustris* also. The difference noticed is in the shape of prostomium at the point of origin of the proboscis and also in the nature of the hair seta being smooth here instead of having fine serrations as seen in *S. lacustris*. According to Naidu (1962b), Brinkhurst and
Jamieson (1971), these two characters are sufficient enough to distinguish the two species of the genus and so the present specimens are considered as *Stylaria fossularis* Leidy.
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<td>No. of needle setae in each dorsal bundle</td>
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<tr>
<td>Length of the longest hair seta of the dorsal bundle in microns</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
<td>298.2</td>
<td>290.4</td>
<td>298.0</td>
<td>270.2</td>
<td>290.0</td>
<td>250.0</td>
<td>255.0</td>
<td>250.0</td>
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<td>260.0</td>
<td>248.0</td>
<td>248.0</td>
<td>247.5</td>
<td>247.0</td>
<td></td>
</tr>
<tr>
<td>Length of the needle seta of the dorsal bundle in microns</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>95.0</td>
<td>94.5</td>
<td>95.0</td>
<td>94.0</td>
<td>78.0</td>
<td>75.0</td>
<td>68.0</td>
<td>63.0</td>
<td>63.0</td>
<td>63.5</td>
<td>62.0</td>
<td>62.0</td>
<td>62.0</td>
<td>62.0</td>
<td></td>
</tr>
</tbody>
</table>

* Including one fragmented seta
Genus *Nais MÜLLER*, 1773

Eyes normally present. Anterior segments usually pigmented. Dorsal setae beginning in VI, hairs and palmate, pectinate, double or simple-pronged needles. Ventral setae of II–V mostly well differentiated from those of the following segments. Pharynx in II–III; pharyngeal and oesophageal glands present; stomach beginning in VII (occasionally in VIII or IX). Vascular system with simple or anastomosing transverse vessels in I–V. Coelomocytes present. Clitellum in ⅓ V–VII, absent between the male pores; spermathecae with distinct ducts; vasa deferentia with prostate glands, joining atria immediately above atrial ducts; atria without prostate; penial setae present, with a simple or double hook.

(Pl. II, figs. 27–31)

(?) *Nais elinguis* MÜLLER, 1773 : 22 (? partim).


BLAINVILLE, 1825 : 131; 1828 : 496. ØRSTED, 1842 : 135. GRUBE, 1851 : 104. UDEKEM, 1855a : 551;
VAILLANT, 1890 : 369, Pl. XXIII, Fig. 11. BOURNE, 1891 : 344. BENHAM, 1892 : 212, Pl. VII, Figs.
GALLOWAY, 1911 : 303.
(?) Opponas is elinguis (Müller). GERVAIS, 1838 : 17
(?) Partim).

Nais heterochaeta BENHAM, 1893 : 383, Pl. XXXIII, Figs. 1-5.

Nais communis PIGUET, 1906a : 247, Pl. X, Fig. 9, Pl. XI, Figs. 14-17, 19, Pl. XII, Fig. 11.

(?) Nais parvula WALTON, 1906 : 697, Fig. 7.

Nais parviseta WALTON, 1906 : 699, Fig. 9.

Nais communis PIGUET, 1913 : 116; 1928 : 80. PIGUET and BRETSCHER, 1913 : 37. SCHUSTER, 1915 : 41, Fig. 27. SMITH, 1916 : 639. STEPHENSON, 1922a : 255; 1932 : 231. SVETLOV, 1924 : 193. STOLTE, 1927 : 1, Figs. 1-20. UDE, 1929 : 46, Fig. 56. MICHAELSEN and BOLDT, 1932 : 591. REDEKE and DE VOSS, 1932 : 15. SZARSKI, 1936 : 399, Pl. XVIII, Figs. 1-5, 9. PREU, 1937 : 255, Figs. 1-13. WESENBERG-LUND, 1938 : 7. SCIACCHITANO, 1938 : 259. CHEN, 1940 : 33, Fig. 4; 1944 : 5. (?) MARCUS, 1943 : 21, Pl. I, Fig. 5, Pl. II, Figs. 6-8. SPERBER, 1948 : 602, Pl. VII, Fig. 1; 1950 : 60, Fig. 10, Pl. I, Fig. 7; 1958 : 46; 1960 : 156. MARCUS, 1949 : 1. ERCOLINI, 1956 : 7. TIMM, 1959 : 25; 1962 : 191, Fig. 1a. BRINKHURST, 1962a : 319; 1963b : 28, Fig. 5h; 1963c : 143; 1964a : 206, Fig. 2f; 1966d : 134. BRINKHURST and JAMIESON, 1971 : 330, Figs. 7. 8E-II. CHEKANOVSKAIA, 1962 : 184, Fig. 100. MOSZYNSKA, 1962 : 11. NAIDU, 1962a : 140, Figs. a-f. BOTEIA, 1963 : 337; DI PERSIA, 1980 : 97.

Nais variabilis var. Punjabis STEPHENSON, 1909 : 255, Figs. 1-3, Pl. XV, Figs. 1-6, Pl. XVI, Figs. 9-16.

Nais variabilis var. punjabensis Stephenson. STEPHENSON, 1910a : 66, Pl. VIII, Figs. 1-2.


Nais communis var. casea STEPHENSON, 1910b : 238, Pl. XI, Fig. 3.

Peterochaeta astronensis PIERANTONI, 1911 : 4, Pl. IV, Figs. 1-12.

(non) Nais communis PIGUET. SOUTHERN, 1913 : 4.
Material examined

Fifteen specimens were obtained from three plankton samples taken from the Veli Lake near Trivandrum on 7-3-'79, 15-3-'79 and 15-7-'79. Of these, six were with mutilated posterior region and hence discarded. A second lot of five specimens was collected from the floating fern, Salvinia molesta from the same lake on 17-7-'79. These together with the entire ones got from the plankton samples were used for the present study.

Description

Worms have an indefinite light yellowish hue and is fairly transparent under the microscope. When placed in a petri dish containing water, they crawl freely on the bottom. Formalin preserved specimens with a single budding zone measured 1.5-2.0 mm in length and have 25-30 segments, segmentation being well marked. Prostomium short and rounded; the surface epithelium is thicker at its tip than elsewhere in the body. Mouth transverse reaching from side to side. Eyes are placed at the base of the
prostomium. They are irregularly ovoid in shape and formed by aggregation of black pigments with a violet tinge. Additional smaller eyes are present (Nebenaugen). In one worm five such spots have been counted all placed dorsally. Body is cylindrical uniformly decreasing in diameter toward the posterior region. Anus at the terminal region.

Ventral bundle begins from the second segment with a constant number of three setae per bundle. Anterior bundles (II, III, IV and V) have slightly proximal nodulus (Pl. II, fig. 28), VI with median nodulus (Pl. II, fig. 29) and posterior with distally placed nodulus for their setae (Pl. II, fig. 30). In the anterior II-V segments, the distal prong is thinner and longer than the proximal. But by the VI segment they are of equal length and width. Setae of II and III segments are comparatively longer (125.0 \( \mu \) m), IV (100.5 \( \mu \) m), VI to XI (90.0 \( \mu \) m) and this is followed by setae of 87.5 \( \mu \) m in the succeeding segments (Table XIV).

Dorsal bundle commencing from the second segment with only one hair seta and one needle seta per bundle. Hair setae smooth without any ornamentation, length varying from segment to segment (Pl. II, fig. 31). They arise from lobulated setal sacs. In some they have fallen out and in some others they have obviously been broken off. Needles bifid, the two prongs being
rather very small. The nodule is indistinct and a sharp bent occurs at the distal region.

Buccal cavity occupies the second segment. Pharynx commences from the anterior septum of the third segment and extends up to 3/4th of the IV segment. This is followed by the oesophageal region till the VII segment where it is continued as the stomach.

Asexual reproduction was noticed in six individuals; 'n' being XVI twice, XVII thrice and XVIII only once.

Habitat

Planktonic forms and also attached to the 'roots' of Salvinia molesta.

Distribution

U.S.S.R. (Chekanovskaya, 1962); Cosmopolitan (Brinkhurst and Jamieson, 1971); Argentina (Di Persia, 1980).

Indian sub-continent: Punjab (Stephenson, 1909); Bugga stream, Cuddapah (Naidu, 1962a).

Remarks

According to the nature of the needle setae whether they are spatulate, single-pointed or double-pointed, Naidu (1962a)
grouped the fourteen species of this genus into three groups; 
_Nais communis_ along with other seven species (_N. bretscheri, 
_N. pardalis, N. elinguis, N. raviensis, N. variabilis, N. menoni_) 
come under the last group with double-pointed prongs. Brinkhurst 
and Jamieson (1971) had taken the character of the ventral setae 
to distinguish _N. raviensis_ from _N. communis_ (the former having 
ventral setae of II-V twice as long as the rest) and also that of 
stomach to distinguish the present species from _N. variabilis_, 
the former having a gradually widening stomach and the latter in 
which the stomach widens abruptly.

It is seen that in the present specimens all these 
distinguishing characters are present. As described by Stephenson 
(1909), Naidu (1962a), Chekanovskaya (1962); Brinkhurst (1966c) 
and Brinkhurst and Jamieson (1971), the needle setae of the 
present specimens also are bifid with prongs minute and equal, 
and nodulus rather indistinct. Hair setae also agree considerably 
with the earlier descriptions in shape and form. Slight diffe-
rence noticeable are in the number of setae per bundle and also 
in the relative length of hairs and needles. In the present 
specimens, incidence of more than one hair seta and one needle 
seta has never been noticed whereas Stephenson (1909), Naidu 
(1962a), Chekanovskaya (1962), Brinkhurst (1966d) and Brinkhurst 
and Jamieson (1971) noted the presence of more than one hair
seta and one needle seta per bundle and according to Stephenson (1909) there seems to be no correlation between the number of hairs and needles as he observed two hairs with one needle seta and one hair seta with two needle setae.

Ventral setae of anterior II-V agree with those described by Stephenson (1909) in being curved (sigmoid) and forked distally, the proximal prong being shorter and thicker than the distal. In the position of nodulus, a perfect correlation is seen with that of Naidu's (1962a) material, being proximal in II-V segments, median in VI and distal in the rest. Even though the present specimens have unequal prongs in the anterior II-V segments, posterior setae have prongs of equal length and width. A comparative study of the setae of all segments reveals that setae of II-V are peculiar from those of the rest. Ventrals in the present specimens have three setae per bundle, a character which is maintained throughout the length of the body. Naidu (1962a) had given the range as 3-5 per bundle, Chekanovskaya (1962), Brinkhurst (1966d) and Brinkhurst and Jamieson (1971) as 2-6 per bundle. When the size of setae is considered the present specimens have comparatively longer setae; setae of II and III showing identical length of 125.0 μ. In Naidu's specimens setae measured 84.0 μ in II and 80.5 μ in III.
Despite these variations, the identity of the species is quite clear and can be confirmed by several well defined characters. Prostomium and eyes of the present specimens do not show any variation from those of Stephenson's (1909) specimen. But according to Naidu (1962a) presence or absence of eyes is insignificant as he says "Absence of eyes cannot be taken as a character to create a new species, as it is found that forms without eyes have been met with in Stylaria fossularis also in the family". In addition to the eyes, additional smaller eyes "Neubenaugens" described by Stephenson (1909) have also been met with in the present specimens. Taking into account all the characters mentioned above, the present specimens are treated as Nais communis Piguet.
TABLE XIV

Number and length of setae in the ventral and dorsal bundles in different segments of *Nais communis* Piguet

<table>
<thead>
<tr>
<th>Segments</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>XIII</th>
<th>XIV</th>
<th>XV</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of setae in each ventral bundle</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
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<td>3</td>
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<td>3</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Length of the ventral seta in microns</td>
<td></td>
<td>125.0</td>
<td>125.0</td>
<td>100.5</td>
<td>100.5</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>87.5</td>
<td>87.5</td>
<td>87.5</td>
<td>87.5</td>
<td></td>
</tr>
<tr>
<td>Length of the hair seta of the dorsal bundle in microns</td>
<td></td>
<td></td>
<td></td>
<td>180.0</td>
<td>182.5</td>
<td>162.5</td>
<td>162.5</td>
<td>160.0</td>
<td>165.0</td>
<td>160.3</td>
<td>170.0</td>
<td>150.0</td>
<td>150.0</td>
<td>150.0</td>
<td></td>
</tr>
<tr>
<td>Length of the needle seta of the dorsal bundle in microns</td>
<td></td>
<td></td>
<td></td>
<td>47.1</td>
<td>47.1</td>
<td>45.0</td>
<td>45.0</td>
<td>45.0</td>
<td>45.0</td>
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<td>45.0</td>
<td>45.0</td>
<td>45.0</td>
<td></td>
</tr>
</tbody>
</table>
Family Tubificidae
Subfamily Tubificinae EISEN, 1879
Genus Limnodrilus CLAPARÈDE. 1862

Male efferent ducts with long vasa deferentia, small bean-shaped atria bearing large prostate glands, ejaculatory ducts long, penes more or less elongate with thick cylindrical sheaths; Genital setae, hair setae and pectinate setae absent. Coelomocytes absent. Spermathecae with spermatophores.

15. Limnodrilus hoffmeisteri Claparède, 1862
   (Pl. III, figs. 1-4; Pl. X, fig. 10)

Limnodrilus hoffmeisteri CLAPARÈDE, 1862 : 226, Pl. I,
   Figs. 1-3, Pl. III, Fig. 12, Pl. IV, Fig. 6.
Camptodrilus californicus EISEN, 1879 : 24, Fig. 6.
Camptodrilus spiralis EISEN, 1879 : 22, Fig. 5.
Camptodrilus corallinus EISEN, 1879 : 23.
Clitellio hoffmeisteri (Claparède). CZERNIAVSKY, 1880 : 325.
Limnodrilus corallinus (Eisen). VEJDOVSKY, 1884 : 45.
   BEDDARD, 1895 : 254. MICHAELSEN, 1900 : 46.
Limnodrilus californicus (Eisen). VEJDOVSKY, 1884 : 45.
Limnodrilus spiralis (Eisen). VEJDOVSKY, 1884 : 45.
Limnodrilus claparedeanus Ratzel. VEJDOVSKY, 1884 : 48,
   Pl. VIII, Figs. 22, 23. GALLOWAY, 1911 : 315.
Limnodrilus hoffmeisteri claparede. LEVINSEN, 1884 : 225.
   VEJDOVSKY, 1884 : 47, Pl. VIII, Figs. 13-17, Pl. XI,
   Fig. 4. STOLC, 1888 : 41. BEDDARD, 1895 : 252.
   RYBKA, 1898: 390. PIGUET, 1899 : 73; 1906b : 390;
   1913 : 137, Fig. 10. MICHAELSEN, 1900 : 43. LINDER,
   1904 : 250. POINTNER, 1911 : 634. PIGUET and
   BRETSCHER, 1913 : 81, Fig. 19c. FRIEND, 1912b : 271.
JUGET, 1957 : 3; 1958 : 90, Figs. 14a, C. BRINKHURST, 1960 : 401, Figs. 4a,b, f-1, k; 1962a : 321; 1963a : 36, Figs. 21a, b; 1963b : 41, Fig. 12b; 1965a : 127, Fig. 4a.
NAIDU, 1965b : 477, Fig. 6; 1966 : 220. POPESCU-MARINESCU et al., 1966 : 63. DI PERSIA, 1980 : 99.
Camptodrilus corallinus Eisen. EISEN, 1886 : 900, Pl. XVI, Figs. 14a-h, Pl. XVIII, Figs. 14 i-k, Pl. XXIII, Fig. 14.
Camptodrilus californicus Eisen. EISEN, 1886 : 901, Pl. XVIII.
Camptodrilus spiralis Eisen. EISEN, 1886 : 899, Pl. XVII, Fig. 15.
Clitellio (Limnodrilus) hoffmeisteri (Claparede). VAILLANT, 1890 : 424.
Clitellio (Limnodrilus) Corallinus (Eisen). VAILLANT, 1890 : 431.
Clitellio (Limnodrilus) spiralis (Eisen). VAILLANT, 1890 : 429.
Clitellio (Limnodrilus) californicus (Eisen). VAILLANT, 1890 : 432.
Limnodrilus dugesi RYBKA, 1898 : 389, Pl. V, Figs. 1-17.
Limnodrilus gotoi HATAI, 1899 : 5, Fig. 3 (in part).
Limnodrilus dugesi Rybka. MICHAELSEN, 1900 : 45. POPESCU-MARINESCU, 1966 : 163.
Limnodrilus lucasi BENHAM, 1903 : 216, Pl. XXV, Figs. 18-22
Limnodrilus vejdolovskypenus BENHAM, 1903 : 213, Pl. XXV, Figs. 10-17.
Tubifex hoffmeisteri (Claparède) DITLEVSSEN, 1904 : 422.
Limnodrilus subsalus MOORE, 1905 : 392, Pl. XXXIII, Figs. 19-22.
**Limnodrilus aurostriatus** SOUTHERN, 1909 : 136, Pl. II, Figs. 3a-g.

**Limnodrilus parvus** SOUTHERN, 1909 : 137, Pl. VIII, Figs. 5a-c.

**Limnodrilus hoffmeisteri** forma *parvus* Southern. SOUTHERN, 1909 : 137.

**Limnodrilus aurantiacus** FRIEND, 1911 : 414.

**Limnodrilus aurostriatus** Southern. FRIEND, 1912b : 274.

**Limnodrilus parvus** Southern. FRIEND, 1912b : 274.


**Limnodrilus socialis** STEPHENSON, 1912b : 294, Figs. 9-16.

**Limnodrilus aurantiacus** FRIEND, 1912b : 274.

**Limnodrilus socialis** Stephenson. STEPHENSON, 1912b : 237;
1913b : 740; 1913a : 260; 1917a : 93, Pl. IV, Figs. 6-7; 1923 : 96, Fig. 36; 1925b : 48; 1926 : 250.


**Limnodrilus gotoi** Hatai. NOMURA, 1913 : 3, Fig. 1; 1929 : 131.

**Limnodrilus parvus** var. biannulatus LASTOCKIN, 1927 : 67.

**Limnodrilus pacificus** CHEN, 1940 : 118, Figs. 33a-c.

**Limnodrilus hoffmeisteri** forma *divergens* MARCUS, 1942 : 169, Pl. II, Figs. 6-9, 11-15.

**Limnodrilus hoffmeisteri** forma *parva* Southern. MARCUS, 1942 : 167, Figs. 4-5.

**Limnodrilus aurantiacus** Friend. MALEVITCH, 1956 : 423.

**Limnodrilus subsalus** Moore. MARCUS, 1944 : 73, Fig. 66.

**Limnodrilus hoffmeisteri** forma *socialis* Stephenson. GAVRILOV and PAZ, 1950 : 563.


**Material examined**

Five full grown specimens were examined during the present study, all collected from the Chackai canal in Trivandrum on 15-7-’79.
Description

Worms occur always in large tangled masses, tail always projecting toward the surface of water. When isolated worms were put in a petri dish containing water, within a short time they coil themselves up. The large mass is so tightly interwined that it is very difficult to separate them. Autotomy seems to be a common phenomenon; a number of worms without posterior region have been obtained during the present study.

Fully matured individuals measure 15 to 35 mm with a diameter of 0.2–0.3 mm and have 80–120 segments (Pl. X, fig. 1). Body bright red in colour, the colour being more deeper in the anterior than in the posterior region and this region has a golden ring-like appearance.

Prostomium bluntly conical and is an extension of the first segment. In specimens having a width of 425 μ in the first segment, the prostomium measures 85 μ at the base, 50 μ at the middle and 102 μ from base to the tip. The body is divided throughout its length into a number of segments, all quite clearly marked off from one another.

Setae both dorsal (Pl. III, fig. 1) and ventral (Pl. III, fig. 2) begin from the second segment and consist of bifid needles only. They are moderately stout, have the usual double
curve with distal nodulus, prong diverging with distal prong slightly longer than the proximal.

Dorsal bundle has four setae in the second segment. The number increases to seven in the III but again drops to six in the IV and V segments. The number shows a gradual reduction to four, three and two toward the posterior region. Anterior II and III segments have comparatively smaller setae (57.5 μ) while those of IV to X show an uniform length of 65.0 μ. In the next two segments the length is reduced to 62.0 μ and behind this the setae have a constant length of 55.0 μ (Table XV).

Ventral bundles have seven setae in the anterior II-V segments, six in the VI segment and four in the VII and VIII segments. In the IX segment the number of setae increase to five, but from X onwards it decreases to three and two. Ventral setae of II and III segments measure 55.0 μ in length. In the IV segment a sudden increase in length of the setae is noticed (65.0 μ) and this length is maintained upto the XI segment where again up to the XI segment where again a reduction in length of the setae (62.0 μ) is noticed (Table XV).

The reproductive organs are well developed in many specimens. The testes are in X and ovaries in XI. Both X and XI segments bulge outwards in sexually mature individuals. In Alum Carmine
stained preparations, these segments have a width of 650/μ whereas the VIII segment of the same specimen measures only 425/μ. The testes are paired structures attached by a narrow base to the junction of septum 9/10 with the ventral body wall. The male funnel is also in X. Spermathecae paired, attached to the septum 9/10 and opening ventrally (Pl. III, fig. 4). Distinct prostate is present attached apically to the atrium. A pair of penial setae (Pl. III, fig. 3) are seen in the XI segment. They are much longer and larger than the ordinary setae, the shaft is straight and the distal end is expanded to form a hood-like structure with scalloped edges. The penial seta measured 540/μ in length and 54/μ in breadth at the base, 27/μ at the middle region and 80/μ at the hood.

Pharynx occupies II and III segments and is bulged outwards. In a worm having a width of 468/μ in the third segment, pharynx measures 255/μ at the middle region. This is followed by oesophagus in the IV segment. Anus opens by a notch between two lateral lobes at the posterior end.

Distribution

Cosmopolitan (Brinkhurst and Jamieson, 1971); Argentina (Di Persia, 1980).
Indian sub-continent: - Lahore (Stephenson, 1912b).

Habitat

Occur in large tangled masses in the bottom sediment of organically polluted water bodies.

Remarks

Stephenson (1912b) had given a detailed description of *Limnodrilus socialis*. Brinkhurst and Jamieson (1971) synonymised this with *L. hoffmeisteri*. The present specimens exhibit all the distinguishing characters of the species enumerated by Brinkhurst and Jamieson (loc. cit.) such as the presence of a pair of testes in the X segment, ovaries in the XI segment, vas deferens highly coiled extending in the XI segment and presence of a distinct prostate. XI segment bears a pair of penial setae also, several times as big as the ordinary setae. They also agree in having conical prostomium, beginning of dorsal and ventral bundles from the II segment with bifid needles having distally placed nodulus and longer distal prong. Chekanovskaya (1962) also described the setae in these worms as monotypic. Thus the present specimens reveal no apparent variation from the earlier descriptions except for the slight differences noticed in the setal characters. Hrabe (1954) observed that the distal denticle (prong) is usually longer, sometimes equal to or may even be shorter than the proximal.
TABLE XV

Number and length of the setae in the ventral and dorsal bundles in different segments of *Limnodrilus hoffmeisteri* Claparède

<table>
<thead>
<tr>
<th>Segments</th>
<th>I</th>
<th>II</th>
<th>III</th>
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<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
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<td>No. of setae in each ventral bundle</td>
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<td>6</td>
<td>4</td>
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</tr>
<tr>
<td>Length of the ventral seta in microns</td>
<td>-</td>
<td>55.0</td>
<td>65.0</td>
<td>65.0</td>
<td>65.0</td>
<td>65.0</td>
<td>65.0</td>
<td>65.0</td>
<td>62.0</td>
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<td>55.0</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>No. of setae in each dorsal bundle</td>
<td>-</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>3</td>
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</tr>
<tr>
<td>Length of the dorsal seta in microns</td>
<td>-</td>
<td>57.5</td>
<td>65.0</td>
<td>65.0</td>
<td>65.0</td>
<td>65.0</td>
<td>65.0</td>
<td>65.0</td>
<td>65.0</td>
<td>62.0</td>
<td>62.0</td>
<td>55.0</td>
<td>55.0</td>
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</table>
Genus *Tubifex* LAMARCK, 1816

Male efferent ducts with vasa deferentia at least as long as the pear-shaped to cylindrical atria which are frequently turned-over apically, otherwise standing vertically in XI, no distinct ejaculatory ducts; prostate glands large, closely connected to the atria subapically on anterior side. Penes present, with tub-shaped or conical to elongate penis sheaths. Spermathecae sometimes absent, spermatophores present unless spermathecae absent. No genital setae. No coelomocytes.

*Tubifex tubifex* (Müller, 1774)

*Lumbricus tubifex* MÜLLER, 1773 : 27 (in part).

*Nais tubifex* (Müller). OKEN, 1815 : 364.

*Tubifex rivulorum* LAMARCK, 1816 : 225.

*Nais filiformis* DUGÈS, 1828 : 336.

*Tubifex filiformis* (Dugès). DUGÈS, 1837a : 33.

*Tubifex filiformis* (Dugès). BRETSCHER, 1900 : 447, Pl. XXXIII, Fig. 4.

*Salamais filiformis* (Dugès). GÉRVAIS, 1838 : 16.

*Saemuris variegata* HOFFMEISTER, 1842 : 9, Pl. II, Figs. 19, 20, 22 (in part).


*JOHNSTON, 1865 : 64.*

*Tubifex rivulorum* Lamark. UDEKEM, 1853 : 3, Pl. I-IV.

LANKESTER, 1871 : 93, Fig. 2. EISEN, 1879 : 14 : 1880 : 392. LEVINSEN, 1884 : 224. VEJDOVSKY, 1884 : 46, Pl. VIII, Figs. 1-8, Pl. IX, Figs. 2-19, Pl. X,
Figs. 1-5, 7-16. STOLC, 1886b : 643; 1888 : 39.

Naiss sanguinea DOYÈRE, 1856 : 306 (in part).

Tubifex bonnetti CLAPARÈDE, 1862 : 230, Pl. II, Figs. 1-6, Pl. IV, Fig. 5.

Tubifex bonneti Claparède. EISEN, 1879 : 15, 186 : 893.


Saemuris diversisetosa forma charcoviensis CZERNIAVSKY, 1880 : 334.

Saemuris diversa forma suchurmica CZERNIAVSKY, 1880 : 332.

? Tubifex campanulatus Eisen. VEJDOVSKY, 1884 : 45. EISEN, 1886 : 893, Pl. VIII, Fig. 7. MICHAELSEN, 1900 : 49.

Tubifex blanchardi VEJDOVSKY, 1891 : 596.


Saemuris variegata Hoffmeister. FUHRMANN, 1897 : 492.

Tubifex tubifex (Miller). MICHAELSEN, 1900 : 48.


Tubifex (Tubifex) fontanus POINTER, 1914 : 607.
Tubifex tubifex var. heterochaeta CERNOSVITOV, 1926 : 321.
Tubifex hattai Nomura, 1926 : 193.
Limnodrilus ohacoensis STEPHENSON, 1931b : 309.
Tubifex (Tubifex) blanchardi Vejdovský. CERNOSVITOV, 1942 : 213.
Limnodrilus siolii MARCUS, 1947 : 11, Figs. 10-14.
Tubifex tubifex Michaelsen. JAROSCHENKO, 1948 : 69.
Tubifex ignotus (Stolc). BRINKHURST, 1960 : 404, Fig. 5.
Tubifex bergi Harabe. CHEKANOVSKAYA, 1962 : 273, Fig. 172. BRINKHURST, 1963a. 23.
16. *Tubifex tubifex* (blancheardi form) 
(Pl. III, figs. 5&6; Pl. X, fig.2)

Material examined

Fifteen specimens were collected from the bottom mud sample of the Veli lake near Trivandrum on 17-7-1979. One specimen (preserved in formalin) was handed over by a colleague for identification.

Description

Live specimens are bright reddish at the anterior region, posterior being paler. Specimens kept in tap water in a petri dish show a tendency to degenerate within a day. Body segmented and segmentation well marked up to the posterior region. Asexual reproduction not observed. Prostomium broader than long over-hanging the mouth. In specimens having a breadth of 170 μm at the first segment, the prostomium measured 119 μm in width at the basal region and 65 μm in length from base to tip. Mouth ventro-lateral.
TABLE XVI

Length, diameter and number of segments of the body in *Tubifex tubifex* (blanchardii form)

<table>
<thead>
<tr>
<th>No.</th>
<th>Length (mm)</th>
<th>Diameter (mm)</th>
<th>No. of segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>0.35</td>
<td>38</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>0.35</td>
<td>44</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
<td>0.34</td>
<td>48</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>0.33</td>
<td>48</td>
</tr>
</tbody>
</table>

Setae, both dorsal (Pl. III, fig. 5) and ventral (Pl. III, fig. 6) begin from the second segment; consists of the same type of bifid setae with distal nodulus, the distal prong being longer and thinner than the proximal. No disparity is noticed between the dorsal and ventral bundle in the number of setae per bundle also. II and III segments have three setae per bundle, followed by five per bundle in IV to VIII segments. IX and X show a reduction to three per bundle, but again four setae is maintained in the XI segment. Further backwards, the number shows a gradual reduction to three and two. Regarding size also, setae in a single bundle of ventral and dorsal have got uniform size except in II, III and IV segments of dorsal and II & III of ventral. In the II and III segments, the outer dorsal seta measures 50 µ whereas the inner two are slightly longer having
a length of 55 μ. Regarding ventral, the outer of II and III measure 45 μ whereas the inner two measure 50 μ (Table XVII).

The reproductive organs are well developed in many specimens. The testes are in X and ovaries in XI, testes being attached to the anterior septum of X segment. Vas deferens highly coiled. Both X and XI segments bulge outward in sexually matured individuals.

Habitat

Found in the sandy substratum of the Veli Lake away from the bar mouth.

Remarks

Brinkhurst and Jamieson (1971) recognised three forms of this species, the "tubifex" form with a full complement of hair setae and needle setae, the "bergi" form with a few hair setae in some specimens or a few meagrely pectinate setae in most others and the "blanchardi" form with bifid setae only. On the basis of this, the present specimens come under the "blanchardi" form, since they have no hair setae and pectinate setae which are replaced by bifid setae.

Regarding the number and shape of the setae, the ventral bundle of the present specimens does not show any wide variation
from that given by Brinkhurst (1966d) for *Tubifex tubifex*. As suggested by him for *T. tubifex* here also the distal prong of the ventral bundle is slightly longer and thinner than the proximal. Another peculiarity of the present specimen is that the dorsal and ventral bundles are identical both in number and in the length of setae except for slight variations noticed in the II, III and IV segments. Reproductive organs also do not show any variation from that described by Brinkhurst and Jamieson (1971) for *Tubifex tubifex*. Here also the testes are placed in the X segment, vasa deferentia long and highly coiled and ovaries are a pair in the XI segment. No modified genital setae have been observed in the present specimens in agreement with the finding of Brinkhurst (1966d).
TABLE XVII

Number and length of the setae in the dorsal and ventral bundles: in different segments of *Tubifex tubifex* (blanchardi form)

<table>
<thead>
<tr>
<th>Segments</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>XIII</th>
<th>XIV</th>
<th>XV</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of setae in the dorsal bundle</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Length of dorsal setae in microns</td>
<td>-</td>
<td>50.0</td>
<td>55.0</td>
<td>55.0</td>
<td>55.0</td>
<td>55.0</td>
<td>55.0</td>
<td>55.0</td>
<td>55.0</td>
<td>55.0</td>
<td>55.0</td>
<td>55.0</td>
<td>55.0</td>
<td>55.0</td>
<td>55.0</td>
</tr>
<tr>
<td>No. of setae in the ventral bundle</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Length of ventral setae in microns</td>
<td>-</td>
<td>45.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
</tr>
</tbody>
</table>

* The setae are numbered serially from the outer to the inner side of each bundle
17. *Tubifex tubifex* (bergoform)  
(Pl. III, figs. 7-9)

Material examined

One specimen collected by a colleague from the bottom mud sample of Sreevaraham temple tank in Trivandrum. The specimen was formalin preserved and the date of collection is not known.

Description

Body transparent, measuring 2.5 mm in length with a diameter of 0.25 mm and having 45 segments. Segmentation well marked. Prostomium conical.

Both dorsal and ventral bundles have their beginning from the II segment. Dorsal bundle is formed of hair setae and bifid needle setae, hair setae being present only up to the XII segment. From XIII segment onwards, dorsal bundle is formed solely of bifid needles only. Upto the IX segment, the dorsal bundles have six hairs and six needles per bundle, in the following three segments (X, XI and XII) there are only three hairs and three needles per bundle. Hairs smooth and straight (Pl. III, fig. 8) and have a range of length between 160.0 μ and 165.0 μ and needles 90.0-98.0 μ (Table XVIII).
Needles all bifid with distal nodulus, prongs having equal length and width (Pl. III, fig. 9).

Ventrals have seven setae in the anterior II - VIII segments. From IX segment onwards a gradual reduction in the number of setae to five and four per bundle has been noticed. Anterior II-IV segments have comparatively longer setae (70.5\( \mu \)m), V segment shows a reduction to 70.0\( \mu \)m, VI-VIII show an identical length of 67.4\( \mu \)m and again a reduction to 62.0\( \mu \)m occurs in the IX segment (Table XVIII).

Remarks

The identity of this form is based on the nature of the dorsal bundle being formed of hair setae and bifid needles. Even though in "tubifex" form also there is a full complement of hair setae and bifid needle setae, the difference lies in the structure of the needle setae; "tubifex" form having pectinate needle setae and the "bergi" form with a few meagrely pectinate setae. In the present specimen it is found that the needle setae are simply bifid, devoid of any intermediate teeth. When compared with the "blanchardi" form, the present specimen has comparatively more setae in the dorsal and ventral bundles; the dorsal bundles of anterior II-IX have a total of twelve setae (6 hairs and 6 needles) whereas in the "blanchardi form", a maximum of only five setae have been noticed both in dorsal and ventral bundles.
<table>
<thead>
<tr>
<th>Segments</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>XIII</th>
<th>XIV</th>
<th>XV</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of setae in each ventral bundle</td>
<td>-</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Length of the ventral setae in microns</td>
<td>-</td>
<td>70.5</td>
<td>70.5</td>
<td>70.5</td>
<td>70.0</td>
<td>67.4</td>
<td>67.4</td>
<td>67.4</td>
<td>62.0</td>
<td>62.0</td>
<td>62.0</td>
<td>60.0</td>
<td>60.0</td>
<td>60.0</td>
<td></td>
</tr>
<tr>
<td>No. of hair setae in each dorsal bundle</td>
<td>-</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>No. of bifid setae in each dorsal bundle</td>
<td>-</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Length of the longest hair seta in microns</td>
<td>-</td>
<td>165.0</td>
<td>165.0</td>
<td>160.5</td>
<td>160.0</td>
<td>160.0</td>
<td>160.0</td>
<td>160.0</td>
<td>160.5</td>
<td>160.5</td>
<td>160.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Length of the needle seta of the dorsal bundle in microns</td>
<td>-</td>
<td>98.0</td>
<td>98.0</td>
<td>98.0</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td></td>
</tr>
</tbody>
</table>
Suborder Lumbricina
Superfamily Lumbricoidea
Family Glossoscoleidae
Subfamily Almini DUBOSCQ, 1902
Tribe Almini Nov.
Genus Glyphidrilus HORST, 1889

Prostomium zygodorus (sometimes prolobous, pro-epilobous or epilobous?). Body quadrangular behind the elitellum; with a posterior dorsal groove; anus dorsal, dorsoterminal or exceptionally terminal. Setae 8 per segment, widely paired in the forebody. Usually more closely paired posteriorly; the dorsal median intersetal distance equal to 0.2 of the circumference. Setai ornamentation consisting solely of one to several transverse or oblique distal ridges. Specialised genital setae unknown but those of the elitellar region at least, sometimes enlarged. Nephropores in b lines. Clitellum annular, occupying several to many segments beginning in or behind segment 12. Body wall protuberant at maturity as a ridge which usually forms a delicate lamella (ala or "wing") dorsal to the ventral setal couples and crossing several to many elitellar segments. Male pores inconspicuous, located ventral to the wings, at or one to a few segments in front of their posterior limits. Paired and, often, median genital markings present in front of and less frequently behind the wings, exceptionally (quadrangulus)
absent; each usually with a peripheral rim and a central area, rarely a simple papilla. Female pores paired in 14 or (Kukenthal) in 13 and 14, presetal in front of or slightly lateral of setae b. Spermathecal pores inconspicuous, occupying some or all of the setal lines, or more numerous, in 2 to 6 intersegments from 12/13 to 18/19 exceptionally more extensive and including the testis - segments.

An oesophageal gizzard in 7 or 8, sometimes extending into an adjacent segment; alimentary diverticula absent; intestine commencing in (14?) 15 to 18, lacking muscular thickening; a dorsal typhlosole present; a ciliated "straining apparatus" separating the oesophageal and intestinal blood sinuses. Paired hearts in 7 to 11 or rarely 12 or 13, some of them with connections from the supraoesophageal vessel, those of 7 or 8 sometimes absent. Subneural vessel present, rarely reaching the anterior end, well developed only posterior to its junction with a pair of lateroparietal vessel. Holonephric; adult nephridia absent in front of segment 12; nephrostomes single ducts avesicles and without sphincters or caeca. Testes and funnels free in 10 and 11; male ducts intramural seminal vesicles usually 4 pairs in 9-12. Prostate glands (always ?) absent. Ovaries and funnels in 13 or 12 and 13; ovisacs present or absent. Spermathecae with ducts, and often the subspherical ampullae, concealed in the parietes; lacking diverticula.
18. *Glyphidrilus annandalei* Michaelson, 1910


*Glyphidrilus annandalei* Michaelson, COGNETTI, 1911: 502,

Pl. XIII, Figs. 11, 12. MICHAELSON, 1913: 92;
1918: 344. STEPHENSON, 1916: 349; 1921: 767;
1922b: 387; 1923: 491. NAIR, 1937: 300; 1938: 39, Figs. 1–24. GATES, 1958c: 54. BRINKHURST and JAMIESON, 1971: 755, Fig. 13. 3A–C.

**Glyphidrilus fluviatilis** and *G. elegans* and *G. rarus* and *G. saffronensis*. RAO, 1922: 53, 62, 64, 66, Figs. 1–4.

**Material examined**

A total of six worms, three immature and three with fully formed 'wings', were obtained from two mud samples taken from a paddy field near Edappazhinji, Trivandrum on 15–7–79 and 31–9–79. A second lot of three specimens, one immature and two with fully developed clitellum was obtained from a paddy field near Ulloor, Trivandrum on 3–9–79.

**Description**

Worms cylindrival with tapering anterior and posterior region. Body dark brown in colour, posterior and being more reddish. Formalin preserved specimens measured 9–17 cm in length and 2–3 mm diameter with 98–260 segments.

When the live worms were placed in a petri dish containing water, they crawled freely on the bottom of the dish with the
tail always waving. The tail seems to be an important organ for respiration. Autotomy seems to be a common phenomenon in this species. When irritated, the worm breaks off bits from the posterior end.

Prostomium is a rounded lobe overhanging the mouth. Peristomium which forms the first segment is somewhat thickened and in one specimen the ventral side was dark reddish in colour. The ventral side is formed of longitudinal corrugations and there are secondary annulations making each segment biannulate, triannulate etc.

Only one type of setae is found throughout the body. Setae single pointed with distal nodulus (Pl. III, fig. 13) and arranged in four pairs per segment forming eight longitudinal rows along the body. Anteriorly, the seta measures 333.2 μ in length and 14.7 μ in breadth at the base and 4.2 μ at the tip. Setae widely paired anteriorly and more closely paired posteriorly. Genital setae not found.

In adult worms, generally the region between segments XXVI and XXXIV show expansions of body wall forming wings. Out of the three specimens examined, in one, the wings extended from the XXVI to the XXXII segment while in the other two, they extended from XXVII to the XXXIV segment (Pl. III, fig. 11).
In the former case even though the wings begin from the XXVI segment they are not prominent in that segment. In the same way they are less distinguishable in the XXXIII and XXXIV segments. Hence in the first observation, they appear to be beginning from the XXVII and ending in the XXXII.

In the region of the wings, the ventral area is uneven owing to the localised development of glandular area and excessive growth of the integument. The annulation is not regular and the body wall shows a number of irregular wrinklers making it very difficult to distinguish even the segments.

In one specimen an unpaired glandular oval thickening was noticed on the ventral side extending segments XXVII and XXVIII (Pl. III, fig. 12). White glandular spots could be noticed in this region between wings and the ventral side much more swollen. Here the setae were sunk inwards owing to the excessive growth of the integument, their tips visible externally. Clitellum developed between the wings; in one specimen the clitellum extended from XXVI to XXIX segment.

Median dorsal papilla arises from the XIII segment and ends in the XXII segment (Pl. III, fig. 10). From XVII segment onwards, they are accompanied by two dorsal lateral papillae
also, the lateral papillae being present up to the XXVI segment. The region of the wings is free of any papillae. In the XXXIII segment, the reappearance of lateral papillae has been noticed, but in the succeeding segments, they are not clearly distinguishable. Each papilla is a circular protuberance with a central area and peripheral wavy margin, the anterior ones being comparatively larger than the posterior.

Dorsal groove starting from the XI or XII segment. In immature form it is not well developed. It extends up to the posterior end. Anus is a short triangular cleft in the posterior tip.

Habitat

Found in the muddy substratum of paddy fields. During the rainy season when the paddy fields are drenched and often covered with water, Glyphidrilus come to the surface layers of the soil. During the summer months when the paddy field is dry, they move deep down to the soil.

Distribution

Indian sub-continent:— Travancore, Coorg, Mysore and Malabar coast (Brinkhurst and Jamieson, 1971).
Remarks

*Glyphidrilus annandalei* Michaelsen is the most common species in South India, while the other two species *G. tuberosus* Stephenson and *G. papillatus* Rosa occur in Northern India and Burma (Nair, 1937). This species has been described by Michaelsen (1910), Cognetti (1911), Stephenson (1916, 1921), Rao (1922) and Nair (1937). Rao (1922) recorded four species of *Glyphidrilus*, but a reexamination of the specimens by Stephenson showed that two species out of the four were identical with *Glyphidrilus annandalei* and the other two were immature forms of the same species.

Brinkhurst and Jamieson (1971) had taken the presence of wings from 25-27 to 1/2 32-33 (35), lateral markings from 13-15 to 26 and also in 1-5 segments behind the wings, median markings in two or more of segments 11-14 to 26 and occasionally on 33-38 as distinguishing characters. All these characters are found in the present specimens with only slight variations. Out of the three specimens with fully developed wings used in the present study two have wings extending from XXVII to XXXIV and one from XXVI to XXXII. Even though Nair (1938) noted the wing to extend between 18 to 34 segments (both inclusive), in the present specimens they are found to be properly extended from 27-32 (6 segments) only. Genital papillae of the present specimens also show a
close resemblance to those described by Nair (1938) in its mode of distribution (anterior region a single, then a triple and again a double series) and structure. The nature of the median papilla agrees perfectly with that described by Nair (op. cit.) and Brinkhurst and Jamieson (1971) in its origin from the XIII segment, but it ends in XXII segment i.e. one segment prior to that in Nair’s specimens. As suggested by Nair (1938) markings are found to be absent in the region of the wings. No apparent variation is noticed in setal arrangement or in its shape. As suggested by Brinkhurst and Jamieson (1971), setae in the present specimens also are widely paired in the anterior segments, the distance between pairs becoming narrower toward the posterior region. Moreover, dorsal groove mentioned by Brinkhurst and Jamieson (op. cit.) also occur in the present specimens.