

Sand dwelling Turbellaria from the Netherlands Delta area

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Abstract

Sand dwelling Turbellaria from the Delta of the Rivers Rhine, Meuse and Scheldt have been investigated. Thirty-eight samples taken from littoral and sublittoral stations in the Grevelingen, Eastern and Western Scheldt have been analysed.

Thirty-three species were recorded (Acoela were not considered); twenty-four of them are new for the area and seven new species are described.

Density and diversity of Turbellaria were higher in the Eastern Scheldt than in the Western Scheldt or in the Lake Grevelingen. A maximum density of 82 ind./100 cm³ was noted. A tentative calculation on relative abundance of the representatives of the different Turbellaria orders is established. Proseriata seem to be dominant in the localities studied.

Introduction

The benthic communities of the Netherlands Delta area are intensively studied at the Yerseke Delta Institute for Hydrobiological Research and at the Zoological Institute of the University of Ghent. Turbellaria have been disregarded so far and the present study is an attempt to fill this gap in our knowledge of the meiofauna of the area. Only Den Hartog (in a number of publications issued from 1963 to 1968) and Boaden (1976) have investigated the turbellarian fauna in the Delta area. Den Hartog sampled in intertidal habitats such as salt march creeks and ponds and sandy mud flats, and focussed his attention mainly on the Trigonostomida. Boaden made an inventory of the sanddwelling species in littoral and sublittoral localities. The total number of species observed by both authors was 65, but no data on density and relative abundance are available.

Material and methods

Sublittoral samples were taken in 20 different localities: 14 in the Lake Grevelingen, two in the Eastern Scheldt and four in the Western Scheldt; seven eulittoral stations in the Western Scheldt were also sampled. Localities in the Eastern Scheldt and Grevelingen are indicated by the code letters of the nearest buoy, and in the Western Scheldt by the coordinates.

Some of the new species had also been found in North Sea localities by the senior author (E.R.S.) and some by D. Degadt and provisionally described by him (1973, unpublished). These data are incorporated in the descriptions below.

The total number of samples was 38, most of them taken in the second half of 1979, while some samples from the Western Scheldt were taken in December 1978. The eulittoral samples were taken with a hand-held plastic corer of 10.2 cm². For sublittoral sampling, different methods were used involving a meioticter (Govaere & Thielemans

1979), Reinecker box-corer (Farris & Crezee 1976), hand-cores held by SCUBA divers, and the Van Veen grab. Sediment analysis was performed on subsamples (Heip *et al.* 1979). Classification of the sediment was according to the Wentworth scale (Buchanan & Kain 1971) and the degree of sorting according to Wolff (1973). The characterisation of the sediment is indicated by letters symbols in Table 1.

Turbellaria were extracted from the sediment using the $MgCl_2$ method (Boaden 1963b, Sterrer 1968) for the qualitative approach, and the Uhlig icewater method (Uhlig 1964, 1966) for quantitative data. Since samples taken with different methods were to be compared an approximatively equal amount of sediment was processed, and Turbellaria were counted alive under the dissecting microscope and identified under the microscope in squeezed preparations. Whole mounts were prepared with lactophenol from the squeezed individuals; other representatives of species available in sufficient numbers were fixed with Bouin's fluid, sectioned and stained with Masson's trichrome, Ehrlich's hematoxylin or Heidenhain's ironhematoxylin, if necessary using eosin or erythrosin as counterstain. Typematerial of the new species is deposited in the zoological collection of the department S.B.M. of the Limburgs Universitair Centrum, Diepenbeek (Belgium). Figures without scale are freehand drawings.

Compositions of the Turbellaria fauna

Observations

Thirty three species were identified and they are listed in Table 1. Acoela, Nemertodermatida and Catenulida were not identified to the species level but their total number was recorded in order to establish the relative abundance of the different turbellarian orders as given in Table 2.

In Lake Grevelingen only seven samples of 19 (from 14 stations) contained Turbellaria. Only five different Neophora species and relatively many Acoela were observed. The total number of individuals in all samples was 82. In the Western Scheldt 11 samples of the 13 (from 11 stations) contained Turbellaria. In the 11 positive samples a total of 58 individuals was observed. Apart from the Acoela,

they belonged to seven different species. In the Eastern Scheldt four of the six samples from the two stations contained 217 individuals of Acoela, Nemertodermatida and 27 different identified species altogether. The other two samples were very rich in Turbellaria but not quantitatively processed. The maximum density we noted was 82 ind./100 cm^3 in a sublittoral station in the Eastern Scheldt (018: 26.10.79).

Discussion

It appears from Tables 1 & 2 that both the density of the Turbellaria and species diversity is much higher in the Eastern Scheldt than in the other two parts of the Delta area. Similar results were obtained in studies on other meiofauna taxa (Heip *et al.* 1979; Van Damme *et al.* 1981). It seems that the high degree of pollution in the Western Scheldt has had a deleterious effect on the composition of its bottom fauna and the silting of the bottom and oxygen deficiency that occurred in lake Grevelingen after its closure in 1971 may be held responsible for the low species diversity and population densities in this habitat.

The composition of the Turbellaria fauna of sandy beaches has been studied by Sopott (1973), Ehlers (1973) and Hoxhold (1974) on the North Sea island Sylt and by Gray & Rieger (1971) at Robin Hood's Bay, Yorkshire. On the beaches of Sylt Proseriata are the dominant group (31–53%), followed by Acoela (21–33%) and Neorhabdocoela (15–28%). Within the Neorhabdocoela, the Kalyptorhynchia are most abundant with 46–56%, closely followed by the Typhloplanoida with 39–48%. At Robin Hood's Bay Acoela and Neorhabdocoela are the dominant taxa, Proseriata representing only 7–27% of the turbellarian fauna, while within the Neorhabdocoela 67–88% of the individuals belong to the Dalyellioida. In the Delta as a whole, Proseriata and Acoela are about equally well represented and approximatively one fifth of the turbellarian fauna consists of Neorhabdocoela and 90% of these are Kalyptorhynchia. It can be derived from the data in Table 2 that the relative abundance of these three main taxa is different in the three parts of the Delta studied and that seasonal fluctuations may occur.

No conclusion can be made from this variety of statements at this moment, except perhaps that the

Table 1. Occurrence of Turbellaria species in Western Scheldt, Eastern Scheldt and lake Grevelingen.

	Grevelingen	Western Scheldt	Eastern Scheldt
<i>Retronectes</i> sp.			c
<i>Bradynectes sterreri</i> Rieger, 1971			b
<i>Paromalostomum fuscum</i> Ax, 1952			c
<i>Haplopharynx rostratus</i> Meixner, 1938			c
<i>Carenscoilia bidentata</i> Sopott, 1972			bc
<i>Cirrifera dumosa</i> Sopott, 1972	d		
<i>Cirrifera aculeata</i> (Ax, 1951)		Bc	bc
<i>Archilopsis unipunctata</i> (Fabricius, 1826)	d		
<i>Promonotus marci</i> Ax, 1954			bc
<i>Archimonocelis oostendensis</i> sp.n.			bc
<i>Parotoplana capitata</i> Meixner, 1938		d	
<i>Parotoplana papii</i> Ax, 1956			b
<i>Kataplana germanica</i> Meixner in Ax, 1951			bc
<i>Philosyrtis coomansi</i> sp.n.		A	bc
<i>Ciliopharyngiella constricta</i> sp.n.			b
<i>Subulagera rubra</i> sp.n.			c
<i>Rogneda hibernica</i> (Southern, 1936)	d		
<i>Scanorhynchus forcipatus</i> Karling, 1955			c
<i>Toia ycia</i> Marcus, 1952	p		
<i>Cicerina remanei</i> Meixner, 1928			b
<i>Paracicerina deltoides</i> sp.n.			b
<i>Gnathorhynchus conocaudatus</i> Meixner, 1929			bc
<i>Schizorhynchoides karlingi</i> sp.n.			c
<i>Schizorhynchoides symmetricus</i> sp.n.			b
<i>Schizochilus choriurus</i> Boaden, 1963	x		c
<i>Neoschizorhynchus parvarostro</i> Ax & Heller, 1970		b	c
<i>Thylacorhynchus caudatus</i> Meixner, 1928		e	
<i>Carcharodorhynchus</i> sp.			b
<i>Limirhynchus danicus</i> Schilke, 1970		B	b
<i>Cheliplanilla caudata</i> Meixner, 1938			b
<i>Celiplanilla rubra</i> Schilke, 1970			c
<i>Rhinipera remanei</i> Meixner, 1928			b
<i>Diascorhynchus rubrus</i> Boaden, 1963		A	bc

a : fine sand, less well sorted
 b : fine sand, well sorted
 c : fine sand, very well sorted
 d : medium sand, well sorted
 e : medium sand, very well sorted
 p : periphyton
 x : no data on the sediment
 Capital letter: eu littoral station

present sampling and processing procedures are insufficient to provide reliable data for populations studies, whilst it cannot be denied that environmental factors strongly affect the fauna composition.

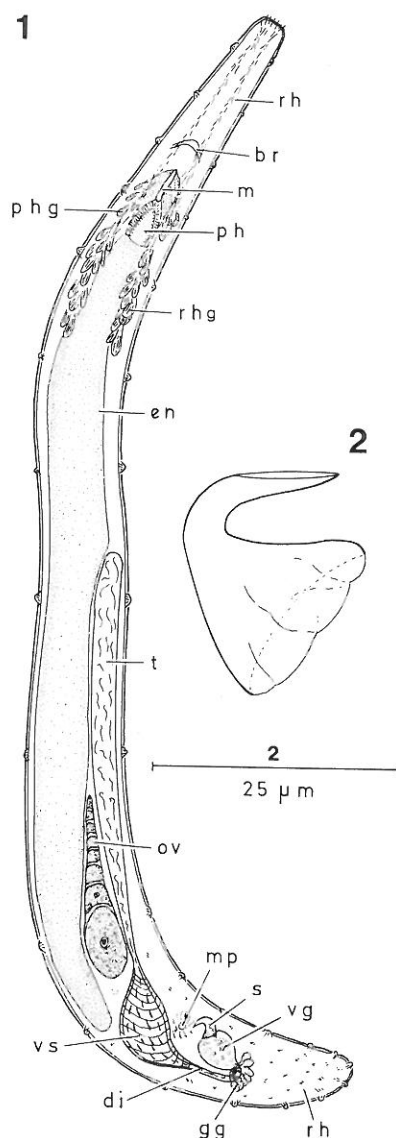


Fig. 1-2. *Bradynectes sterreri*. 1. General organisation (from living animal). 2. Stylet (from whole mount).

Descriptions and discussions of the new species and some known species

Bradynectes sterreri Rieger, 1971 (Figs. 1-2 & 24)

New locality: Eastern Scheldt, near buoy 013, fine sand at 3-4 m depth, 24.08.79.

Material: several animals studied alive two of them in whole mount and one serially sectioned.

Table 2. Percentage of numbers of different turbellarian orders in the Grevelingen, Western Scheldt, Eastern Scheldt and the individual Eastern Scheldt stations.

	Grevelingen	Western Scheldt	Eastern Scheldt	Total	Eastern Scheldt			
					Station 018		Station 013	
					26.10.79	21.12.79	26.10.79	21.12.79
Turbellaria n	82	58	217	357	89	33	75	20
Acoela	62%	14%	29%	34%	20%	27%	38%	30%
Nemertodermatida	0%	0%	1%	1%	0%	3%	1%	0%
Catenulida	0%	0%	10%	6%	24%	6%	0%	0%
Macrostomida	0%	2%	7%	4%	4%	21%	4%	5%
Proseriata	27%	57%	35%	37%	35%	27%	37%	35%
Neorhabdocoela	11%	27%	18%	18%	17%	15%	19%	30%

Description and discussion

In his original description of the species, Rieger (1971) discerned three different phenae: the Kristineberg-form, the Carolina-form and the Robin Hood's Bay-form. A fourth form, the Sylt-form was added to the list by Faubel (1974). The distinction of these forms is based on stylet shape and size, location of the gonads, and presence or absence of a sphincter around the vas deferens. The present specimens differ from all the above mentioned forms in that the ovaria are between testis and gut, there is no sphincter at the vas deferens and the stylet measures 24 μm at its convex side and 26 μm at its concave side.

Archimonocelis oostendensis sp. n. (Figs. 3-5 & 25)

Localities:

1. Oostende (Belgium), eulittoral zone of the sandy beach at the Memorial Monument, fine sand with detritus (not analysed), 25.07.72 (Typelocality).
2. North Sea, at N lat. 51°12'32" and E. long. 2°48'52", fine sand at 15 m depth, 28.09.72 and at N lat. 52°02'12" and E long 3°47'00", medium sand at 18 m depth, 13.09.72, (De Gadt).
3. Eastern Scheldt, near buoy 013, fine sand at 4 m depth, 02.08.79.

Material: Several animals studied alive from all localities, five of them in whole mount (one designated as holotype).

Description

The living animals are about 2.5 mm long, filiform and colourless, without eyes. The anterior tip is provided with sensory bristles and the caudal end with adhesive papillae. The cnidosacs are placed at regular distances in a medio-dorsal row. The topography of the organs is shown in Fig. 3.

Except for the gonads, all the genital organs are situated in the hindmost part of the animal. A vagina surrounded by glands and a prepenial bursa occur in front of the male organs. The female duct ends in the posteriorly situated female pore with the usual cement glands.

A single row of 16-25 testis follicles occur. The seminal vesicles however are paired. The copulatory organ is directed forwards with caudal seminal vesicles, an interposed prostate vesicle and a stylet, 49-53 μm long, 3.5-5 μm wide at its centre and 7-9 μm at the proximal opening, with a subterminal opening, and ending in a blunt massive extension 6-8 μm in length (measurements on five specimens). The stylet is surrounded by bristles, 35-40 μm long, all but two roughly of the same type (0.7 μm thick). The two bristles nearest to the stylet are some 1.1 μm thick, with a subterminal large and flattened lateral hook. Adjacent to the copulatory organ this far described, an accessory organ can be observed. It consists of a bundle of accessory glands of which the exit is encircled by eight needles: five of them are very fine, 18 μm long (average in the holotype) and of the same shape as the majority of needles around the stylet. The other three needles

are 26–31 μm long and of three different construction-types as can be seen in Fig. 5.

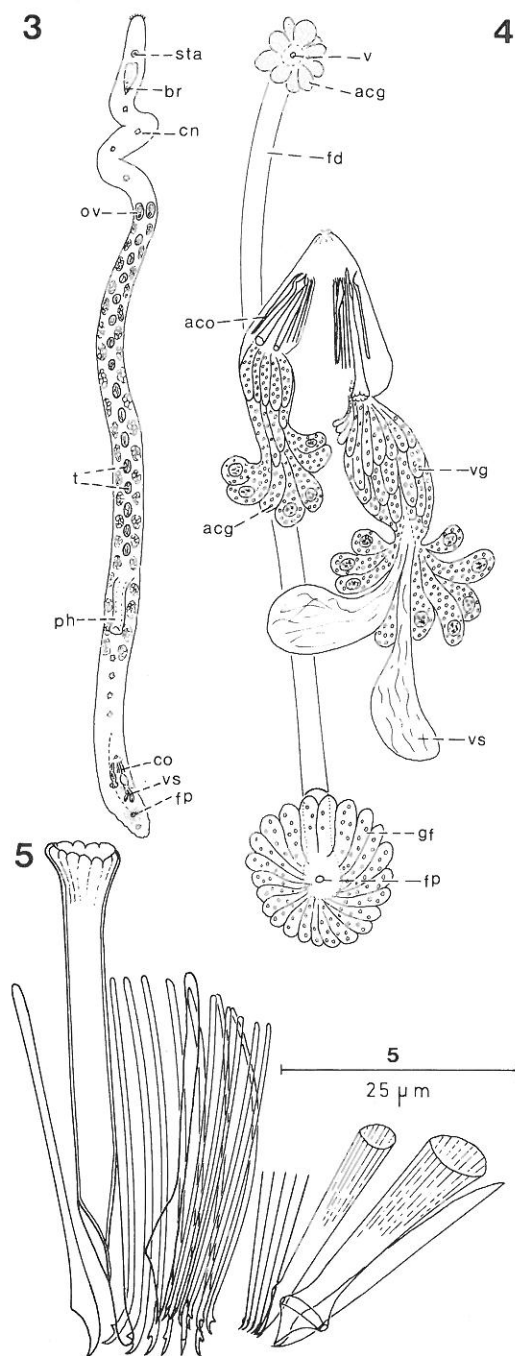


Fig. 3–5. *Archimonocelis oostendensis*. 3. General organisation. 4. Copulatory organ. (Both from living animal.) 5. Cuticular apparatus (from whole mount).

Discussion

Within the genus *Archimonocelis* (Family Monocelididae, Proseriata), *A. semicircularis*, *A. coronata* and *A. oostendensis* are evidently closely related, the presence of an accessory glandular organ in the copulatory organ being considered as a synapomorphy. An obvious evolutionary trend within the genus is the specialisation and diversification of the bristles, features that may have arisen more than once as in *A. bathycola*, *A. helfrichi*, *A. semicircularis* and *A. oostendensis*. A specialised character apparently unique to *A. oostendensis* is the distinct separation of the accessory organ from the copulatory organ.

Identification key to species of the genus *Archimonocelis*

1. Unpaired seminal vesicle
A. kionocystis Karling, 1966
2. Paired seminal vesicle
3. Without accessory organ
4. With accessory organ
5. With hooks
A. bathycola (Westblad, 1952)
6. Stylet surrounded by 4 hooks
A. helfrichi Karling *et al.* 1972
7. Stylet surrounded by a crown of hooks
A. mediterranea Meixner, 1938
8. All bristles of the same type
A. coronata Karling, 1966
9. Bristles of different types
10. Bristles around the accessory organ not separated from the others; 2 different types
A. semicircularis Karling, 1966
11. Bristles around the accessory organ separated from these around the stylet; 6 different types
A. oostendensis sp. n.

Philosyrtis coomansi sp. n.* (Figs. 6–8)

Localities:

1. Eastern Scheldt, near buoy 013, fine sand at 3–4 m depth, 24.08.79, 26.10.79, 21.12.79 (Typelocality); near buoy 018, fine sand at 3–4 m depth, 24.08.79.

* Dedicated to Prof. Coomans, director of the Laboratorium voor Morf. & Syst. der Dieren of the University of Ghent.

2. Western Scheldt, at N Lat. $51^{\circ}22'42''$ and E long. $03^{\circ}52'00''$, fine sand at 3–4 m depth, 12.12.79.

Material: Several animals studied alive, two of them conserved as whole mounts (one of them designated as holotype) and two specimens sectioned.

Description

The species moves rapidly and is extremely haptic, colourless and transparent, with a length less than 1 mm (0.6 mm in whole mount). The cephalic lobe is clearly set off and provided with long sensory bristles. A short row of cilia occurs at

both sides behind the cephalic lobe. Adhesive papillae and bristles occur on the lateral side of the animal at more or less regular distances and at the tailtip. Three types of rhabdites are present: large isolated rhabdites all over the body, numerous grouped needle-like rhabdites between brain and pharynx and six parallel rows at the anterior end. The following generic characters (Ax 1956) could be checked in sectioned material: dorsal unciliated epidermis with nuclei, ventral ciliated epidermis of the creeping sole with insunk nuclei, pharynx lumen ciliated.

The location of the pharynx ($50\ \mu\text{m}$ diameter), gonads and copulatory organ and common genital pore can be seen in Fig. 6. The caudally situated and elongated seminal vesicle is surrounded in its distal part (with muscular wall) by well developed prostate glands which do not form a distinct prostate vesicle (Fig. 7). The cuticular apparatus consists of three different types of needles: a central group of 6 straight needles, $32\text{--}35\ \mu\text{m}$ long, two needles of $40\ \mu\text{m}$ long at both side, which are stouter than the former ones and two large lateral spines of $42\ \mu\text{m}$. The latter are somewhat bent and have a sickle-like terminal end with a small backward projection for the attachment of the muscles surrounding the whole apparatus.

Discussion

Ph. coomansi differs from *Ph. sanjuanensis* Ax & Ax, 1967; *Ph. santacruzensis* Ax & Ax, 1974 and from *Ph. rutilata* Sopott, 1976 in that the cuticular elements in these species are separated in two groups. *Ph. fennica* Ax, 1954 and *Ph. eumeca* Marcus, 1950 are different from *Ph. coomansi* for they have a large number of cuticular needles and from *Ph. rotundicephala* Sopott, 1972 in that this species has only one kind of cuticular elements.

Ciliopharyngiella constricta sp. n. (Figs. 12 & 13)

Locality: Eastern Scheldt, near buoy 013, fine sand at 3–4 m depth, 24.08.79 (Typolocality).

Material: One animal studied alive and prepared in whole mount (holotype).

Description and discussion

The individual studied is a slender, colourless

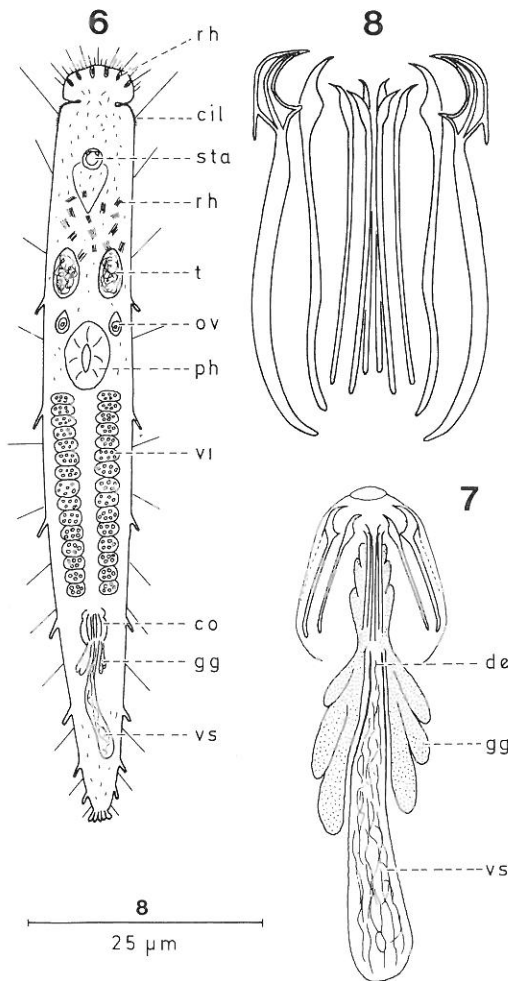


Fig. 6–8. *Philosyrtis coomansi*. 6. General organisation. 7. Copulatory organ. (Both from living animal.) 8. Cuticular apparatus (from whole mount).

and very translucent animal. Its organisation agrees in most respects with that of *Ciliopharyngiella intermedia* Ax, 1952: a pharynx rosulatus slightly behind the body middle, a single testis some distance in front of it, an avoid copulatory bulb (functioning as prostate vesicle with two kinds of prostate secretions), a pair of extra-capsular elongated seminal vesicles, a common genital pore and a bursa posteriorly to it. The seminal duct, running axially through the prostate vesicle is somewhat expanded to form an intracapsular seminal vesicle. The ovovitellaria, with posterior egg-producing compartment, are situated at both sides of the pharynx extending in equal parts in front and behind the latter. The stylet is 80 μm long and depicted in fig. 13. Its most conspicuous feature is an abrupt narrowing at about 1/3 from its distal end. The main characters in which the animal studied differs from *C. intermedia* are tabulated below:

<i>C. intermedia</i> Ax, 1952	<i>C. constricta</i> n. sp.
- dark grey, very opaque	- colourless, very translucent
- stylet 100–120 μm long without constriction	- stylet 80 μm long, constricted
- vitellaries completely in front of the pharynx	- vitellaries in part behind the pharynx

Though the above description is based on only one individual, these differences justify in our opinion the erection of a new species.

Subulagera rubra sp. n. (Figs. 9–11 & 26)

Localities:

1. North Sea, at N lat. 51°50'50" and E long. 03°37'15", medium sand at 18 m depth, 28.09.72 (Type locality) and at N lat. 52°36'30" and E long. 03°18'15", medium sand at 27 m depth, 12.09.72 (Degadt).
2. Eastern Scheldt, near buoy 018, fine sand at 4 m depth, 24.08.79.
3. Germany, Helgoland, eulittoral, fine sand, Aug. 1974 and Sylt, many localities in eu- and sublittoral. (leg. Dr. U. Ehlers, Göttingen).
4. France, Atlantic coast, sandy beach of Arcachon, Sept. 1974 (leg. Dr. U. Ehlers, Göttingen).
5. Boaden, 1977, (p. 52, 53, Fig. 5: *Subulagera* sp. locality not mentioned).

Material: Several animals studied alive from the North Sea stations and from the Eastern Scheldt. Three whole mounts (one of them designated as holotype) and four specimens serially sectioned (all from the North Sea). Four sectioned specimens from Sylt (Dr. Ehlers).

Description

The living animals are 1.5–2.2 mm long and about 0.1 mm broad, slowly moving and without eyes. The colour is red (pigment is dissolved in the mesenchyme) with yellow-brown spots in the rear-end. Two kinds of dermal rhabdites (4 μm and 2 μm) and two kinds of adenal rhabdites occur, the latter produced in numerous and well developed glands in the front end of the animal. The pharynx (110 μm diameter) is situated slightly before the middle of the body. The epidermis is cellular and nucleated. Habitus and topography of the species is depicted in Fig. 9. A reconstruction of the genital organs is shown in Fig. 11. The paired testes are small, lying just behind the brain and in front of the gut. The large paired seminal vesicles, posterior to the pharynx, are surrounded by weak spirally arranged muscles. The lining epithelium is slightly thickened where the seminal vesicles join each other at their entrance into the copulatory bulb. This copulatory bulb is pear-shaped (about 140 μm long and 65 μm diameter) and surrounded by three muscle layers: a thin inner layer of which the fibres are mainly longitudinal, and two outer thicker layers which form spirals at right angles to each other. The bulb (actually the prostate vesicle) is filled with strands from only one type of glands which large cellbodies are lying extracapsular. Proximally and distally in the bulb some spaces between the prostate secretion and the bulb wall is left and filled with a loose tissue. The axial seminal duct is lined by a very thin epithelium (without nuclei) and surrounded by fine longitudinal muscles.

The cuticular apparatus (Fig. 10, 26) is extremely complicated as in *S. mucronata* Ehlers, 1974. As far as its construction could be analysed and understood it consists of a funnellike and slightly caved stylet (12 μm at its proximal end, tapering to a diameter of 2–2.5 μm and 29–32 μm long). The proximal rim of the funnel seems to be reflected to form a kind of collar or sheath. The dorsolateral

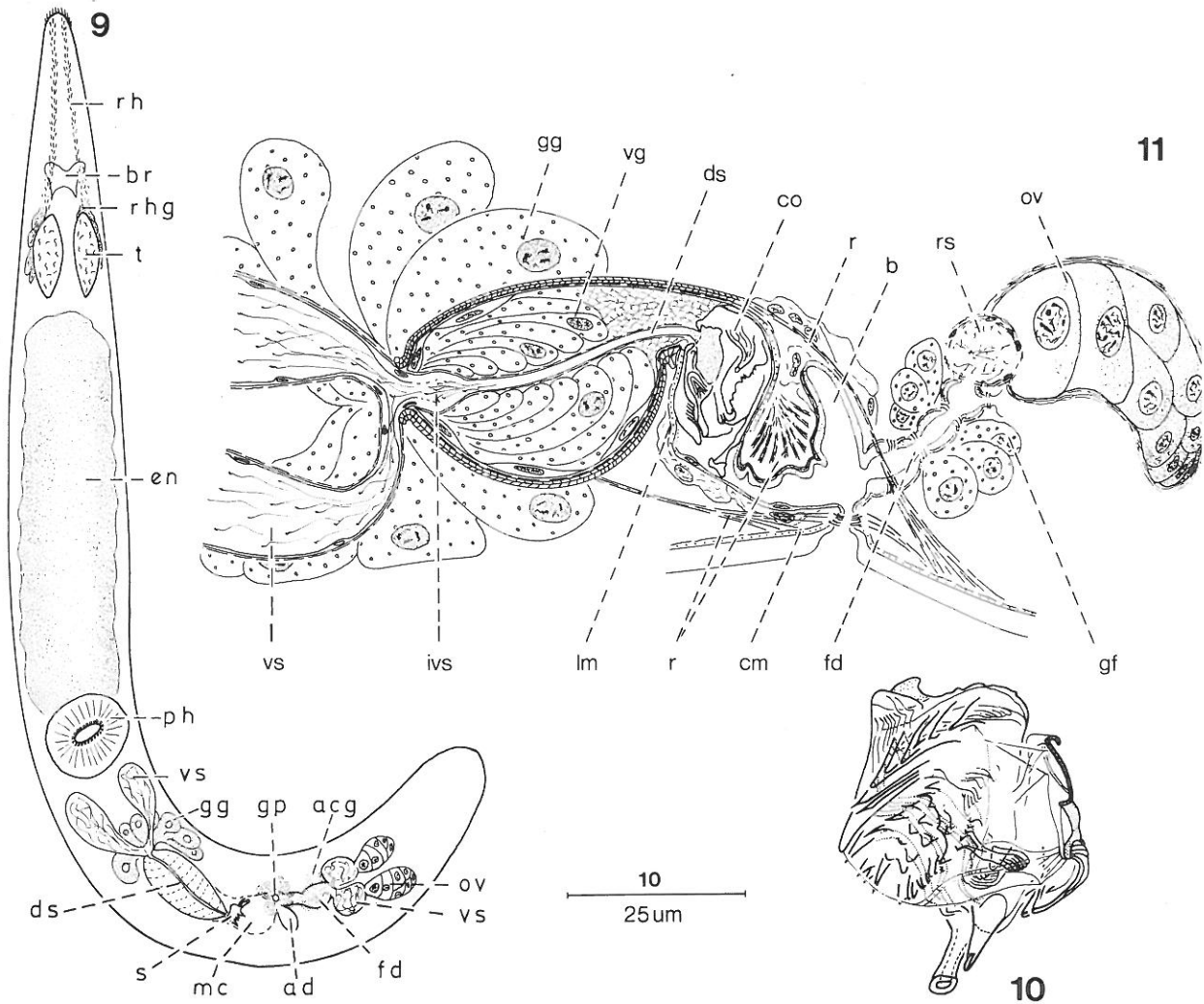


Fig. 9-11. *Subulagera rubra*. 9. General organisation (from living animal). 10. Cuticular apparatus (from whole mount). 11. Sagittal reconstruction of the genital apparatus, viewed from the left (from serial sections).

side (left) of this collar is ornamented with 4-5 rows of some 10 small spines and one row of about 12-15 larger flat and triangular spines; at the left side the collar bears one strong and solid spine accompanying the stylet's distal end. The right side of the collar shows numerous parallel and sinuous folds or ridges. The maximum diameter is $33 \mu\text{m}$ and the maximum height (without stylet) is about $31 \mu\text{m}$.

The individuals from the North Sea and from the Eastern Scheldt, all collected in the late summer, had not reached full female maturity and had very small ovaries. Vitellaria were not observed clearly, neither in the living nor in the sectioned material. According to Degadt's preliminary description, vitellaria could be found mainly posteriorly to the

pharynx. The individuals from Sylt had reached full sexual maturity and in Dr. Ehlers' drawings vitellaries were depicted also in front of the pharynx. The female duct, which enters the common atrium through its posterior wall, is short and surrounded by weak longitudinal and some circular muscles forming consecutive weak sphincters. The epithelium of the female duct is high with insunk nuclei and surrounded by large basophilous glands. At its proximal end the female duct bifurcates into two seminal receptacles which can be considered as part of the oviducts: the ovaries are indeed directly connected to their seminal receptacle and enveloped in the same tunica.

The genital atrium contains the copulatory stylet

in its anterior part. Furthermore it forms a large mediodorsally directed diverticle, an atrial bursa, in its posterior part. The ventral wall is lined by a flattened and nucleate epithelium. The epithelium of the dorsal wall is also thin, without nuclei and with a very thick basement membrane which stains heavily in iron hematoxylin. Numerous muscles are attached to the anterior wall of the bursa. Several protractor muscles of the bulb, and some dorso-ventral muscles, run around the atrium. The genital pore is guarded by a sphincter of some 4–5 muscle fibres.

Discussion

The genus *Subulagera* was introduced by Ehlers (1974) for *S. mucronata*. In this species the seminal receptacles have an excentric position and enter the oviducts from the side. It also has a copulatory bursa that is connected to the distal part of the female duct. In spite of these differences the new species is provisionally considered as a representative of the genus *Subulagera*. In our opinion, the construction of the stylet in both species is basically the same, while the differences mentioned evidently are a shift in relative position of homologous structures. From the study of sectioned paratypes of *S. mucronata* the pharynx construction may also show some structural differences in both species. The taxonomic importance of all these differences is difficult to evaluate at this moment: many monospecific genera have been described within the poorly diagnosed subfamilies Brinkmaniellinae (Den Hartog 1964b) and Adenorhynchinae (Ax & Heller 1970). We agree with Karling *et al.* (1972), Rieger (1974), Ehlers (1974) and even Luther (1962), that a thorough revision of the family Promesostomidae is necessary.

Paracicerina deltoides sp. n. (Figs. 14, 15, 27 & 28)

Locality: Eastern Scheldt, near buoy 013, fine sand at 3–4 m depth, 21.12.79, (Typolocality).

Material: One animal studied alive and prepared as a whole mount (holotype).

Description

The habitus and the general organisation of the individual studied (Fig. 14) agrees with that of

Paracicerina globulosa (Brunet 1973). But it must be mentioned that our specimen has a pair of eyes and a terminal girdle of ten adhesive papillae. The testes are paired and lie anteriorly to the pharynx just before the vitellaria. The cirrus is 30–35 μm long and 18–24 μm broad (Fig. 15). Its spines are not uniform: the proximal spines are longer than the distal ones while distally the cirrus is surrounded by a crown of triangular hook shaped spines (6–8 μm long). The bursa, with its two cuticular spermducts, is situated in front of the copulatory organ.

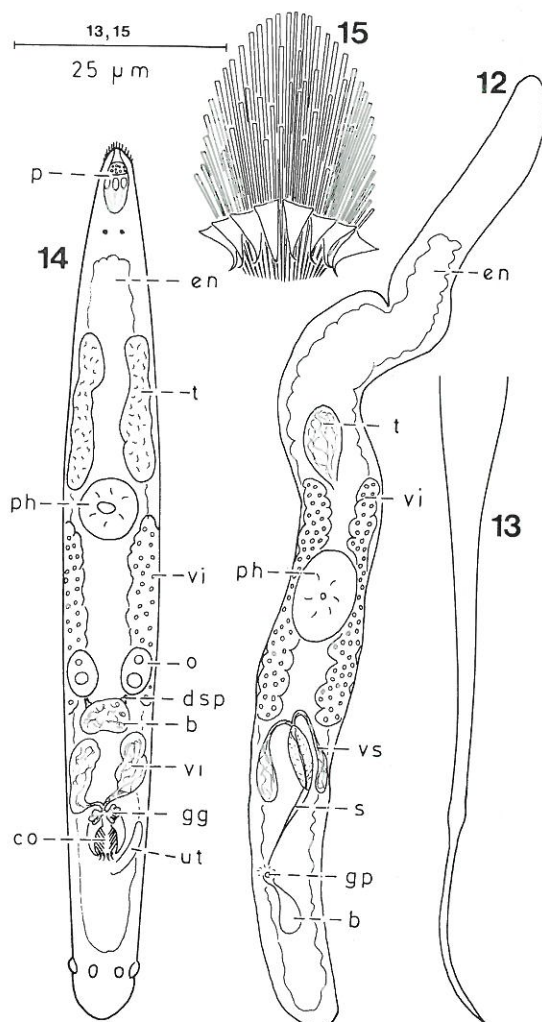


Fig. 12–13. *Ciliopharyngiella constricta*. 12. General organisation (from living animal). 13. Stylet (from whole mount).

Fig. 14–15. *Paracicerina deltoides*. 14. General organisation (from living animal). 15. Cuticular apparatus, semi-schematically (from whole mount).

Discussion

Since the above description is based on only one individual as is Brunet's (1973) description for *P. globulosa* it is with great hesitation that a new taxon is introduced. The main differences between both specimens are:

<i>P. globulosa</i> Brunet, 1973	<i>P. deltoides</i> sp.n.
- without eyes	- with eyes
- no adhesive papillae	- a girdle of ten adhesive papillae
- bursa behind copulatory organ (?)	- bursa in front of the copulatory organ
- cirrus with nearly uniform spines (Brunet 1973 p. 23 fig. 23b)	- cirrus with more spines and a distal crown of large curved spines.

More material of the mediterranean as well as of the Delta population is undoubtedly necessary.

Schizorhynchoides symmetricus sp. n. (Fig. 16-18)

Localities:

1. Eastern Scheldt, near buoy 013, fine sand at 3-4 m depth, 24.08.79 (Typelocality).
2. Bredene (Belgium), eulittoral zone of the sandy beach, fine sand (not analysed), 28.08.68.

Material: Several animals studied alive, three of them in whole mount (all from the Eastern Scheldt, one of them designated as holotype).

Description

The slender and colourless animals are about 1 mm (in whole mounts) and provided with a tail. A terminal girdle of six adhesive papillae occur. Eyes and sensory bristles are absent. The proboscis is 90-120 μm long or about 1/10th of the total body length. As in the other representatives of the genus *Schizorhynchoides* the pharynx is situated slightly behind the body middle and is preceded by two pairs of testes of which the left ones lie somewhat more anteriorly than the right ones.

The paired elongated seminal vesicles fuse to a seminal duct which runs axially through the copulatory bulb. The prostate vesicle fills the proximal part of this bulb. The cuticular organ consists of a slightly curved stylet (29-31 μm long) lying in a

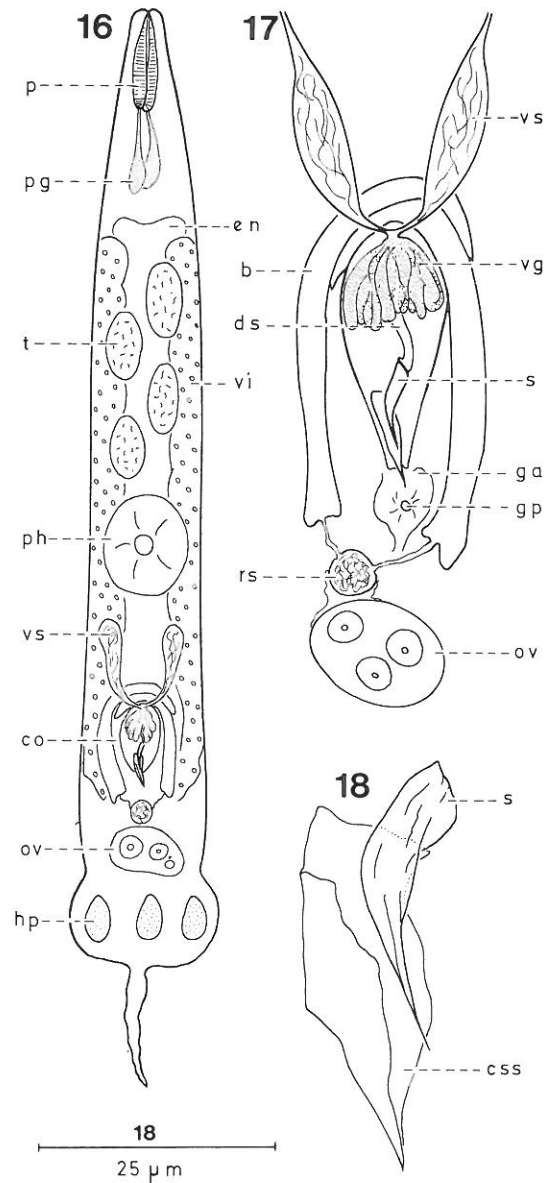


Fig. 16-18. *Schizorhynchoides symmetricus*. 16. General organisation. 17. Copulatory organ. (Both from living animal.) 18. Cuticular apparatus (from whole mount).

V-shaped cuticular sheath (34-40 μm long).

A little spherical seminal receptacle in front of the unpaired ovary is connected with two large elongated bursae by two non cuticular ducts. The slender bursae lie on either side of the copulatory bulb, with their anterior part reflected over the latter. No external vagina was observed.

Discussion

See the discussion below on *S. karlingi* n. sp..

*Schizorhynchoides karlingi** n. sp. (Figs. 19–23 & 29)

Locality: Eastern Scheldt, near buoy 018, fine sand at 3–4 m depth, 24.08.79, (Typelocality).

Material: Three specimens studied alive, two conserved as whole mounts (one of them designated as holotype).

Description

The slender, red, and blind animals are about 2 mm long, have some sensory bristles at the anterior tip and a rounded tail end. The proboscis is about 1/12 th of the total body length. No rhabdites were observed. The topography of the pharynx and genital organs can be derived from Fig. 16. The genital pore, surrounded by glands, is found in the last quarter of the body, the male organ anteriorly, the female organs posteriorly of it. The seminal duct, arising from the confluence of the paired seminal vesicles, run axially through a large copulatory bulb (ca 100 μm long). This duct is expanded to form a relatively small prostate vesicle, the glandbodies lying inside and outside the bulb. The proximal half of the cuticular organ is in part enclosed in the bulb and directly connected to the prostate vesicle. The cuticular apparatus consists of a thin walled cylindrical sheath (33 μm long and 21 μm wide with a proximal expansion), that is ornamented with little bumps and longitudinal folds, and provided on its inner side with five spines. One of the spines arises from the proximal expansion. It is 33 μm long and roughly circular in cross section. This spine probably functions as a sperm draining stylet. The other spines are arranged in pairs on the distal part of the sheath: a lateral proximal pair (39 μm) and a mediolateral distal pair (33 μm). These four spines are clearly triangular in cross section.

The unpaired, caudally situated ovary is connected to the bursa by a weakly cuticularised spermduct. It is funnel shaped, ending in a spherical

widening at the side of the bursa were accessory glands occur.

Discussion

Ten species are now known in the genus *Schizorhynchoides*. In most of them, the copulatory stylet is surrounded by a kind of sheath that may be: (1) gutterlike (V-shaped in section) as in *S. meixneri* Boaden, 1963a, *S. rarus* Ax, 1951, *S. symmetricus* sp. n., *S. canaliculatus* L'Hardy, 1963; and most probably also in *S. aculeatus* L'Hardy, 1963, or (2) cylindrical and spiny as in *S. coronostylus* Boaden, 1963a and *S. karlingi* sp. n.; or (3) cylindrical and slightly or not cuticularised as in *S. diplorchis* Meixner, 1928, *S. globulosus* Brunet, 1970 and probably also in *S. macrostylus* L'Hardy, 1963 (with thickened (muscular?) sheath: 'pénis . . . armé d'une canule cuticulaire'). Only in *S. spirostylus* Boaden, 1963a, with a very long stylet, has such a sheath not been described.

The organisation of the female apparatus is poorly known in most species. From the information available it seems much like that in other Schizorhynchidae and even other Schizorhynchia. There are always present: a single caudally situated ovary (with or without adjacent seminal receptacle) and a non-muscular syncytial bursa in front of it. The bursa is connected to the ovary (or seminal receptacle) by (1) a single spermduct in *S. coronostylus*, *S. karlingi*, *S. globulosus*, *S. macrostylus* and *S. meixneri* (in the latter two species only observed in sectioned material); (2) paired spermducts in *S. diplorchis*, *S. spirostylus* and *S. symmetricus*; (3) unknown in *S. aculeatus*, *S. canaliculatus* and *S. rarus*. On the other hand the bursa opens (1) to the exterior by a vagina in *S. diplorchis* (vagina anteriorly to the male pore), *S. coronostylus* and *S. rarus* (vagina posteriorly to the male pore); or (2) in the atrium as in *S. meixneri* and *S. globulosus*; or (3) has no opening of its own in *S. macrostylus*; while (4) the exact situation is unknown in the other species but most probably without external vagina. The taxonomic weight of this character is of minor importance: an external vagina can arise more than once independently, as can be seen in other genera (e.g. in *Thylacorhynchus*, *Proschizorhynchus*). The bursal complex in *S. symmetricus* is rather peculiar and necessitates closer consideration: the presence of two sperm-

* Dedicated to Prof. Karling, honoured in this Symposium and volume.

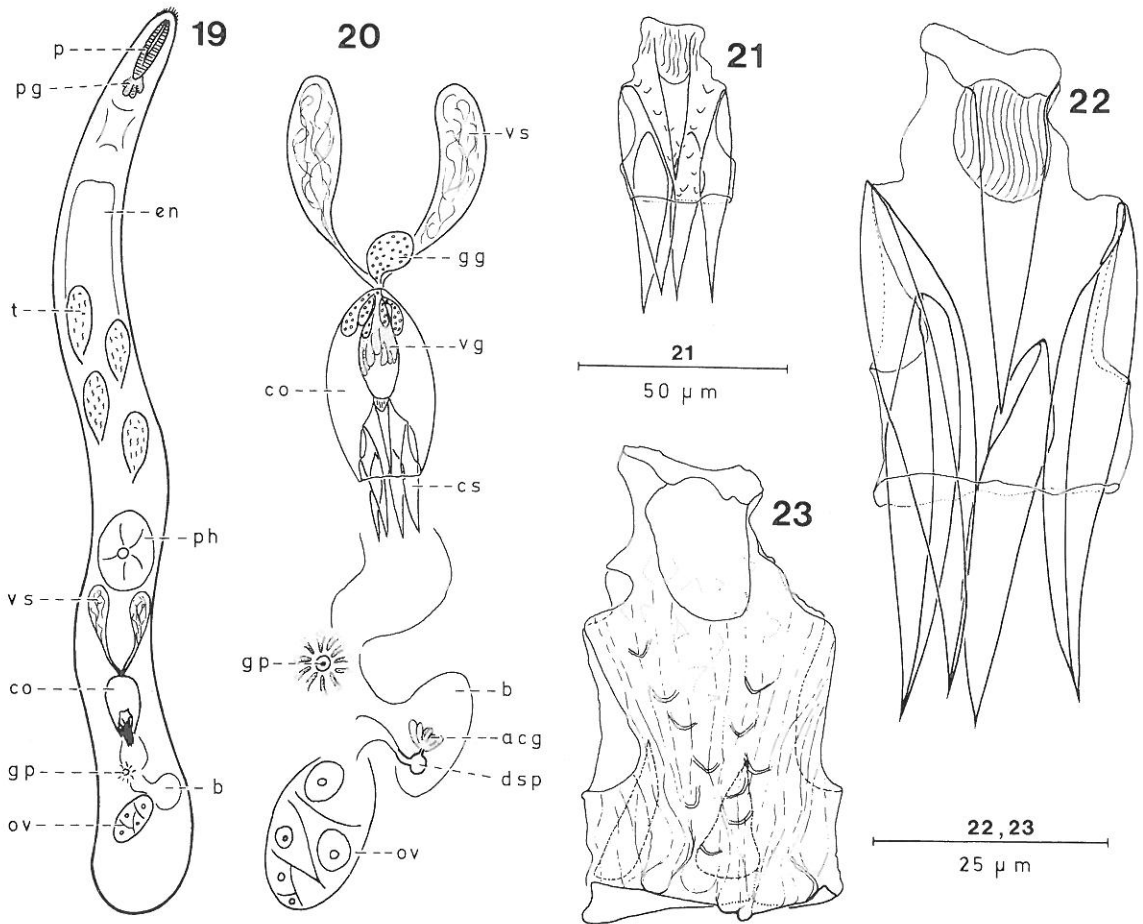


Fig. 19–23. *Schizorhynchoides karlingi*. 19. General organisation. 20. Genital organs (both from living animals). 21. Cuticular apparatus at low magnification. 22. Spines of the cuticular apparatus. 23. Sheath of the cuticular apparatus. (21–22 from whole mount.)

ducts in *S. duplorchis* and in *S. spirostylus* might be considered of a remnant from an ancestor with paired ovaries (for discussion on related problem: see Karling 1955) (so a plesiomorphy) but the duplication of the spermducts in *S. symmetricus* is evidently the result of the duplication of the bursa, (both apomorph characters). A bilobed bursa has been mentioned for *S. canaliculatus* and *S. meixneri* but in neither of these species does a duplication of the bursa occur. From the above discussion we can conclude: (1) that *S. symmetricus* is closely related to *S. meixneri* and *S. canaliculatus* (stylet construction, bilobed or duplicated bursa) while *S. aculeatus* and *S. rarus* may be included in this species-group (stylet construction), (2) that *S. karlingi* is related to *S. coronostylus* and *S. globulosus* and perhaps *S. macrostylus* (stylet construction and unpaired spermduct) (3) that *S. duplorchis* and *S.*

spirostylus form a third group of related species (paired spermducts, stylet construction?).

Identification key to the species of the genus *Schizorhynchoides*

1. Cuticular parts of the copulatory organ consisting of two simple stylet-like pieces (stylet + gutterlike sheath) 2.
- Cuticular organ otherwise 6.
2. External vagina present (behind male pore) *S. rarus* Ax, 1963
- No external vagina 3.
3. Two large bursae anteriorly directed and next to the male copulatory bulb *S. symmetricus* n. sp.
- A single, sometimes bilobed bursa 4.
4. Animals with elongated caudal end but without a little tail *S. aculeatus* L'Hardy, 1963
- With distinctly off set tail 5.

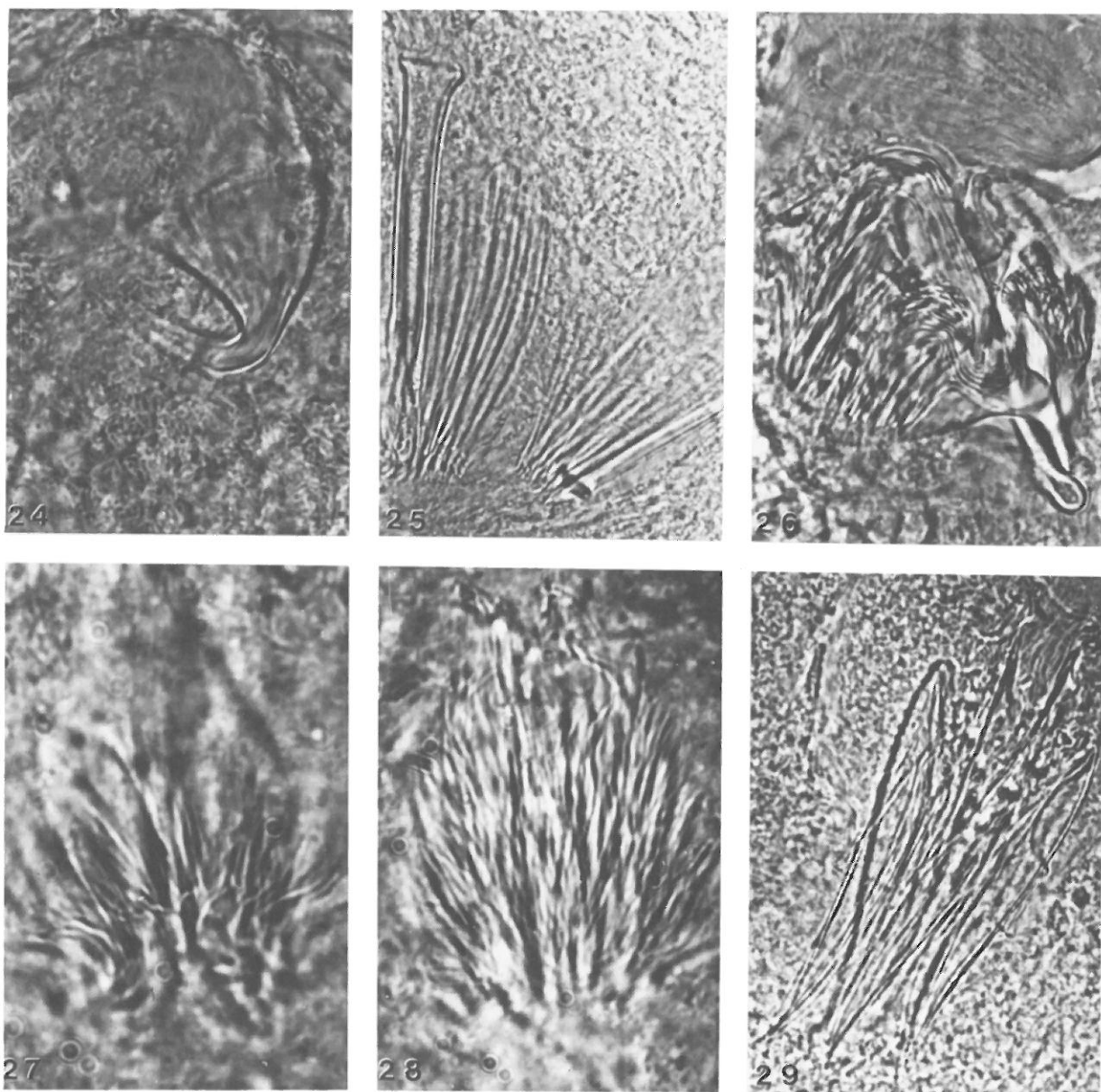


Fig. 24-29. 24. *Bradynectes sterreri*; stylet. 25. *Archimonocelis oostendensis*; cuticular apparatus. 26. *Subulagera rubra*; cuticular apparatus. 27-28. *Paracicerina deltoides*; cuticular apparatus, distal view (27) and proximal view (28). 29. *Schizorhinchoides karlingi*; cuticular apparatus. (All photographs are from whole mounts.)

5. Stylet and gutterlike sheath straight, 25-27 μm and 35-40 μm respectively

S. canaliculatus L'Hardy, 1963

Stylet slightly curved gutterlike sheath very thin, 28-30 μm and 25 μm respectively

S. meixneri Boaden, 1963

6. Stylet large, spirals or with spiral ornamentation

7.

Stylet small with cuticular sheath (weak or folded or spiny)

8.

7. Large stylet with spirally arranged ridge. A single, weakly cuticularised spermatid duct

S. macrostylus L'Hardy, 1963

Stylet forms spiral. Paired cuticular spermatid ducts

S. spirostylus Boaden, 1963

8. Stylet surrounded by a weakly cuticularised sheath. Two spermatid ducts
S. diplorenchis Meixner, 1928
Stylet surrounded by a spiny or folded sheath.
An unpaired spermatid duct 9.
9. Stylet straight, sheath with spines 10.
Stylet curved, sheath with longitudinal folds
S. globulosus Brunet, 1970
10. Sheath with four spines *S. karlingi* n. sp.
Sheath with numerous small spines
S. coronostylus Boaden, 1963

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Abbreviations

acg : accessory glands	di : ductus intervesicularis	ivs : intra capsular seminal vesicle	rhg : rhabdite glands
aco : accessory organ	ds : seminal duct	lm : longitudinal muscle	rs : seminal receptacle
ad : atrial diverticle	dsp : spermatic duct	m : mouth	s : stylet
b : bursa	en : enteron	mp : male pore	sta : statocyst
br : brain	fd : female duct	ov : ovary	ut : uterus
cil : cilia	fp : femal pore	p : proboscis	t : testis
cm : circular muscle	ga : genital atrium	pg : proboscisglands	v : vagina
cn : cnidosac	gf : glands in female duct	ph : pharynx	vg : prostate vesicle
co : copulatory organ	gg : glands	phg : pharyngial glands	vi : vitellary
cs : cuticular spines	gp : genital pore	r : retractor muscle	vs : seminal vesicle
css : cuticular stylet sheat	hp : adhesive papillae	rh : rhabdites	
de : ejaculatory duct			

