

# Anatomy and Taxonomy of Some Species of Polycystididae (Turbellaria, Kalyptorhynchia) from N. Atlantic and Mediterranean Coastal Areas

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## Abstract

Schockaert, E. R. (Limburgs Universitair Centrum, B-3610 Diepenbeek, Belgium) and Karling, T. G. *Anatomy and taxonomy of some species of Polycystididae (Turbellaria, Kalyptorhynchia) from N. Atlantic and Mediterranean coastal areas.* Zool. Scr. 4 (4): 133–143, 1975.—*Acrorhynchides styliferus* sp.n. from Norway and the British Isles and *Polycystis contorta* sp.n. and *Typhlopolycystis coomansi* sp.n. from Norway and the Mediterranean are described. Additional notes are given on the anatomy and distribution of *Paracrorhynchus bergensis* Karling, *Polycystis groenlandica* (Levinsen), *P. crocea* (Fabricius) and *Typhlopolycystis mediterranea* Brunet. The taxonomy of the species and the corresponding genera is discussed.

## Introduction

Throughout many years the senior author (Karling) has collected and made preliminary studies on material of several species of Polycystididae in Scandinavian and North American coastal waters. A number of these species will be presented here. Some of these species have also been found in the Mediterranean.

This study belongs to a series of papers (in part already published: Schockaert & Brunet, 1971; Schockaert & Karling, 1970) intended to result in a monographic review by the junior author on the anatomy and taxonomy of the family Polycystididae.

## Material and methods

Observations on living animals, including drawings and photographs, have been made by the senior author on Atlantic material and by Dr M. Brunet (Marseille) on Mediterranean material. Some drawings and notes by the late Dr E. Westblad have also been considered. Whole mounts (canada balsam or Turtox CMCP-9 embedding medium) and serial sections have also been made by them (or in their laboratories). The studies on the preserved material have been elaborated mainly by the junior author. Material for serial sections has been fixed in Bouin's fluid or mercury-chloride solutions. Sections of 4–5  $\mu\text{m}$  have been stained with Ehrlich's hematoxylin or Heidenhain's ironhematoxylin, eosine or erythrosine being used as counterstains.

Drawings without a linear scale have been made free-hand. No linear scale has been drawn in the photographs, the measurements of the pictured organs appearing from the corresponding linear drawings and from the text.

The position of the structures in the longitudinal axis of the animal is determined in per cent of the whole body length beginning from the anterior tip.

All material, including the types, is deposited in the Section of Invertebrate Zoology, Swedish Museum of Natural History, Stockholm.

## Description and discussion

*Acrorhynchides styliferus* sp.n. (Figs. 1, 4, 9)

*Localities.* Norway, S. of Bergen, Korsfjord, N. Oddane, seaweed on surf-exposed rocks, 1965-02-12 (leg. Karling, Bergen Biol. Stat. Ref. No. 342-65, type locality). British Isles, Tynemouth, Cullercoats, tidepool, 1950-07-28 (leg. Westblad).

*Material.* Observations on living material, including drawings and photographs; one animal sectioned sagittally (holotype No. 2670), two whole mounts.

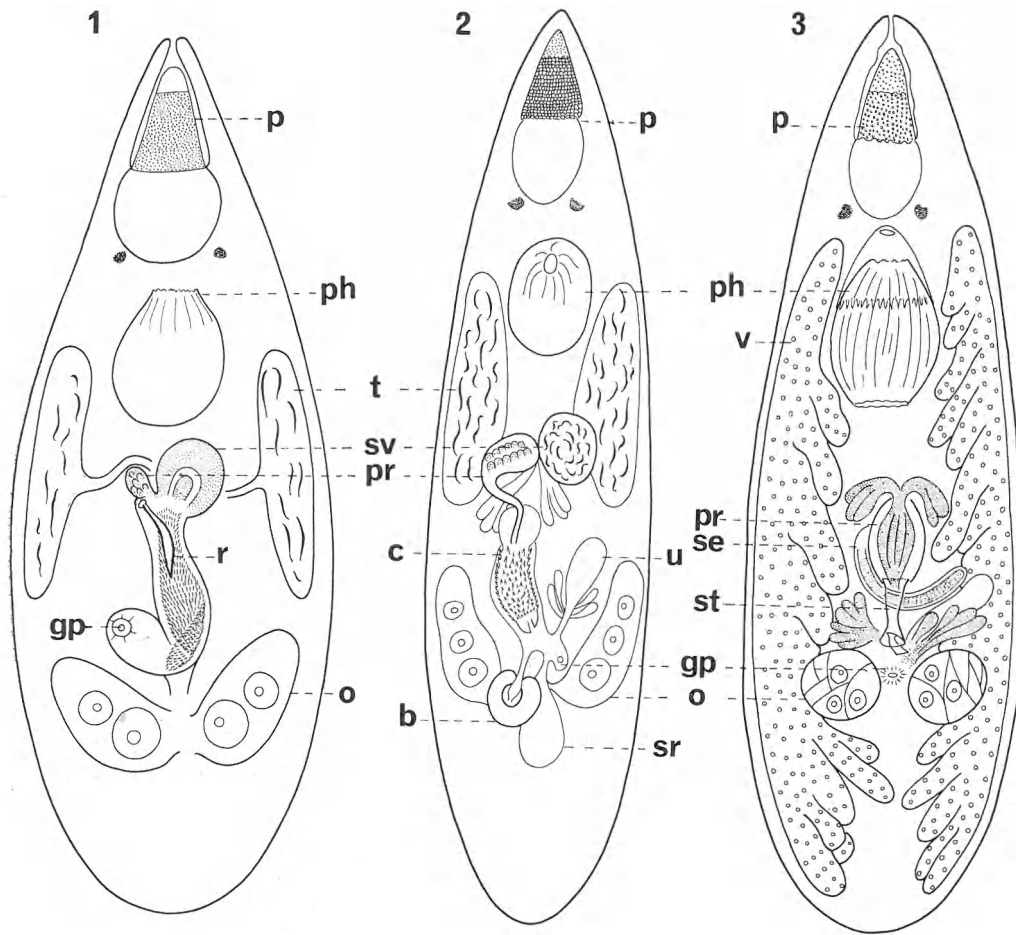
*Derivation of the species name.* Stylus = pricker, bearing on the hard rod dominating the view of the genital apparatus in the living animal.

*Description.* 1.5 mm long, colourless with paired eyes, externally resembling *Acrorhynchides caledonicus* (Claparède, 1861) (Fig. 1). Also the internal anatomy is in most respects the same in the two species.

In living material a very conspicuous solid rod can be seen in the spiny cirrus of the male copulatory apparatus (137 and 156  $\mu\text{m}$  long in two specimens, Figs. 1, 4). It is somewhat dagger-like, distally sharp, in cross section almost circular, basally with an irregular knob. In one of the whole mounts and in the sectioned specimen the rod has disappeared, evidently dissolved in the acid fixative (Bouin's solution). In the other whole mount, remainders of the proximal knob was found. In this specimen as well as in living animals the proximal knob is situated close to the prostatic vesicle and can evidently be moved by the strong retractor muscle inserting at this point on the cirrus wall (Fig. 9).

Another characteristic of *A. styliferus* is the differentiation of some (6?) strong, 5–13  $\mu\text{m}$  high teeth based on small cushions of an almost unstained substance in the dorsal wall of the cirrus (Fig. 9). Also more distally there is a group of strong teeth. Just as in regard to the rod the substance of the cirrus teeth appears to be at least partially dissolved in the fixatives, this armature, though striking in living animals, being indistinct in whole mounts.

*Discussion.* The genus *Acrorhynchides* Strand, 1928, includes the species *A. caledonicus*, *A. robustus* (Karling, 1931) and *A. styliferus*. The comparative anatomy and the taxonomy of the first two species are dealt with in Karling, 1931 and 1956. The close relationship between *A. caledonicus* and *A. styliferus* in comparison with *A. robustus* appears on sectioned material, for instance in the strong muscular collar enclosing



Figs. 1-3. Squeezed live specimens (free-hand drawings). — 1, *Acrorhynchides styliferus*. — 2, *Paracrorhynchus bergensis*. — 3, *Polycystis groenlandica*.

the distal part of the male genital canal and in the lack of copulatory bursa in the first two species.

The solid rod in the cirrus is functionally as well as chemically of certain interest. It has evidently no function in the ejection of sperm and secretion, nor in the fastening of the atrial structures of the copulatory partners. More probable is the function of the rod as weapon and/or sexual stimulator, two functions well known for "cuticular" organs in turbellarians (e.g. Reisinger, 1968, pp. 32-38).

The hard structures in the atrial organs are mostly "cuticular", i.e. products of epithelial cells, or "pseudocuticular", i.e. derivatives of the basement membrane, both of them insoluble in acid fixatives. Penial hooks of aragonite have been described in the planarian *Dendrocoelopsis spinosipenis* (Kenk) (Kenk, 1973, p. 14) and the same chemical composition can provisionally be assumed for the rod (and the spines?) in the male genital canal of *A. styliferus*.

- 1. Male copulatory cirrus with a globular copulatory bursa, without a distal muscular collar. 2  
*A. robustus*
- Cirrus without copulatory bursa, with a strong distal muscular collar.
- 2(1). Cirrus with a sharp, 130-160  $\mu\text{m}$  long solid rod and some large teeth in its dorsal wall. *A. styliferus*
- Cirrus without rod and large teeth. *A. caledonicus*

***Paracrorhynchus bergensis* Karling, 1956 (Figs. 2, 5-8)**

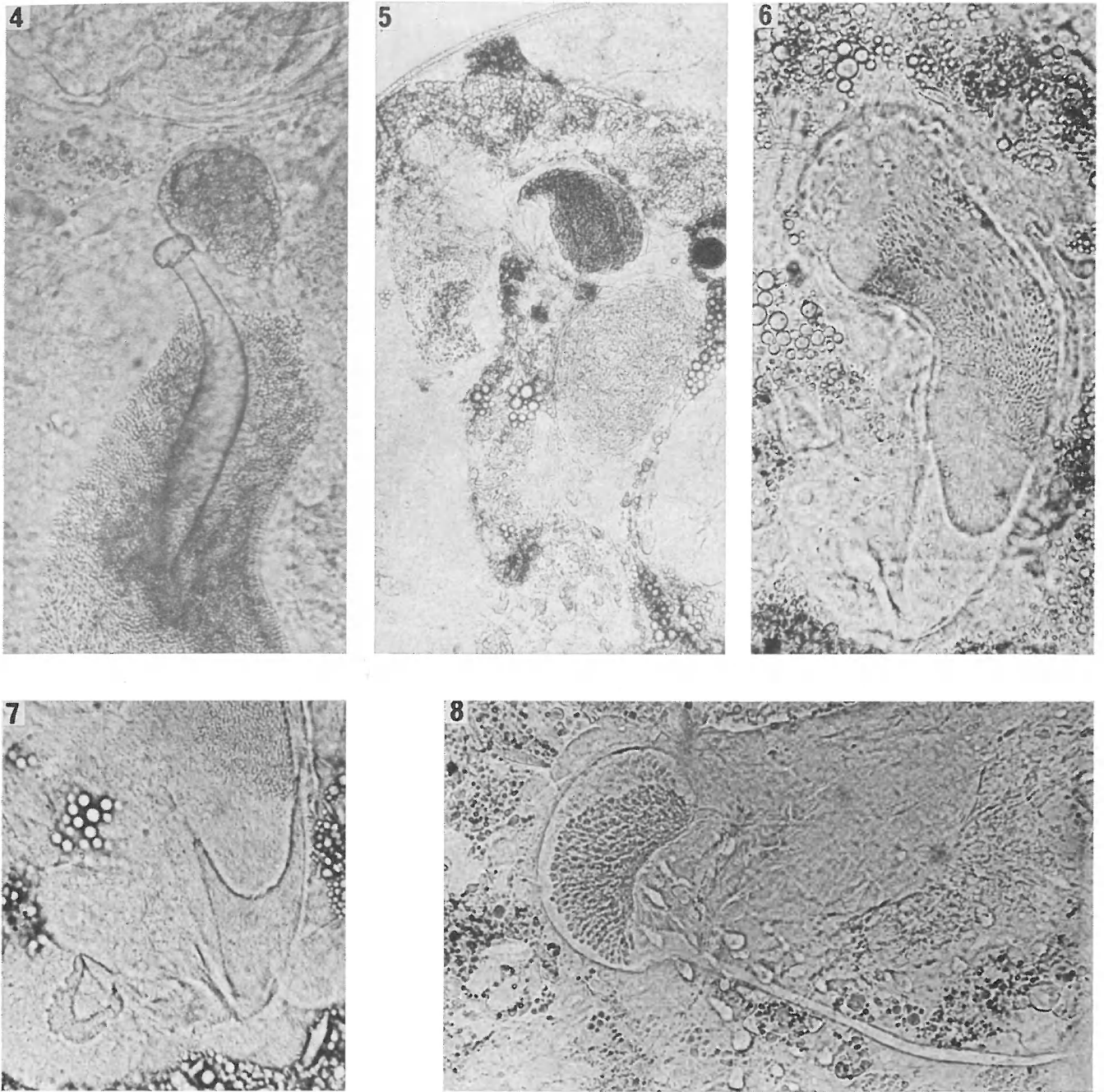
*New localities.* Norway, Raunefjord (off Bergen, leg. Karling); Kviturdvickspollen, tidepool with gravel and *Enteromorpha* (1964-06-21, Bergen Biological Station, Ref. No. 287-64); Mariholmen, salt-marsh (1965-08-18, Ref. No. 359-65).

*Previous records.* Norway, Bergen-area, in the phytal (type locality, Karling, 1956, p. 224).

*Material.* Holotype (No. 2674, transversal sections, 2 slides); observations on two living specimens.

*Description and discussion.* The original description was based on some sketchy drawings by Westblad and one serially sectioned specimen. Observations on new material make it possible to give some supplementary reports on the organization of the species. Freely swimming adult animals are unpigmented and about 1.3 mm long with about 13  $\mu\text{m}$  large eyes. The proboscis is not especially small (as mentioned in Karling, 1956) and has a distinctly delimited apex (Fig. 2). Paired lateral yolk glands were seen but have not been drawn in the picture. In one of the studied specimens an unpaired globular seminal vesicle was observed close to the oviform prostatic vesicle (Fig. 5), which narrows to a long ejaculatory duct (Fig. 8) traversing the large penial papilla (Figs. 6, 7). Large complexes of prostatic glands open in the proximal end of the prostatic vesicle which is internally asymmetrical, evidently with an eccentrically situated seminal duct as described in the related species *Koinocystella inermis* Karling, 1952. However, neither the pore of the seminal vesicle nor sperm in the prostatic vesicle has been observed.

Karling describes a globular complex of cells interpreted as a bursa, connected by a short fine canal with the large male genital canal. In this organ a group of small cells was found closing the proximal aperture of the canal. In one of the squeezed specimens this bursal organ could be easily identified by its globular shape and its peculiar closing apparatus (Fig. 7). In the other squeezed specimen besides this organ



Figs. 4-8. Parts of the genital apparatus from squeezed live specimens. — 4, *Acrorhynchides styliferus*, proximal part of spiny cirrus with the rod. — 5-8, *Paracrorhynchus bergensis*; 5, from left to right: cirrus, prostatic vesicle (dark), seminal vesicle, pharynx (adult specimen);

6, everted spiny cirrus; 7, tip of everted spiny cirrus and bursa with closing apparatus (left below); 8, prostatic vesicle and ejaculatory duct from young specimen.

a large sac filled with sperm was found behind the atrium (Fig. 2). I interpret this sac as the seminal receptacle ("End-blase", Karling, 1956), connected with the female genital canal. The function of the "male bursa" remains unknown.

*Polycystis groenlandica* (Levinsen, 1879) (Figs. 3, 10, 11, 15, 26)

*Gyrator groenlandicus* Levinsen, 1879

*Macrorhynchus groenlandicus* (Levinsen) Graff, 1882

*Polycystis groenlandica* (Levinsen) Graff, 1913

*New localities.* Norway, S. of Bergen, Korsfjord (leg. Karling): 1) Isle of Tekslo, coarse shell, 25 m, 1964-06-16 (Bergen Biol. Stat. Ref. No. 280-64); 2) Lille Vardöy, coarse shell, 12 m, 1965-08-05 (Bergen Biol. Stat. Ref. No. 332-65).

*Other distribution.* Greenland, Disko Bay, Egedesminde (Levinsen, 1879). White Sea, Solovetsk Islands (Sabussov, 1897 according to Graff, 1913).

*Material.* Observations on living material including drawings and photographs; one whole mount, three specimens serially sectioned (all preserved material from Tekslo).

*Description.* Our knowledge of this species was hitherto based on a short description of the living animal and a figure of the male cuticular organ (Levinsen, 1879).

A free swimming animal is 2-3 mm long, longish fusiform, colourless with paired eyes and with dots of green and blackish-brown colour in the intestine.

The epidermis is syncytial, the pharynx and the proboscis

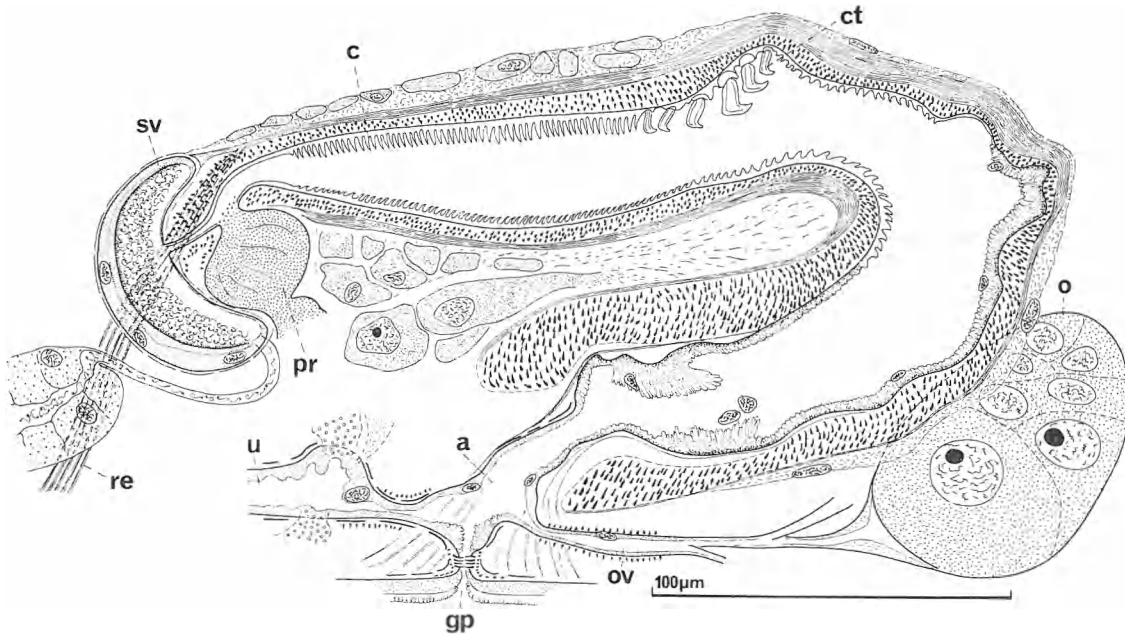


Fig. 9. *Acrorhynchides styliferus*, sagittal reconstruction of the atrial organs, from the left side.

are of the regular polycystidid type, the latter with three pairs of retractors and a dorsal and a ventral pair of integument retractors. There are no cellular nuclei at the proboscis junction.

The topography of the genital organs is shown in Figs. 3 and 15. The testes, not drawn in the figures, are laterodorsally situated at the pharynx level. The common genital atrium has a high nucleated epithelium and receives the uterus from

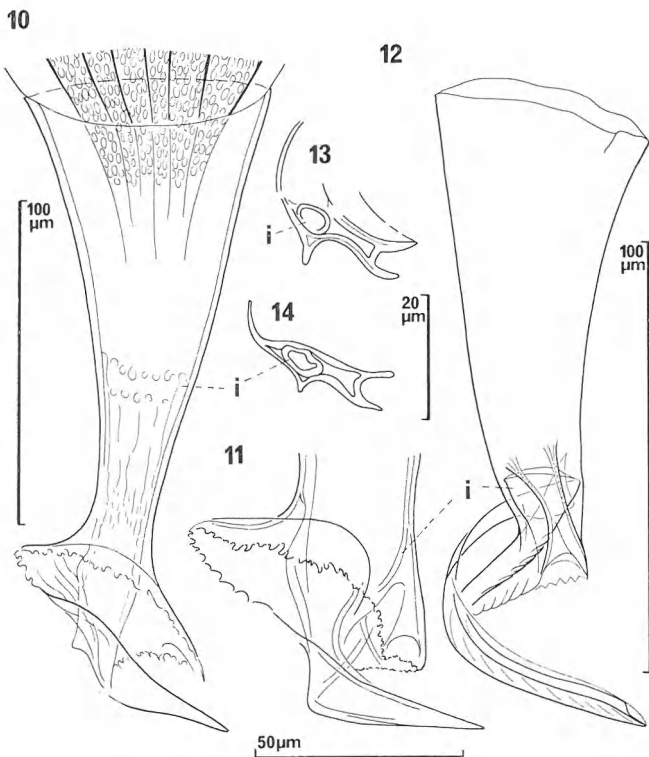
the frontal side, the female duct (common oviduct) from behind and the male genital canal from the dorsal side. The common genital pore is situated ventrally at about 65%.

The two seminal vesicles join each other under the prostatic vesicle. From here the common seminal duct curves around the male genital canal on the left side and opens into this canal mediadorsally through a protruding muscular papilla close to the tip of the stylet.

The pyriform prostatic vesicle is lined with a thin membrane distally fixed at the rim of the (external) stylet, proximally with an opening for the gland ducts. On the inner side of the membrane a layer of mainly longitudinally directed muscle fibers ( $lm_1$ ) reaches the rim of the stylet. Outside the membrane there are two muscular layers ( $lm_2$  and  $lm_3$ ), also with mainly longitudinally directed fibers, extending around the proximal part of the male genital canal. A ventrolateral fold in the wall of this canal, caused by retraction of fibers belonging to the outermost layer, indicates that these two muscle layers act in uncovering the stylet in copulation. Antagonistic with this muscle system is a layer of circular fibers around the genital canal at the level of the distal part of the stylet. A large mass of glands discharge their eosinophilous secretion into the male genital canal close to the seminal papilla.

The size and the complicated distal part of the stylet (Figs. 10, 11, 26) easily identify the species with Levinsen's *Gyrator groenlandicus*. The length of the stylet is about 200 µm and the width of the proximal opening about 80 µm. At approximately 140 µm from the proximal rim the stylet narrows to appr. 20 µm, then enlarges to an appr. 74 µm wide oblique collar which encloses a short and narrow screw-shaped appr. 40 µm long tip. The free border of the collar is irregularly toothed. The stylet is as usual double-walled, the internal wall (the internal stylet) lacking proximally and in the collar.

The vitellogermloduct of each side unite to a short oviduct and the two oviducts unite to a short common



Figs. 10-14. Cuticular stylets. — 10, 11, *Polycystis groenlandica* (from squeezed live specimen). — 12-14, *Polycystis croeca* (12, from whole mount; 13, 14, cross sections of distal hook, 13 more proximally).

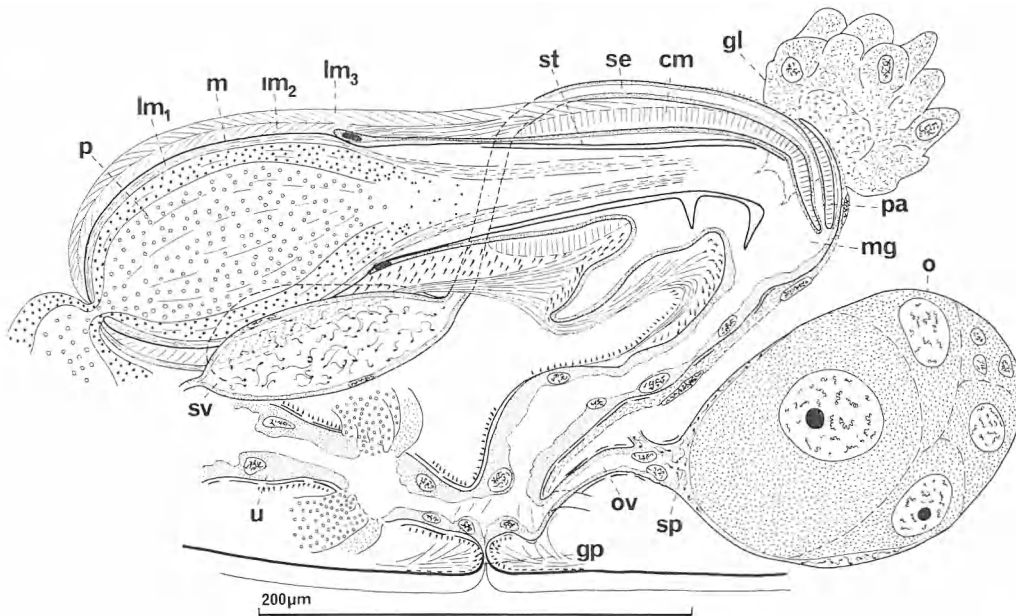


Fig. 15. *Polycystis groenlandica*, sagittal reconstruction of the atrial organs from the left side.  
*lm*<sub>1</sub>, muscular layer inside the membrane; *lm*<sub>2</sub> and *lm*<sub>3</sub>, muscular layers outside the membrane.

oviduct opening into the common atrium without any kind of bursal structures. Sperm can be found in the proximal parts of the paired oviducts as well as in stroma of the ovaries.  
**Discussion.** See below.

***Polycystis crocea*** (Fabricius, 1826) (Figs. 12–14, 27, 28).  
 Synonyms cf. Graff, 1913, p. 330.

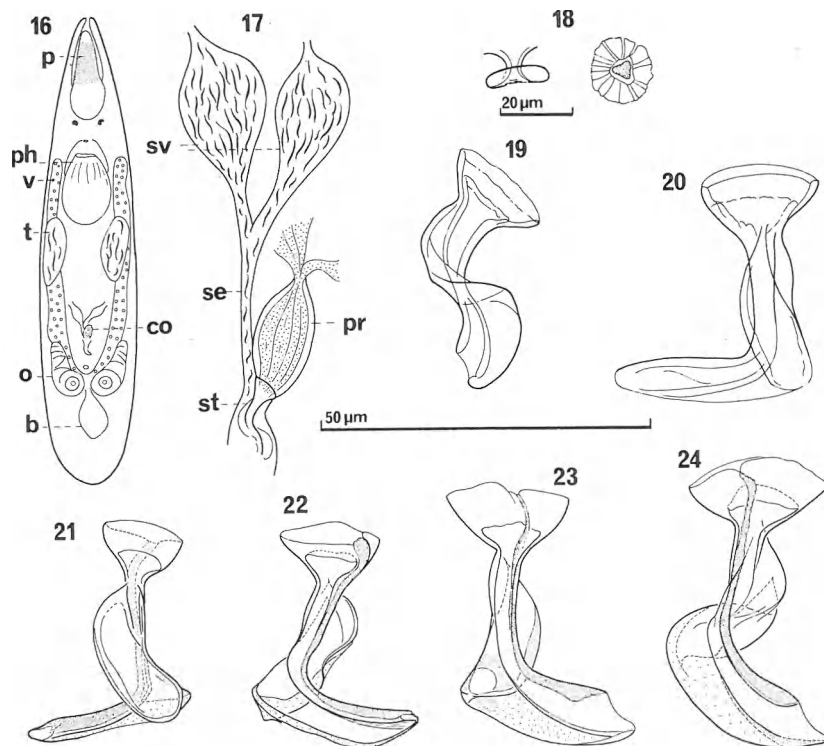
**New locality.** USA, Massachusetts, Nahant, East Point, tidal zone, algae, stones and gravel, June–July 1972 (leg. Karling).

**Other distribution.** Greenland, Iceland, Canary Islands (?), Adriatic (?), European coasts from the White Sea to the English Channel, SW. part of the Baltic Sea (Graff, 1913 with references; Krüger & Meyer, 1938; Meixner, 1938; Westblad, 1954; Evdonin & Minichev, 1969).

**Material.** Observations on living material, including photographs and drawings (Westblad, Karling), serial sections and whole mounts.

**Description.** *P. crocea* seems to be most abundant in the northern parts of its area of distribution (Jensen, 1878, p. 54; Levinsen, 1879, p. 20; Evdonin & Minichev, op. cit.). Southwards it is often found in sterile condition in the warmer seasons (Jensen, loc. cit., Meixner, 1925, p. 316; Karling, unpubl.). The reported finds from the Adriatic have been called in doubt (Graff, 1913; Meixner, 1938) and also the records from the Canary Islands must be checked as regards new material.

The anatomy of *P. crocea* is rather well known from the studies by Graff (1882, 1905) and Meixner (1925). Here a contribution only will be given on the structure of the male cuticular organ (the stylet). This organ (Figs. 12–14, 27, 28),



Figs. 16–24. *Polycystis contorta*. — 16, squeezed live specimen (Norway, Tekslo). — 17, seminal vesicles, prostatic vesicle and stylet from the same specimen. — 18, bursal “nozzles” from the same specimen. — 19–24, stylets of different specimens from the Bergen area, Norway; 19 and 20 from squeezed live animals, 21–24 from whole mounts (21, the holotype, cf. Fig. 31).

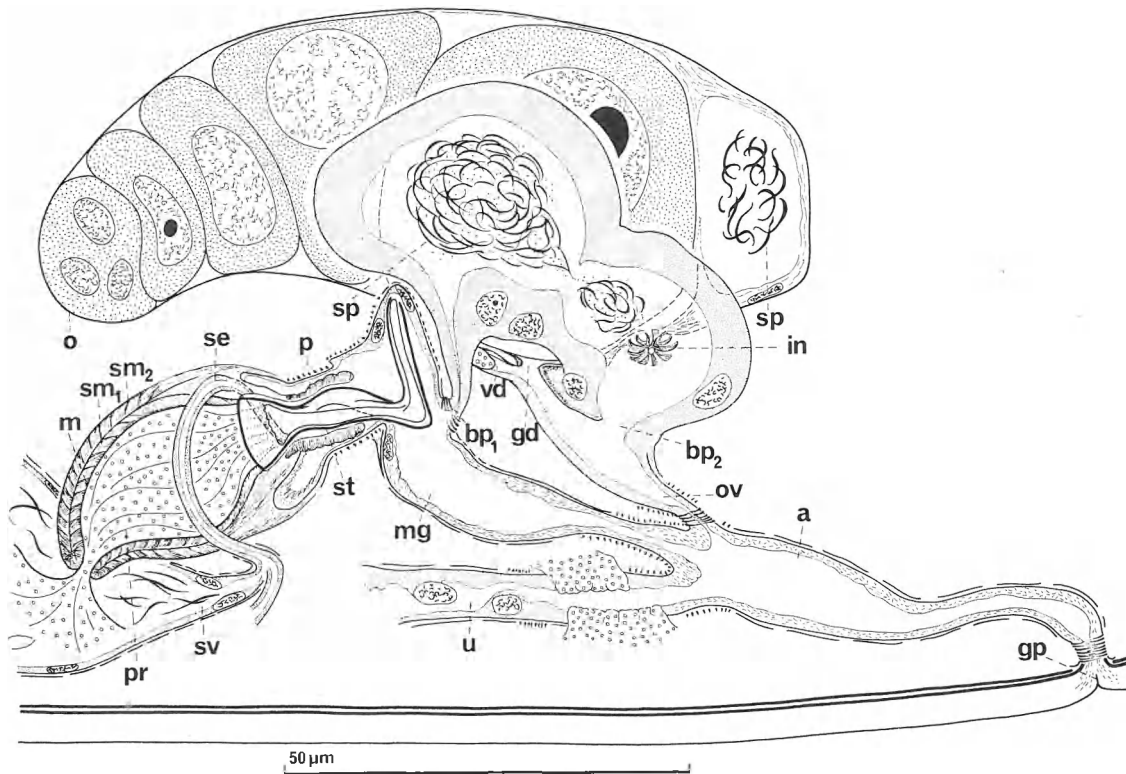


Fig. 25. *Polycystis contorta*, sagittal reconstruction of the atrial organs from the left side.

$sm_1$  and  $sm_2$ , internal and external spiral muscle layers;  $bp_1$ , proximal,  $bp_2$ , distal bursal pore.

pictured by several authors, is according to Graff (1882) 130  $\mu\text{m}$  long, a measure agreeing with our own (115–145  $\mu\text{m}$ ). The records vary mainly due to different stretching of the curved distal hook. A structure not previously recorded is the internal stylet, which in this species is extremely short, the proximal one-layered part of the stylet being appr. 3/4 of the whole length. The internal stylet begins proximally as a funnel fixed to the external stylet; from here it tapers to a fine tube within the curved hook, amalgamated with the external stylet along a strand of prickly substance and in the extreme tip of the stylet. The external stylet is distally provided with four wings (Figs. 13, 14) already described by Meixner (1925, p. 317, Fig. III, 22). Two of the wings form a groove functioning perhaps in the ejaculation of sperm.

Graff describes a variant of the stylet with distally lacinated external stylet and complicated, finely toothed hook (1905, Fig. IV, 7). We have not seen anything like that, even in strongest magnification, but the fibrous cuticula of the twisted hook can appear somewhat toothed in optical sections.

*Discussion.* See below.

#### *Polycystis contorta* sp.n. (Figs. 16–25, 31, 32)

*Distribution.* Norway, S. of Bergen, Korsfjord, Teksto, shell gravel, 25 m, 1964-06-16 (type locality, Bergen Biol. Stat. Ref. No. 280-64) and several other localities in the same area, shell gravel, 7–50 m (leg. Karling, ref. No. 331-65, 335-65, 336-65, 345-65, 247-68, 249-68, 261-68). Mediterranean, Marseilles area, several localities, *Amphioxus* sand (leg. Brunet).

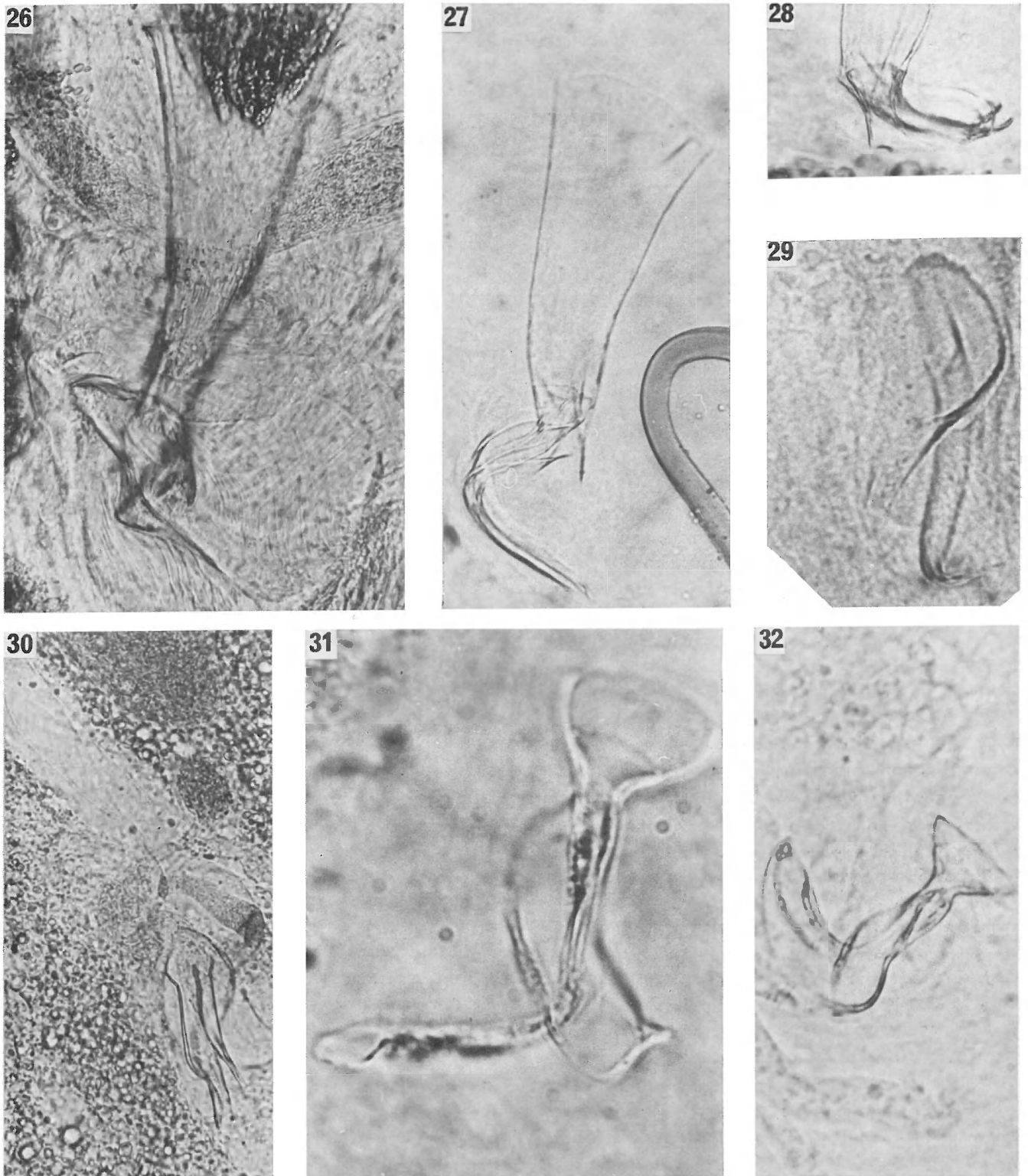
*Material.* Live material from Norway, a large material of whole mounts and serial sections from Norway and the Marseille area. Holotype No. 2681 a whole mount.

*Derivation of the species name.* Contorta = twisted, bearing on the shape of the stylet.

*Description.* Colourless, 1.5 mm, small irregular rhabdites, paired eyes, apex of the proboscis very small, pharynx in the anterior body part, anteriorly directed, common genital pore at about 75% (Fig. 16).

The small fusiform prostatic vesicle (appr. 50  $\mu\text{m}$ , Figs. 17, 25) is covered with two sheaths of spirally arranged fibers outside a thin membrane. The internal layer ( $sm_1$ ) is distally fixed at the proximal rim of the stylet, whereas the external one ( $sm_2$ ) extends around part of the male genital canal, withdrawing together from the membrane giving rise to a circular space around the distal part of the bulb. The seminal duct curves around the bulb on its right side, penetrates into the circular space and opens lateroventrally into the male genital canal between the stylet and a papillar fold of this canal provided with strong circular muscle fibers. The seminal duct arises by uniting of the distal parts of the large seminal vesicles under the prostatic bulb.

The 51–57  $\mu\text{m}$  long stylet (measured along its central axis) appears rather different owing to its position and the degree of squeezing (Figs. 19–24, 31, 32; Fig. 21 most closely conforms with results obtained on sections). It consists of a basic funnel and a tube, in its middle part bent at a right angle. The tubiform part appears more or less screw-shaped due to an irregular enlargement of the external stylet winding around the internal one. External and internal stylet are coherent along a ribbon of granular substances probably indicating the folding process with subsequent marginal fusion through which the double-walled stylet has been formed from a hollow cuticular hook (Karling, 1956, p. 204). Distally a similar substance fills out the space between the two walls.



Figs. 26–32. Male cuticular apparatus. — 26, *Polycystis groenlandica* (squeezed live animal). — 27, 28, *Polycystis croeca* (two different specimens in whole mounts; 28, tip of stylet only). — 29, 30, *Typhlopolycystis*

*coomansi* (29, holotype, Marseilles area; 30, squeezed live specimen from the Bergen area). — 31, 32, *Polycystis contorta* (31, holotype; 32, squeezed specimen from the Bergen area, cf. Fig. 24).

The epithelium of the proximal part of the male genital canal enclosing the stylet is sometimes rather high with active nuclei, sometimes (later?) pseudociliated with flattened nuclei. More distally the epithelium is membraneous without nuclei running over into the similar epithelium of the tubiform common atrium. The course of the muscular fibers externally lining the male genital canal is proximally circular, more

distally longitudinal and again around the distal pore circular, forming a sphincter.

The epithelial tissue of the common oviduct and the paired oviducts—on each side branching into germiduct and vitello-duct—is continuous with the hind part of the large bursal mass situated medially behind the stylet (Fig. 25). Thus, the the changing bursal cavity can communicate with the common

oviduct as well as with the paired oviducts. Paired insemination pores with "cuticular" wall, "nozzles", evidently produced by the ovarian tunica, forward the alien sperm to the ovarian stroma (Figs. 18, 25). The anterior part of the bursa communicates with the male genital canal through a narrow pore ( $bp_1$ ) enclosed by a weak sphincter. This bursal part can be homologized with the "male bursa" of some other polycystidids, e.g. *Polycystis naegelii*.

The funnel-shaped to tubiform common atrium branches proximally (anteriorly) into three canals, dorsally the common oviduct, ventrally the stalk of the uterus and in between the male canal. It is enclosed by longitudinal fibers, and a single layer of several fine circular fibers form a sphincter around the common genital pore.

#### Discussion of the genus *Polycystis*

The female apparatus reveals a rather low evolutionary level in the species *P. crocea* and *P. groenlandica*: a dichotomic system of ducts without bursal structures and insemination canals. Another symplesiomorphy is the lack of a "male" bursa (see below). There are distinct synapomorphies in the construction of the stylet: the longish tubular shape without enlarged basal funnel, the complicated tip and the comparatively short internal stylet. The male genital canal is in its distal part provided with a strong sphincter, distal to which the seminal duct opens—perhaps another synapomorphy; in the other *Polycystis*-species the seminal duct opens in the basal area of the stylet. Also in the construction of the proboscis apparatus there is a conformity worthy of mention: three pairs of proboscis retractors and two pairs of integument retractors, the number of these retractors in the other *Polycystis*-species being four and one respectively. An autapomorphy of *P. crocea* is the aberrant construction of the unpaired seminal vesicle with adjacent enlarged seminal ducts (Meixner, 1925).

*Polycystis contorta* is closely related to *P. riedli* Karling, distinct synapomorphies being the bursal complex communicating with the male as well with the female ducts and provided with paired insemination canals in the shape of cuticular "nozzles", furthermore the annular fold around the base of the stylet, but the distal part of the stylet is in *P. riedli* shaped as a watch-spring and provided with a broad collar (cf. Karling, 1956). Also the species *P. dolichocephala* (Pereyaslawzewa), *P. matarazzo* (Marcus), *P. fredylina* (Marcus) and *P. felis* Marcus have a bursal complex of the same construction with paired nozzles and in all these species the complex of accessory glands opening in the male genital canal (see below) is lacking (preliminary report, cf. Karling, 1956 and Marcus, 1948 and 1954).

In contrast to these species, *P. naegelii* Kölliker, *P. gabriellae* (Marcus) and *P. orientalis* Evdonin do not possess nozzles and the oviducts store sperm without differentiation of bursal organs. However, the male genital is provided with a "male" bursa. A bundle of accessory glands discharge secretion into the proximal part of this canal.

Summarizing, we conclude that there are three rather distinct species groups in the genus *Polycystis*: the *crocea* group with *P. crocea* and *P. groenlandica*, the *riedli* group with *P.*

*riedli*, *P. contorta*, *P. dolichocephala*, *P. matarazzo*, *P. fredylina* and *P. felis* and the *naegelii* group with *P. naegelii*, *P. gabriellae* and *P. orientalis*.

#### *Typhlopolycystis mediterranea* Brunet, 1965 (Figs. 33–39)

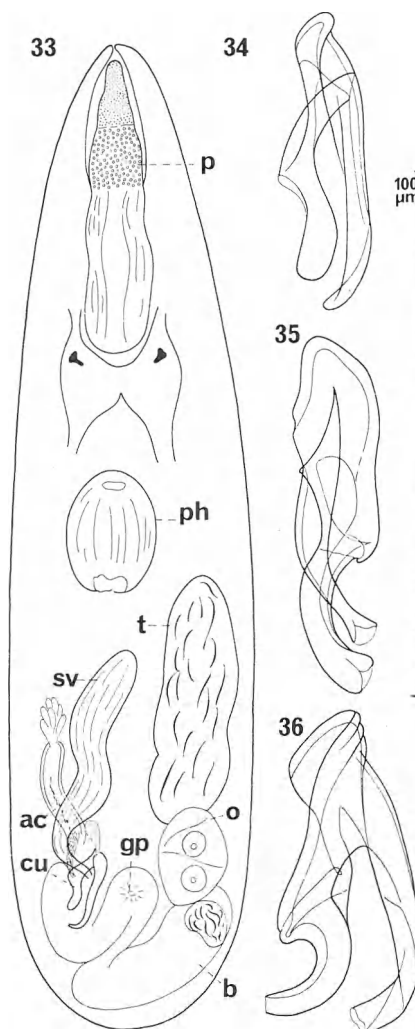
*T. limicola* Schilke, 1970.

*New localities.* Swedish W. coast, Isle of Bonden, shell gravel, 20–30 m, 1961-08-07 (leg. Karling) and 1974-06-11 (leg. Schockaert). Norway, S. of Bergen, Korsfjord, Liholmen, fine shell gravel, 7 m, 1968-07-29 (leg. Karling, Bergen Biol. Stat. Ref. No. 261-68).

*Other distribution.* French Mediterranean coast, Marseilles area, Plateau des Chèvres, *Amphioxus* sand (type locality, Brunet, 1965). German N. Sea coast, Sylt, sand in the tidal zone (Schilke, 1970).

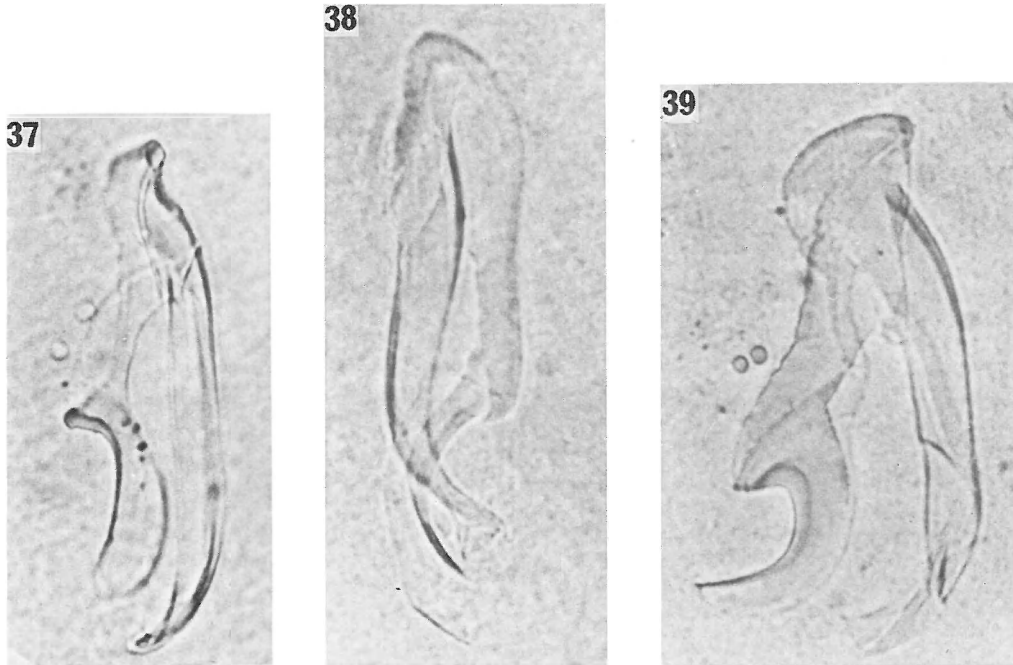
*Material.* The material of Brunet (op. cit.) deposited in the Swedish Museum of Natural History. Holotype No. 2703, a whole mount (considering the taxonomic importance of the male cuticular apparatus and by agreement with Brunet this specimen replaces the sectioned specimen nominated by this author as holotype). Live material and one whole mount from Liholmen, live material and two whole mounts from Bonden.

*Description and discussion.* Brunet's description is based on live material, whole mounts and sections. Schilke bases his description of "*T. limicola*" on two living specimens. Our material from Liholmen and Bonden appears sufficient to



Figs. 33–36. *Typhlopolycystis mediterranea*. — 33, squeezed live specimen. — 34–36, male cuticular apparatus from whole mounts, cf. Figs. 37–39 (34, specimen from Liholmen; 35, from Bonden; 36, from the Marseilles area, holotype).





Figs. 37–39. *Typhlopolycystis mediterranea*, male cuticular apparatus from whole mounts (the same specimens as in Figs. 34–36).

identify the whole accessible material as *T. mediterranea* Brunet.

The living animal is, according to Brunet, brown-yellowish, 2 mm long, according to Schilke grey, 0.8 mm. A living specimen from Liholmen was almost colourless, 1.8 mm long (Fig. 33). The big proboscis and the slow movements are highly characteristic for the genus.

Some contributions will be given here to the knowledge of the male genital apparatus. The figure of a specimen from Liholmen differs in some details only from the figure and information of Brunet (1965, p. 159, Fig. 12–3). Brunet has found a bulb enclosing an almost globular thin-walled prostatic vesicle discharging part of its secretion through a strong blunt hook in the cuticular organ and a large thick-walled accessory vesicle opening through a tubiform stylet. In our preparation no true prostatic bulb was found constituting the basal support for the cuticular organ. The male cuticular apparatus of the lectotype (Figs. 36, 39) agrees with the drawing by Brunet (op. cit., Fig. 12-2). As mentioned above its main parts are two “stylets”, one of which is hook-shaped, the other a longish tube. The stylets are based on a cuticular girdle enclosing a seminal papilla. One side of the girdle is broad, strongly cuticular, the other side almost thread-like, weakly cuticular, sometimes folded. The girdle appears in slight magnification as the strong basal piece of the hook from the proximal part of which the tubiform stylet emerges. The length of the apparatus in four whole-mounted specimens is 74–78  $\mu\text{m}$  (Brunet: 70–80  $\mu\text{m}$ ). The apparatus of our northern material (Figs. 34, 35, 37, 38) mainly agrees with that of the Marseilles population. Its length is in the Liholmen specimen 73  $\mu\text{m}$ , in the two specimens from Bonden 87  $\mu\text{m}$ . Differences in the length and in the shape of the different parts appearing in the figures do not motivate a splitting of the material in subspecies or forms.

According to Schilke (1970, p. 160, Fig. 5B) “*T. limicola*” differs from *T. mediterranea* by a weaker proximal girdle and a

pointed curved tip of the tubiform stylet, the length of which is 61  $\mu\text{m}$ . The total length of the cuticular organ is not given but can be estimated to about 70  $\mu\text{m}$ . However, the specific status of “*T. limicola*” can not be accepted considering the sparse material (no whole mounts) and the rather incomplete figure giving no clear picture of the ring. Also in our material the tip of the stylet can appear more or less curved and pointed.

#### *Typhlopolycystis coomansi* sp.n. (Figs. 29, 30, 40–43)

*Distribution.* French Mediterranean coast, Marseilles area, Plateau des Chèvres, *Amphioxus*-sand, 8–10 m, 1966-02-03 (type locality, leg. Brunet). Norway, S. of Bergen, Korsfjord, Isle of Tekslo, coarse shell sand, 25 m, 1964-06-16 (leg. Karling, Bergen Biol. Stat. Ref. No. 280-64).

*Material.* Observations on living material including drawings and photographs. One whole mount (holotype No. 2702) and one slide serial sections, both from Marseilles.

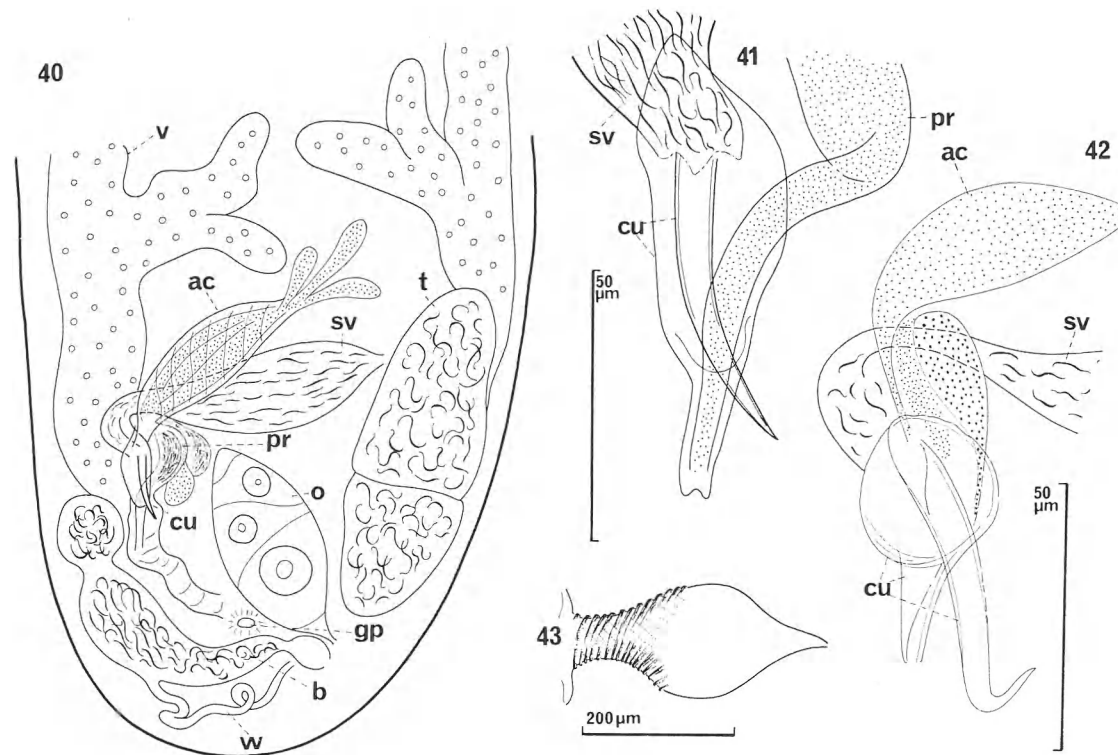
*Derivation of name.* Name of species in honour of Prof. Dr A. Coomans of the Zoological Institute of the University of Gent.

*Description.* About 2 mm long with extremely big proboscis (1/4–1/3 of body length), with paired eyes and slow movements. Yellowish, rather opaque.

The proboscis apparatus agrees in its main features with that of *T. coeca* (Karling, 1956). There are four pairs of proboscis retractors and one pair of subventral integument retractors. The caudal parts of two lateral pairs of proboscis retractors fuse to one pair of bundles at the level of the pharynx.

The common genital pore is situated at about 85%. The ovary and the testis are unpaired in caudal position, but the testis appeared to be divided in two parts in the Bergen material, perhaps indicating its paired origin (Fig. 40).

In the holotype the cuticular apparatus appears as an almost circular basal piece distally provided with a short straight tube and proximally with a pointed stylet, in the preparation reaching distally past the tip of the tube (Figs 29, 42). In the Bergen specimen the basal piece appears



Figs. 40–43. *Typhlopolycystis coomansi*. — 40, caudal body part with genital organs, squeezed live specimen from the Bergen area. — 41, distal part of the male organs with the cuticular apparatus from the

same animal. — 42, male atrial organs from the holotype (Marseilles area). — 43, seminal receptacle from the holotype.

irregularly oviform with a stylet not reaching the tip of the tube (Figs. 30, 41). The tube is 20  $\mu\text{m}$  long, the stylet 52  $\mu\text{m}$  in the holotype, the corresponding measurements in the Bergen specimen 22 and 55  $\mu\text{m}$ . The bent tip of the stylet in the holotype is evidently an artefact and the same can evidently be said about the differences in shape between the two subjects—a longitudinal stretching of the basal piece results in a withdrawing of the stylet.

The other parts of the male apparatus are very similar in the two preparations (Figs. 40, 42). A large fusiform accessory vesicle discharges its secretion through the pointed stylet and at least a part of the prostatic secretion—accumulated in what seems to be a thin-walled copulatory bulb—is discharged through the short tube. Sperm from the unpaired seminal vesicle and another part of the prostatic secretion are stored in the rest of the bulb and evidently discharged on a soft papilla enclosed by the basal part of the cuticular organ.

In a living specimen (Bergen) a fine winding canal inserts on the distal part of the bursa wall (Fig. 40). Whether this structure can be identified with the pyriform seminal receptacle with strongly muscular wall observed in a whole mount (Marseilles, Fig. 43) is yet an unanswered question.

#### Discussion of the genus *Typhlopolycystis*

Our knowledge of the anatomy in the genus *Typhlopolycystis* is based on Karling's description (1956) of *T. coeca* Karling. The main features in the anatomy of the other two species, *T. mediterranea* and *T. coomansi*, apparently agree with that of *T. coeca*, distinct specific differences appearing in the structure of the male cuticular apparatus.

The species of the genus *Typhlopolycystis* are in life rather easily recognized by their big proboscis and their slow movements indicating that they live in lenitic habitats such as sublittoral mud and shell gravel. The testis and the ovary are according to most observations unpaired, situated on the right body side, testis in front of ovary. In *T. coeca* once a rudimentary testis was found on the left side (Karling, 1956) and in *T. coomansi* once a testis divided into two parts was found. The vitellaries are evidently always paired but with a tendency to fusion in different regions. Schilke reports a left-side position of testis and ovary (1970).

In the male copulatory apparatus sperm is discharged from an unpaired fusiform seminal vesicle through the ejaculatory duct opening on an unarmed papilla. The prostatic secretion filling some thin-walled sacs within the weakly differentiated copulatory bulb is discharged through a cuticular tube (groove), the prostatic stylet, and secretion from an accessory reservoir is discharged through another cuticular tube, the accessory stylet. The ejaculatory duct and the duct from the accessory reservoir traverses the copulatory bulb. The two stylets are parts of a cuticular apparatus, the proximal girdle of which is based on the copulatory bulb (see Karling, 1956, Fig. 88).

The cuticular apparatus has a similar construction in *T. coeca* and *T. coomansi*, a basal papilla distally provided with a prostatic stylet in the shape of a short straight groove and a straight pointed accessory stylet. The same basic pattern can be found in *T. mediterranea*, but the papilla is reduced to a ring recognized as such only through a careful analysis, the prostatic stylet is a strong hook, evidently groove-shaped as in the two other species, and the accessory stylet is blunt,

not pointed, evidently weakly cuticular, easily folded. Nomination of a specific subgenus for *T. mediterranea* could be discussed.

*Diagnosis for the genus* Typhlopolycystis *Karling (slightly changed from Karling, 1956)*: Polycystididae with extremely big proboscis, with unpaired ovary and testis and paired yolk glands. Common genital pore subterminal. The copulatory bulb encloses a prostatic vesicle, the ejaculatory duct and the duct from an accessory secretory reservoir. The cuticular apparatus is a basal girdle provided with two outlets, one for the prostatic, the other for the accessory secretion. The large male genital canal opens dorsally, the uterus anteriorly and the common female duct caudally into the common atrium. A large bursa of resorptions type and a small seminal receptacle are joined to the female duct. — Type species *T. coeca* Karling.

- |       |   |                        |
|-------|---|------------------------|
| 1.    | Cuticular apparatus with hook-shaped prostatic stylet and blunt tubular accessory stylet. | <i>T. mediterranea</i> |
| —     | Cuticular apparatus with short straight prostatic stylet and pointed accessory stylet.    | 2                      |
| 2(1). | With eyes. Accessory stylet tubular, flexible.  | <i>T. coomansi</i>     |
| —     | Without eyes. Accessory stylet narrow, needle-like.                                       | <i>T. coeca</i>        |

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### Abbreviations in the figures

<i>a</i> common atrium	<i>o</i> ovary
<i>ac</i> accessory prostatic vesicle	<i>ov</i> common oviduct
<i>b</i> bursa	<i>p</i> proboscis
<i>bp</i> bursal pore	<i>pa</i> papilla
<i>c</i> cirrus	<i>ph</i> pharynx
<i>cm</i> circular muscles	<i>pr</i> prostatic vesicle
<i>co</i> male copulatory apparatus	<i>r</i> rod
<i>ct</i> teeth in the cirrus	<i>re</i> retractor
<i>cu</i> male cuticular apparatus	<i>se</i> common seminal duct
<i>e</i> ejaculatory duct	<i>sm</i> spiral muscles
<i>gd</i> germiduct	<i>sp</i> sperm
<i>gl</i> glands	<i>sr</i> seminal receptacle
<i>gp</i> genital pore	<i>st</i> stylet
<i>i</i> internal stylet	<i>sv</i> seminal vesicle
<i>in</i> insemination canal (pore)	<i>t</i> testis
<i>l</i> longitudinal muscles	<i>u</i> uterus
<i>m</i> membrane	<i>v</i> vitellary
<i>mg</i> male genital canal	<i>vd</i> vitelloduct
	<i>w</i> winding canal

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