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A NEW ASCHELMINTH, PROBABLY RELATED TO THE PRIAPULIDA

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With 18 text-figures

INTRODUCTION

Two years ago I found two specimens of a curious animal in a sample of coral sand from Curaçao. It superficially resembled the larva of priapulids, animals that are restricted to cold water. The condition of the specimens did not permit of a description and I did not succeed in determining the group to which the species could possibly belong.

Later I happened to see a paper by Remane (1963) in which he gives a simple figure of "a not yet described animal from the sandy bottom of the Red Sea". I immediately recognized it as a relative of the species from Curaçao. Upon request Professor Remane informed me that he had fixed some specimens, but that these were lost. He had not found more material of the species and he had not heard of these animals being found at another locality. In his opinion both his and my material obviously belong to the same genus.

Recently I found a number of additional specimens in another sample of coral sand also from Curaçao. In the present paper a preliminary description of this material is given. When I had finished my description I found some specimens of a much larger animal that may be the mature form of the described species. A short description of this interesting animal is added.

I am indebted to Dr. P. Wagenaar Hummelinck, Utrecht, who kindly put a number of bottom samples from the Piscadera Bay (Curaçao) at my disposal. I also wish to thank Prof. Dr. A. Remane, Kiel (Germany), and Prof. Dr. R. P. Higgins, Winston-Salem, North Carolina (U.S.A.), for their information and advice.

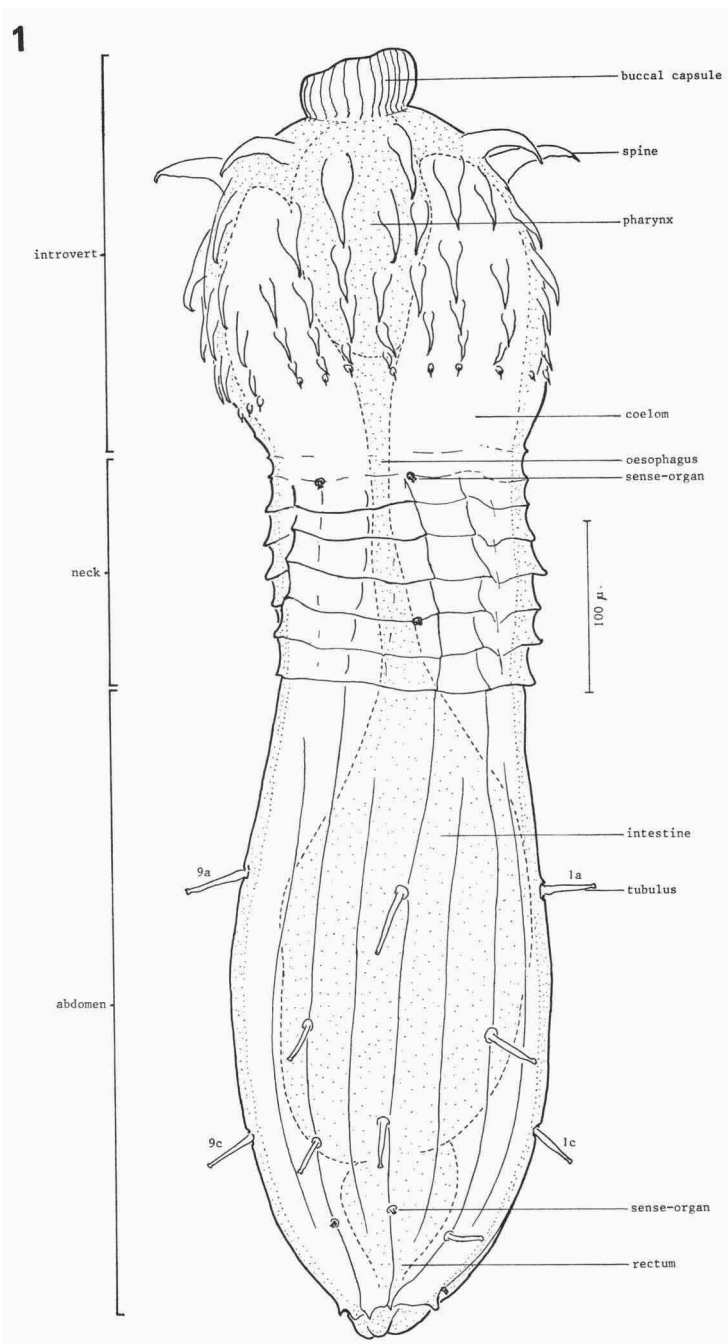


Fig. 1. *Tubiluchus corallicola* n. gen., n. sp. Habitus, lateral view (Holotype).

Tubiluchus corallicola* n. gen., n. sp.*Material.**

Holotype: whole mount no. 6354, Curaçao, outer Piscadera Baai, depth 3.5 m, coral sand with shell gravel, leg. P. Wagenaar Hummelinck, 3 January 1964, sta. 1453. Paratypes: 5 whole mounts nos. 6350-6353, 6355, and 15 specimens in alcohol, coll. no. 6356, all from the same locality; whole mount no. 6349, Curaçao, outer Piscadera Baai, depth 4 m, coral sand, leg. P. Wagenaar Hummelinck, 29 November 1963, sta. 1456A.

All specimens are in the collection of the Rijksmuseum van Natuurlijke Historie, Leiden.

Diagnosis.

The animal is small, up to 750 μ long, of cylindroid shape, with a pronounced radial symmetry. The body consists of three regions: (1) the introvert, with 20 longitudinal rows of spines; (2) the neck, with cuticular ridges around the body; (3) the abdomen, with 20 longitudinal cuticular ridges.

The digestive tract is straight, and consists of a terminal mouth, a buccal tube provided with hooks, a muscular pharynx, an oesophagus, a sac-like intestine, a rectum, and a terminal anus. There is one large body cavity, the nature of which is unknown. A small number of free cells float in it. Excretory and reproductive systems were not observed. Layers of circular and longitudinal muscles lie beneath the epidermis. Both the introvert and the pharynx have a circlet of retractor muscles that are attached to the body wall. The most important part of the nervous system is a large nerve ring around the buccal tube. Small sense-organs are present on the cuticle of the neck and the posterior part of the abdomen. Tubules are present on nine of the cuticular ridges of the abdomen; they may serve as tactile organs.

Description.

External morphology. — Fig. 1 shows an individual in its most extended condition. The introvert is bulbous then, and the buccal tube is protruded to form an external buccal capsule, that may serve as a feeding apparatus. The introvert is armed with 20 rows of hooks or spines, that gradually decrease in size posteriorly (fig. 10). Each row consists of five hooks. The length of the anteriormost hooks is about 28 μ . The smallest hooks form an evident circlet, but definite circlets could not be recognized in the arrangement of the other hooks. The hooks can be erected. The whole introvert can be invaginated into the abdomen. It undoubtedly acts as a locomotory organ.

In the neck-region six to eight circular cuticular ridges are present. Moreover ten longitudinal ridges can be recognized as extensions of the tubulus bearing ridges of the abdomen (odd numbers in fig. 12). These are particularly conspicuous in contracted animals (fig. 2, 3). The folded cuticula

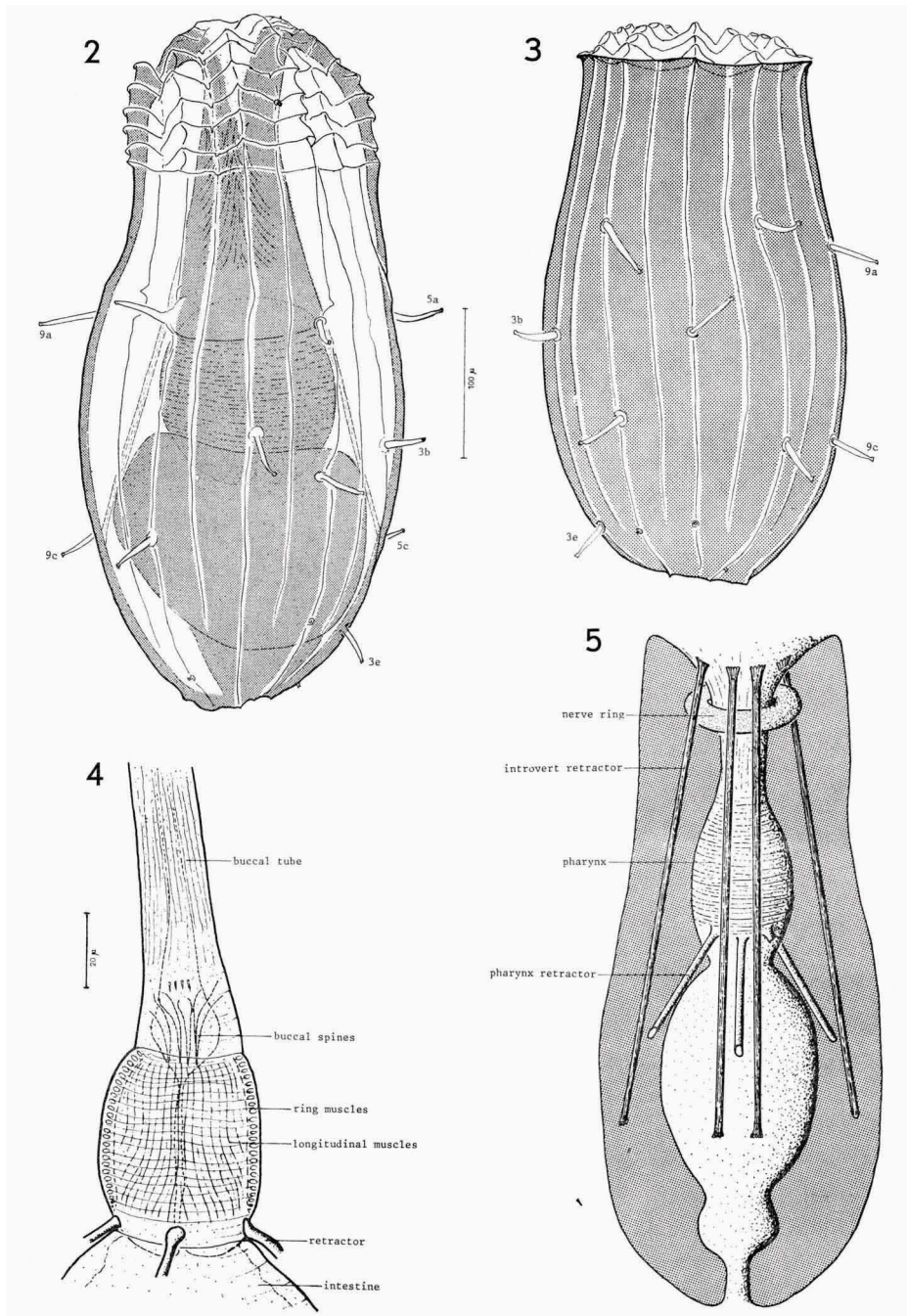


Fig. 2-5. *Tubiluchus corallicola* n. gen., n. sp. 2, partly contracted specimen; 3, contracted specimen; 4, pharynx; 5, retractor muscles, diagrammatic.

of the neck acts as a closing apparatus when the introvert is withdrawn (fig. 3), similar to the placids of Kinorhyncha. A number of small sense-organs is present in the neck-region; it is unknown whether they have a fixed arrangement.

The abdomen is slender in extended animals, occupying slightly more than half the body length. It is more bulbous in contracted animals. Just like the introvert it shows a pentaradial symmetry. Ten of the longitudinal cuticular ridges extend from the neck to the end of the body; tubuli and sense-organs may be present on them. The others are shorter, and devoid of tubuli and sense-organs. The normal arrangement of the tubuli and sense-organs is illustrated in a diagram (fig. 12). It appears from this that there is an indistinct bilateral symmetry in this arrangement. Only one of the odd ridges does not bear tubuli, so this one most probably is the mid-dorsal or mid-ventral ridge. At this moment it is impossible to give a definite answer to the question which side is ventral. Only the presence of a dominating nerve cord could give an indication, but this has not yet been observed. Six circlets of tubuli and sense-organs, indicated by the letters *a* to *f* in the diagram, can be recognized, but irregularities may occur. An example can be seen in fig. 2, where one of the tubuli 5c has a more anterior position than it should have. The small sense-organs are always present, but some pairs of tubuli may be absent. On the other hand one specimen had one extra tubulus 9b. The presence of the tubuli in seven specimens is recorded in the following table.

ridge:	1		3		5		7		9		
circlet:	a	c	b	e	a	c	b	d	a	b	c
slide no.											
6350	×	×	×	×	×	×	×	—	×	—	×
6351	×	×	×	×	×	×	×	×	×	—	×
6352	×	—	×	×	×	×	×	—	×	—	×
6353	×	—	×	×	×	×	×	—	×	—	×
6354	×	×	×	×	×	×	×	×	×	×	×
6355	×	×	×	×	×	×	×	—	×	—	×
6359	×	—	×	×	×	×	×	×	×	—	—

Digestive system. — The buccal tube may be three times as long as the pharynx in a stretched position. Five large buccal spines (fig. 4, 9) are present in its posterior part, and perhaps a second series of very small spines. The buccal spines are 16 to 18 μ long, and 3 to 4.5 μ wide at their base. The buccal tube can be everted when the pharynx is brought forwards (fig. 1), which is perhaps accomplished by muscles in the wall of the buccal tube.

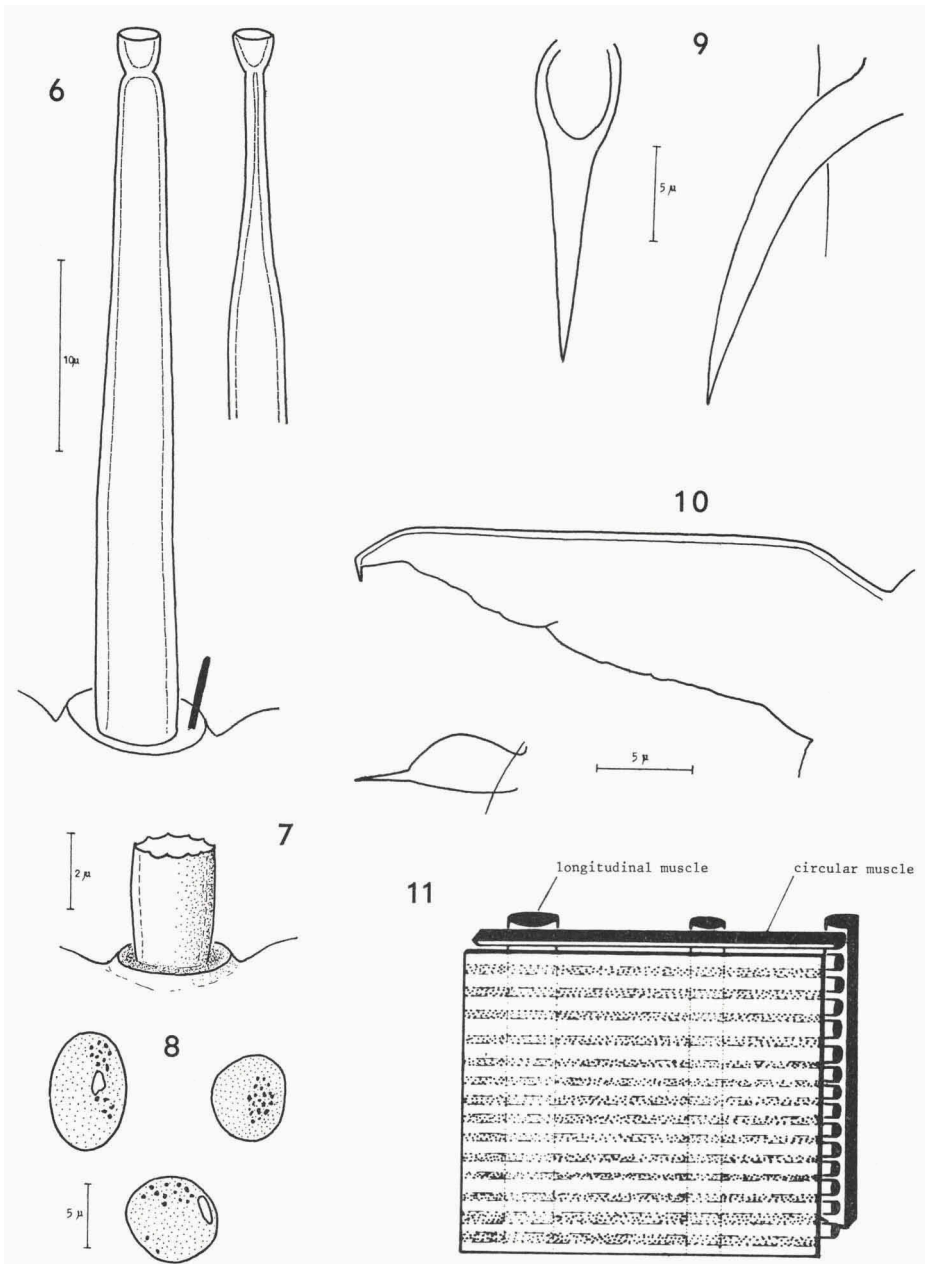


Fig. 6-11. *Tubiluchus corallicola* n. gen., n. sp. 6, tubulus; 7, sense-organ; 8, cells from coelom; 9, buccal spines; 10, largest and smallest hooks of introvert; 11, diagram of dermal musculature of abdomen.

The pharynx is composed of an outer layer of ring muscles, and many strong longitudinal muscles. Radial muscles are not conspicuous. Some gland cells may be present in the anterior part, and the non-muscular posterior part may also be glandular. Spines or other cuticular structures were not observed in it.

When the pharynx is in its anterior position the oesophagus is stretched (fig. 1), otherwise it is very short. The intestine is a large, sac-like organ, lined with a relatively thin epithelium. A short rectum is set off from it by an evident constriction.

Body cavity. — There is one spacious body cavity. Its nature is still unknown, but it most probably is a pseudocoel, similar to that of the kinorhynchs and priapulids. The small number of cells that float in it are circular or elliptic in outline (fig. 8), with a diameter of 5 to 10 μ . They always contain a number of dark granulae.

Musculature. — The dermal musculature of the abdomen (fig. 11) consists of a continuous layer of circular muscles (1 to 2 μ wide), and a discontinuous layer of longitudinal muscles (2 to 6 μ wide). In the neck-region the situation is not much different, but in the introvert only very few circular muscles are present, and the longitudinal muscles are not very numerous either. The latter probably operate the spines; only their ends are attached to the epidermis.

The six retractor muscles of the introvert are inserted just anterior to the nerve ring (fig. 5), and at the level of the third circlet of tubuli (fig. 12). The number of pharynx retractors could not be determined with certainty, but there are at least six of them. They are inserted on the posterior part of the pharynx and on the body wall at the level of the second circlet of tubuli. Probably this animal, unlike the Priapulida, is capable of feeding without invaginating the introvert.

The pharynx retractors are simple muscles, but the introvert retractors are in fact bundles of about five muscles.

Nervous system. — A simple, large nerve ring is present around the buccal tube. It is not enclosed in the epidermis. In contracted animals (fig. 2) it is nearly invisible, since it is enclosed in the invaginated introvert then. It is to be regretted that no large nerve fibers could be found; they undoubtedly lie in the epidermis. Only some very delicate fibers could be seen crossing the anterior part of the body cavity.

Sense-organs. — The very small organs on the neck and the posterior part of the abdomen are presumed to be sense-organs. They are beaker-shaped, about 3 μ high, and with a diameter of about 2 μ at the top (fig. 7). The distal edge has 8 to 10 teeth or lobes.

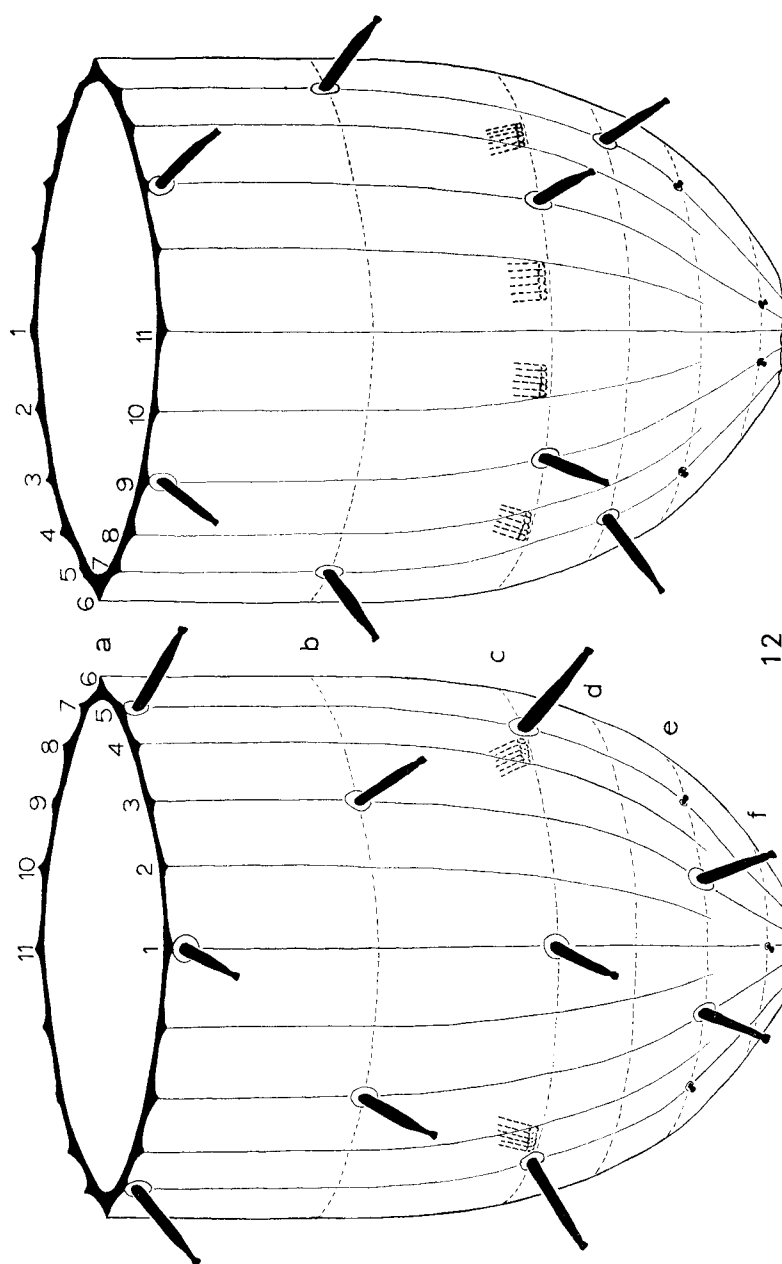


Fig. 12. *Tubiluchus corallicola* n. gen., n. sp. Diagrams showing distribution of tubuli, sense-organs, and cuticular ridges on abdomen. Ridge no. 1 is dorsal or ventral. Insertion of introvert retractors is also shown.

The tubuli (fig. 6) are stiff, tube-shaped organs, flattened distally, and with a cup-shaped distal end; their length is 35 to 40 μ , their width 3 to 4 μ . They are jointed into the cuticula. A small bristle, about 5 μ long, is situated anteriorly to the base of each tubulus. Remane (1963) considered these organs to be adhesive tubuli. Indeed they strongly resemble the adhesive tubules of certain Rotatoria, Gastrotricha, and Kinorhyncha, but there are no indications that they really have an adhesive function. Secretory cells were not observed at their bases, secretion was never observed within the tubuli, and sediment particles were never seen adhered to the distal ends. Since it is also highly improbable that they have a locomotory function, I can only imagine them to be tactile organs.

Excretory system. — Excretory organs are certainly not present in the anterior part of the body, but they may be present in the posterior part of the abdomen. In contracted specimens (nearly all specimens were in a contracted state) the intestine is pressed into the rectal region, which makes observations difficult. Anyhow, excretory organs, if present, are not large and conspicuous. Excretory cells were not observed in the epidermis either.

Reproductive system. — Not even a trace of gonads could be found. We may conclude from this that the described material possibly consists only of sexually immature specimens.

A mature form (fig. 13-18)

When the samples in which *Tubiluchus* had been found, were re-examined, some specimens of a previously overlooked, larger animal were found. They proved to have several characters in common with *Tubiluchus* so that they possibly represent its mature form, or are at least closely related to it. Anyhow, it is worth while to give a short description here, although the scanty material does not permit of a thorough investigation. It is hoped that continued search will produce more material, including intermediate forms.

The animal has a worm-like appearance (fig. 13). Its length is about 1.5 mm, exclusive of a tail that is up to about 2.5 times as long as the body. Its width is about 0.2 mm. The body consists of four regions: the introvert, the neck, the abdomen, and the tail.

The bulbous introvert is provided with 20 rows of hooks; each row consists of five or six hooks of decreasing size. These hooks (fig. 16) differ considerably from those of *Tubiluchus*: their distal end is more or less blunt, bearing a terminal or subterminal bristle. Moreover they are smaller, their maximum length being about 24 μ .

The neck-region shows a number of circular cuticular ridges, but there are

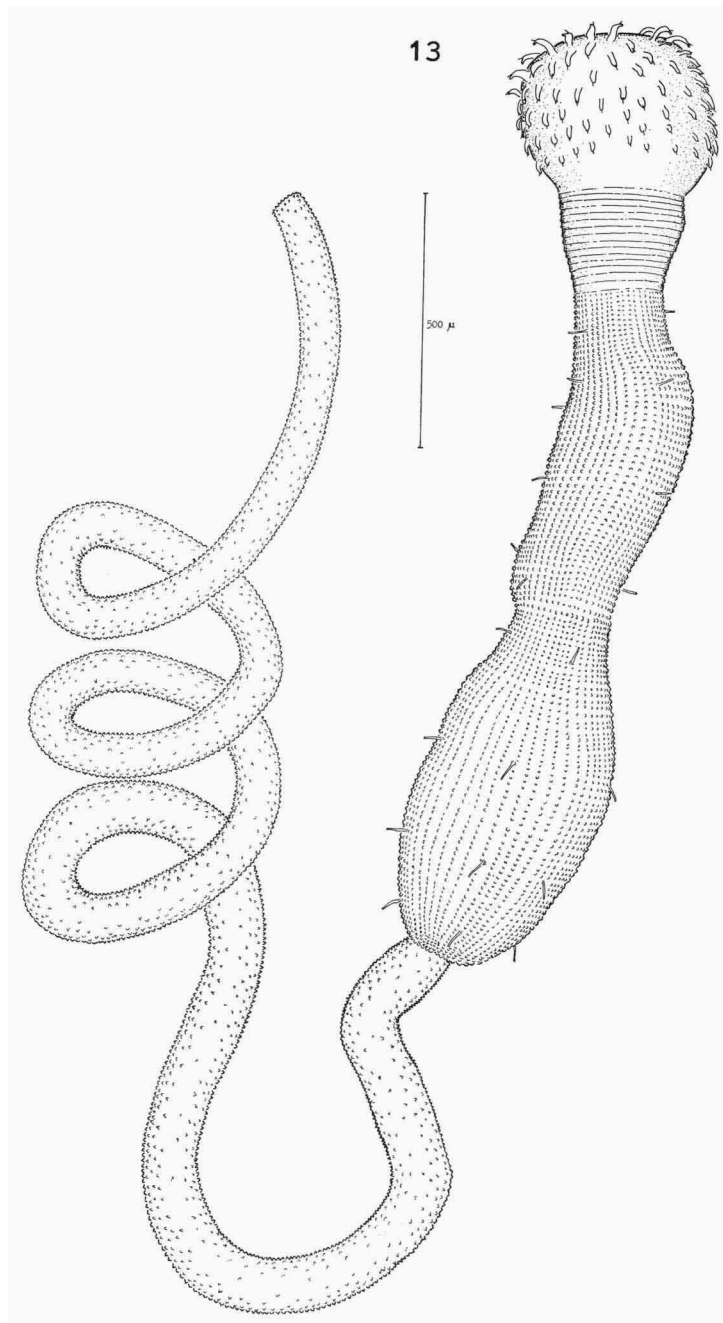


Fig. 13. Mature form, perhaps conspecific with *Tubiluchus corallicola*; habitus.

no longitudinal ridges or folds. A small number of sense-organs is present.

The abdomen is not short and stiff as in *Tubiluchus*, but long and flexible, apparently capable of making peristaltic movements. It is completely covered with papillae, that are arranged in 40 longitudinal rows. These papillae (fig. 18) are peculiar in that they are supported by 11 or 12 rod-shaped cuticular structures. Tubuli and sense-organs are present all over the abdomen. The tubuli (fig. 14) differ slightly from those of *Tubiluchus* and they are considerably shorter, being about $27\ \mu$ long. A bristle with a length of about $3\ \mu$ is present near the base. The sense-organs (fig. 15) differ from those of *Tubiluchus* in that they are implanted on a papilla, and that they are accompanied by a bristle.

The rows of abdominal papillae extend over the whole length of the tail, which is densely covered with them. Sense-organs only occur on the proximal part.

As yet not much can be revealed about the internal morphology. The digestive system does not differ fundamentally from that of *Tubiluchus*. The inner surface of the pharynx is covered with numerous anchor-shaped spines (fig. 17). The anus is situated near the base of the tail. Two ovaries were observed in the posterior part of the abdomen in one specimen. The body cavity extends into the strongly muscular tail, which is apparently contractile.

Ecological notes

The animals were collected from samples of fine, white sand consisting exclusively of calcareous grains: coral and shell fragments, and shells of Foraminifera. One of the samples contained many larger shell fragments. The sand is inhabited by a rich microscopical fauna. Foraminifera, Nematoda, Annelida, Ostracoda, and Copepoda are extremely abundant. Turbellaria, Nemertini, Sipunculida, Isopoda, Cumacea, and Acari occur in smaller numbers. Algae were absent (sta. 1456A) or almost absent (sta. 1453).

In 1956 Remane & Schulz (1964) found similar animals in the Red Sea, near the biological station of Al Ghardaqa (Egypt). They described the biotope as follows: "Sandgebiete an der unteren Grenze des Eulitorals meerwärts des erodierten Korallensockels. Hier hatten sich Feinsandflächen mit Rippelmarken gebildet, in deren Rinnen Foraminiferen-Schalen angehäuft waren. Es fehlte infolge der intensiveren Wasserbewegung die Mikrophytenvegetation mit Cyanophyceen und Diatomeen...". The sandfauna included Nematoda, Gastrotricha, Polychaeta, Tardigrada, Copepoda, Amphipoda, Cumacea, and Pantopoda.

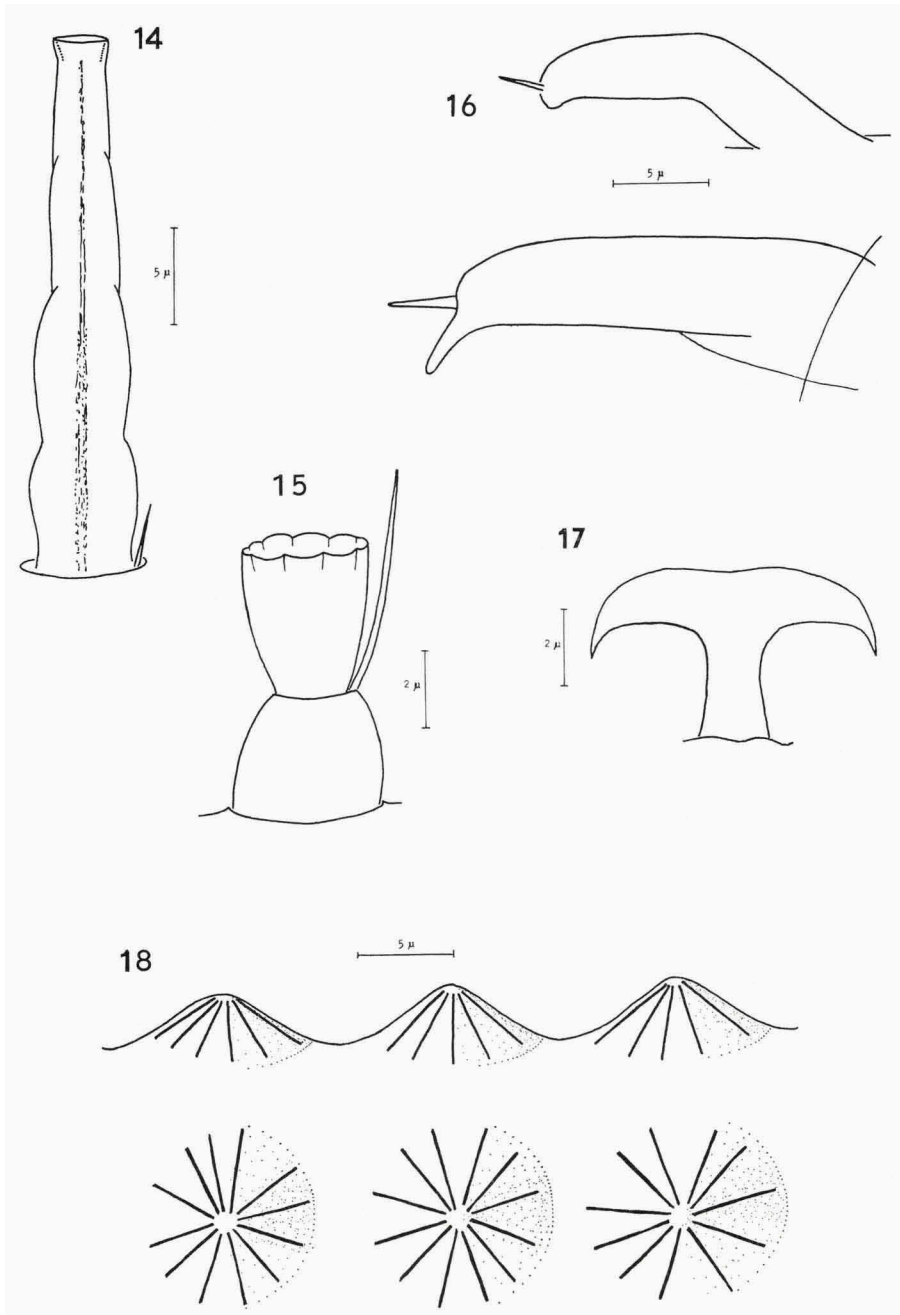


Fig. 14-18. Mature form, perhaps conspecific with *Tubiluchus corallicola*. 14, tubulus; 15, sense-organ; 16, hooks of introvert; 17, pharyngeal spine; 18, papillae of abdomen.

Discussion on relationship

The above description undoubtedly will suffice for recognition of the animal, but it will not enable us to arrive at a definite conclusion about its systematic status. This will only be possible when more is known about the structure of the nervous, excretory, and reproductive systems. I hope to obtain more material which will permit of a thorough study. Properly fixed specimens that are more suitable for sectioning than my specimens, would be extremely valuable. They are indispensable for a further study of the internal structure. For the time being I call the group tubiluchids, without giving it a definite status.

Nevertheless we may already conclude that the new group has several characters in common with the Priapulida and the Kinorhyncha. In my opinion they all belong to the same phylum, for which the name Rhynchohelminthes could be used, as proposed by Lang (1953). It is quite probable that the fossil Ottoida, described by Walcott (1911) from the middle Cambrium, also belong to this phylum, but it is less evident that the Acanthocephala can also be included in the phylum Rhynchohelminthes.

The introvert of the tubiluchids does not differ fundamentally from the introvert of priapulids and kinorhynchs. In the kinorhynchs it bears five to seven circlets of spines, and in the priapulids 25 longitudinal rows of papillae. A neck that may act as a closing apparatus is present in the kinorhynchs, but priapulids do not possess a neck-region. The abdomen consists of 11 segments in the kinorhynchs, and is superficially annulated in the priapulids (their larvae have a lorica consisting of a dorsal and a ventral plate), but it shows a radial symmetry in tubiluchids. The tail of the mature tubiluchid may be compared with the caudal appendage in the genus *Priapulus*.

The sense-organs and tubulae do not occur in other groups, but adhesive tubules may occur on the abdomen of kinorhynchs, and on the introvert of priapulids. The larva of *Priapulus* bears four tactile bristles on its abdomen.

The buccal region and the pharynx of the tubiluchids resemble those of the kinorhynchs. The spined buccal capsule may be compared with the mouth cone of the kinorhynchs. The pharyngeal spines of the adult tubiluchid perhaps conform to the buccal and pharyngeal teeth of the priapulids, although they are of a strongly different appearance.

The body-wall musculature of the tubiluchids agrees fundamentally with that of the priapulids. The tubiluchids are unique in that they possess pharynx retractors. The nerve ring of the tubiluchids agrees with the nerve ring of kinorhynchs and priapulids, but a dominating ventral nerve cord, which is always very conspicuous in priapulids, could not yet be observed.

If the adult animal described above is indeed conspecific with *Tubiluchus corallicola*, the tubiluchids must have a postembryonic development that agrees well with the metamorphosis of the priapulids.

We may conclude that the tubiluchids have more characters in common with the Priapulida than with any other group, but their relation has to be proved by further investigations.

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