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DOLICHODASYS ELONGATUS N.G., N.SP., A NEW MACRODASYID GASTROTRICH FROM NEW ENGLAND[1]

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GAGNE, G. D. 1977. *Dolichodasys elongatus* n.g., n.sp., a new macrodasyid gastrotrich from New England. *Trans. Amer. Micros. Soc.*, 96: 19–27. A new genus of macrodasyid gastrotrich collected from a low energy beach at Nahant, Massachusetts is described. *Dolichodasys elongatus* n.g., n.sp., is distinguished by its lack of lateral adhesive tubules, the presence of a single caudal tubule in the adult, and the possession of an aberrant type of sperm with associated refractile bodies. A prominent posterior glandular bursa is present. Juveniles resemble the adult in general form but possess four posterior adhesive tubules.

Recent investigations of the meiobenthos of low energy beaches and other sulfide-rich marine habitats have revealed a wealth of new taxa (see Boaden, 1974; Fenchel & Riedl, 1970). Among these have been a group of macrodasyid gastrotrichs characterized by their extreme elongation and reduction in size of adhesive elements. The present paper describes a new representative of this group from a low energy beach at Nahant, Massachusetts.

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Materials and Methods

Animals were extracted by placing substrate samples into 7% $MgCl_2$ for 15 min, then swirling and pouring the supernatant through a 75 μm mesh Nitex screen. The animals were washed from the screen into small glass fingerbowls with a jet of sea water. Living gastrotrichs were isolated with a micropipette under a dissecting microscope and relaxed by placing them into a 3 to 1 sea water—7% $MgCl_2$ mixture. Morphological observations were then carried out using either phase contrast or Nomarski interference contrast microscopy.

For histological studies, the animals were relaxed in 7% $MgCl_2$ and then fixed at 45 C in one of the following fixatives for polyester wax embedding: Zenker's, Heidenhain's "Susa," or Champy's. Sections were stained by one of the following methods: Heidenhain's hematoxylin and eosin; Heidenhain's azan; the Feulgen reaction counterstained with either orange-G or fast green. Histochemical tests included the Periodic Acid-Schiff reaction, with a control of prior digestion of glycogen with salivary diastase, and alcian blue at pH 2.5.

Order Macrodasyida Remane, 1925
Family Lepidodasyidae Remane, 1927 sensu Hummon, 1974
Dolichodasys n.g.

Lepidodasyidae with extremely elongated body; lateral adhesive tubules absent; anterior adhesive tubules fused, two per side; posterior tubules reduced in number; lateral pestle organs absent; spacious buccal cavity; pharyngeal pores at posterior end of pharynx; median dorsal ovary situated in middle third of body; prominent glandular bursa in posterior body region, with well-developed ventral duct; receptaculum absent; paired lateral testes; sperm aberrant, fusiform, associated with refractile bodies; paired male genital pores anterior to bursa.

Dolichodasys elongatus n.sp.
(Fig. 1)

With the characteristics of the genus; adult body length of 2.5–2.7 mm exceeds 40 times the body width; single posterior adhesive tubule in adult; juvenile with four posterior adhesive tubules; locomotory cilia in two ventral bands, except in anterior pharyngeal region where four ventral bands are present; 6–8 sensory hairs in head region; sensory hairs also occur laterally throughout body length; adult pharynx length 1/6–1/7 total gut length.

Type locality: Curlew Beach, Nahant, Massachusetts.

Holotype: USNM No. 54380, collected 31 March 1975. Whole mount fixed in OsO_4 vapors, mounted in glycerine jelly.

Paratype: USNM No. 54381, collected 19 October 1973. Whole mount fixed in Zenker's fluid, stained with alcian blue pH 2.5 and nuclear fast red, mounted in Permount.

Description

The length of the adult may exceed 2.6 mm, with a width of 60–70 μm. The head is poorly demarcated from the rest of the body. Stiff sensory bristles, 20–25 μm long, occur in the cephalic region and laterally throughout the length of the body. Ventral cilia are distributed in two lateral bands, each 10 μm wide, except in the anterior pharyngeal region where two lateral and two medial bands are present (Fig. 2). The dorsal cephalic surface also has a sparse covering of cilia. The anterior adhesive tubules are poorly developed, 6 μm long, two per side and fused. A single posterior adhesive tubule is present in the adult. Lateral and dorsolateral adhesive tubules are absent.

The epidermis is finely granular in appearance, covered with a very flexible thin cuticle. Greenish epidermal glands are present in moderate numbers. Adhesive ability is found throughout the body length despite the lack of cuticularized adhesive tubules. A pair of protonephridia is located lateral to the pharynx, just posterior to the pharyngeal pores (Fig. 2). Another pair was observed in one specimen, located laterally in the region of the first third of the intestine. Each protonephridium consists of a single tubular cyrtocyte.

The mouth is terminal, with a scalloped margin provided with short sensory hairs. A spacious rectangular to slightly trapezoidal buccal cavity precedes the pharynx. The lining of the buccal cavity produces a secretion staining positively with alcian blue at pH 2.5. The pharynx lumen is triangular in cross-section, with the apex of the triangle pointing dorsally (Fig. 5). The lumen is lined with a thin cuticle. Paired pharyngeal pores open ventrolaterally, 25 μm from the beginning of the intestine.

The intestine is composed of four rows of cuboidal cells. The anterior intestinal lumen also stains intensely with alcian blue. The cells forming the posterior two-thirds of the intestine contain numerous granular inclusions. The anus opens ventrally, ca. 50 μm from the posterior end of the adult.

The paired testes occur lateral to the second ¼ of the intestine. This region is filled with large spherical spermatids (Fig. 4A). The vasa deferentia lie posteriorly to the testes, containing mature or nearly mature sperm. The vasa deferentia (Fig. 7) terminate anteriorly to the bursa copulatrix. The sperm collect at this point and appear to exit ventrally through paired genital openings.

The spermatids and sperm are associated with refractile ovoid bodies measuring 5 μm in their longest dimension. These bodies form loose masses within the cytoplasm surrounding the spermatid nuclei, becoming organized into compact bundles lying along the ventral surface of the mature sperm (Figs. 4, 11). The function of the bodies is not clear. They stain with the PAS technique following diastase treatment, suggesting the presence of a glycoprotein. Sperm found in the oviduct posterior to the oocyte are not associated with these bodies. It is possible, therefore, that the refractile bodies function as food reserves for the sperm and are depleted by the time the sperm reach the oocyte after copulation.

The sperm (Figs. 4B, 12), a highly aberrant type within the Gastrotricha, has a fusiform shape and reaches a total length of slightly over 50 μm; it measures 4 μm at its widest point. The head is 25 μm long and contains a large

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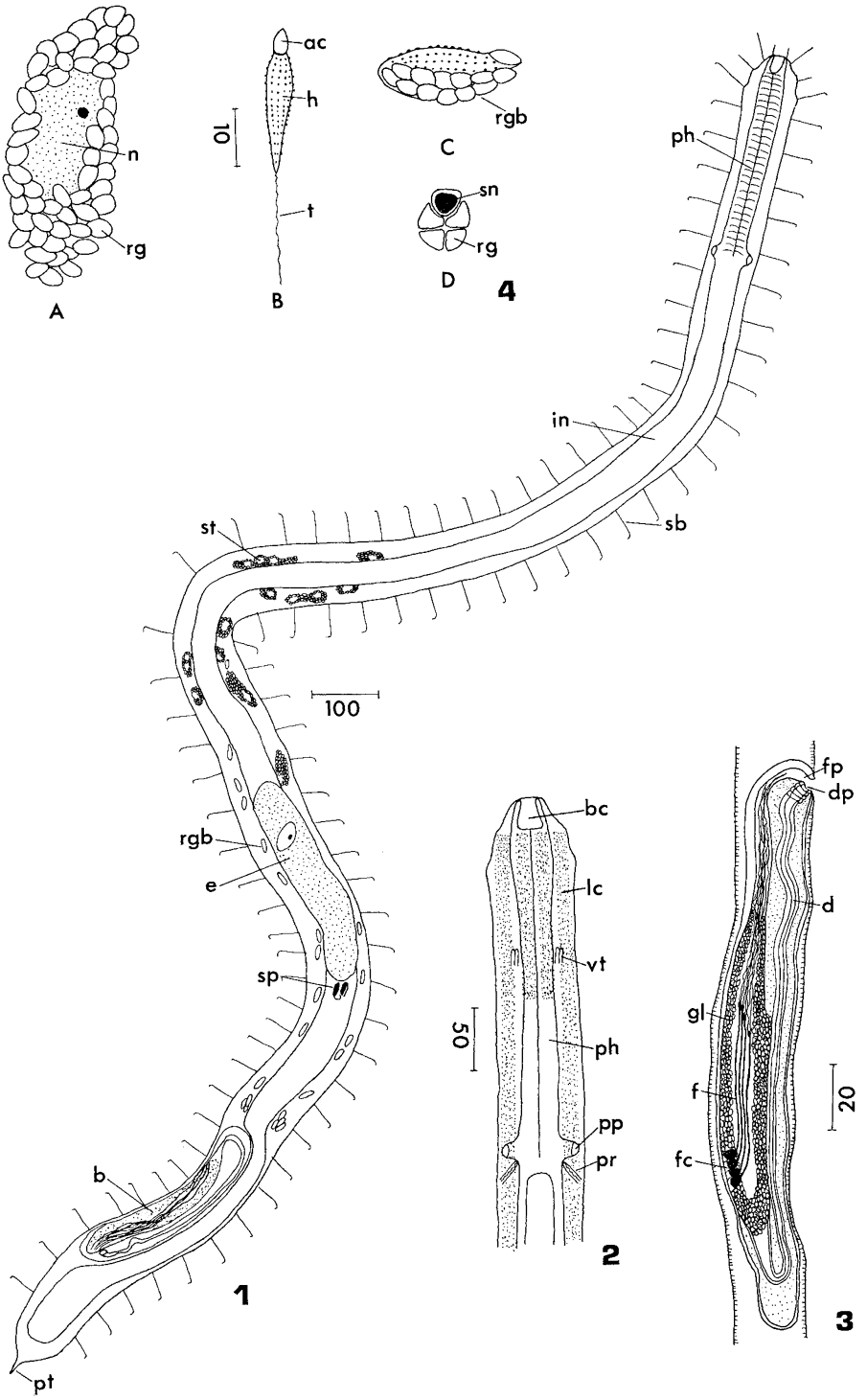
Legend: ac, acrosome; b, bursa; bc, buccal cavity; bcf, developing bursa; bm, bursa musculature; br, brain; d, bursa duct; dp, ventral duct pore; e, oocyte; f, bursa filament; fc, filament forming cell; fp, exit pore of filaments; gl, glandular substance of bursa; h, head of sperm; in, intestine; jpt, juvenile posterior tubules; l, lumen; lc, ventral locomotory cilia; lm, longitudinal muscle; n, nucleus; ov, oviduct; ph, pharynx; pp, pharyngeal pore; pr, protonephridium; pt, adult caudal tubule; rg, refractible body; rgb, refractile body bundle; sb, lateral sensory hair; sn, sperm nucleus; sp, sperm; st, spermatid; t, sperm tail; vd, vas deferens; vlm, ventrolateral longitudinal muscle; vt, ventral adhesive tubules.

FIG. 1. *Dolichodasys elongatus*, n.g., n.sp., adult animal, dorsal view. Fig. 2. Anterior end, ventral view. Fig. 3. Bursa, lateral view, reconstructed from sectioned specimens. Fig. 4. Sperm morphology. A. Spermatid; B. Sperm, dorsal view; C. Sperm with refractile body bundle, lateral view; D. Cross-section through sperm and refractile body bundle. Fig. 5. Cross-section through pharynx. Fig. 6. Cross-section through region of largest oocyte. Fig. 7. Cross-section near posterior end of vas deferens. Fig. 8. Section through anterior end of bursa. Fig. 9. Section through middle of bursa. Fig. 10. Diagrammatic representation of growth from juvenile to mature adult.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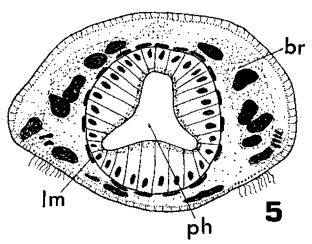
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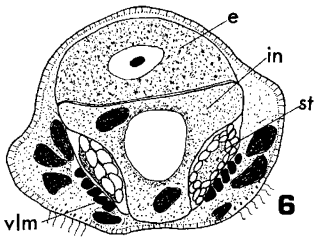
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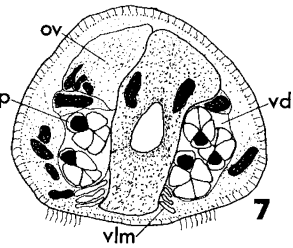
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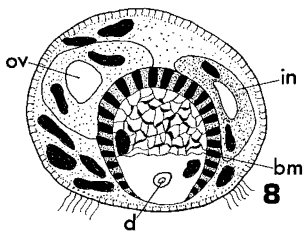
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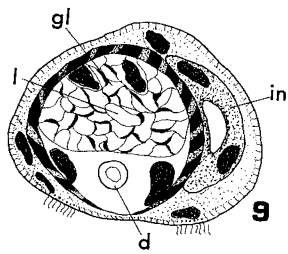
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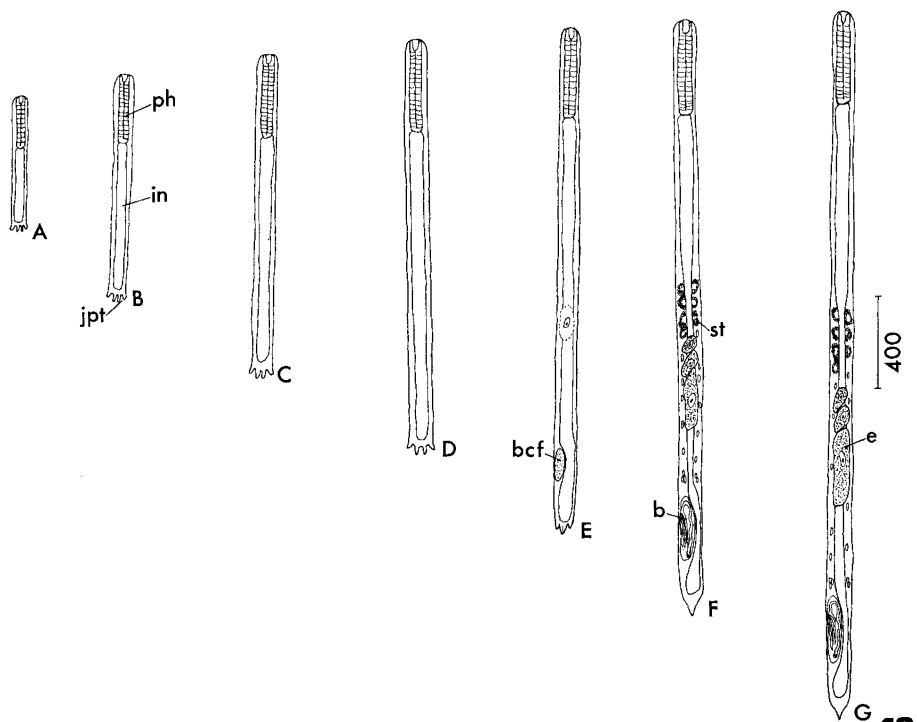
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densely staining nucleus. The cytoplasm of the head forms a series of 10–12 rows of small conical projections. A cap-like acrosome is found anteriorly. The head tapers posteriorly into a filamentous tail 25 μm in length. Motility of the sperm has not been observed.

No identifiable ovary has been observed in the adult animal. The only indication of the location of the ovary is the presence middorsally of two or three oocytes, which are enclosed in a membrane bound oviduct (Fig. 6). The posteriormost oocyte is always the largest, measuring as much as 400 μm in length. One to several sperm are often observed within the oviduct posterior to the large oocyte (Fig. 1). These sperm are not associated with refractile bodies. The oviduct continues posterior to the oocyte and terminates on the left side of the bursa (Fig. 8). No opening from the oviduct to the bursa was observed.

The bursa (Figs. 3, 13) is the most conspicuous structure in the posterior body region, measuring 250 μm in length. It is situated to the left of the intestine, growing so large as to push the intestine against the right body wall (Fig. 9). The bursa consists of a dorsal glandular sac and a ventral thick-walled duct. The glandular sac is surrounded by muscle fibers. The glandular substance is alcian blue positive and may therefore produce an acid muco-polysaccharide secretion. Four to five pyriform cells embedded in the dorsal epithelium of the glandular sac each give rise to a filament which enters a small lumen and passes posteriorly (Fig. 3). Each filament branches into smaller filaments posteriorly. One specimen was seen to extrude the branched filaments through a pore situated posterior to the opening of the ventral duct. The filaments were quite sticky, adhering to the glass slide and coverslip. While the function of the filaments is not known, a role in the transfer of sperm during copulation is possible.

The bursal duct connects with the glandular subtance in the anterior region of the bursa. The duct extends the entire length of the bursa and opens ventrally at the posterior end of the bursa.

Growth and Development

The smallest animal observed measured 500 μm in length (Figs. 10A, 14). It resembled the adult in general form, with all organ systems well developed, except for the reproductive system. The juvenile differs from the adult in the possession of four posterior adhesive tubules grouped into two pairs, a posterior pair and a posterolateral pair 15 μm from the posterior end. As the animal matures and elongates, the four posterior tubules are replaced by the single caudal tubule of the adult (Fig. 10). The posterior pair of tubules appears to participate in the formation of the adult caudal tubule, resulting in a single tubule supplied by a pair of adhesive glands. The posterolateral pair is resorbed and eventually disappears. This situation is contrary to the usual mode of development in the Gastrotricha, in which the number of adhesive tubules increases with increasing length (Teuchert, 1968).

The juvenile also differs from the adult in the ratio of pharynx length to total gut length. As pointed out by Hummon (1966), this ratio should be used as a taxonomic criterion only with discretion, since it tends to be highly variable with age. Juvenile *D. elongatus* 500–600 μm in length have a pharynx/gut ratio of 0.37, whereas this ratio in adult animals is 0.11–0.17. This relationship reflects the fact that growth is not uniform but mostly occurs posterior to the pharynx. The pharynx of *D. elongatus* shows growth until the animal reaches about 1.5 mm in length, after which pharynx length remains relatively constant.

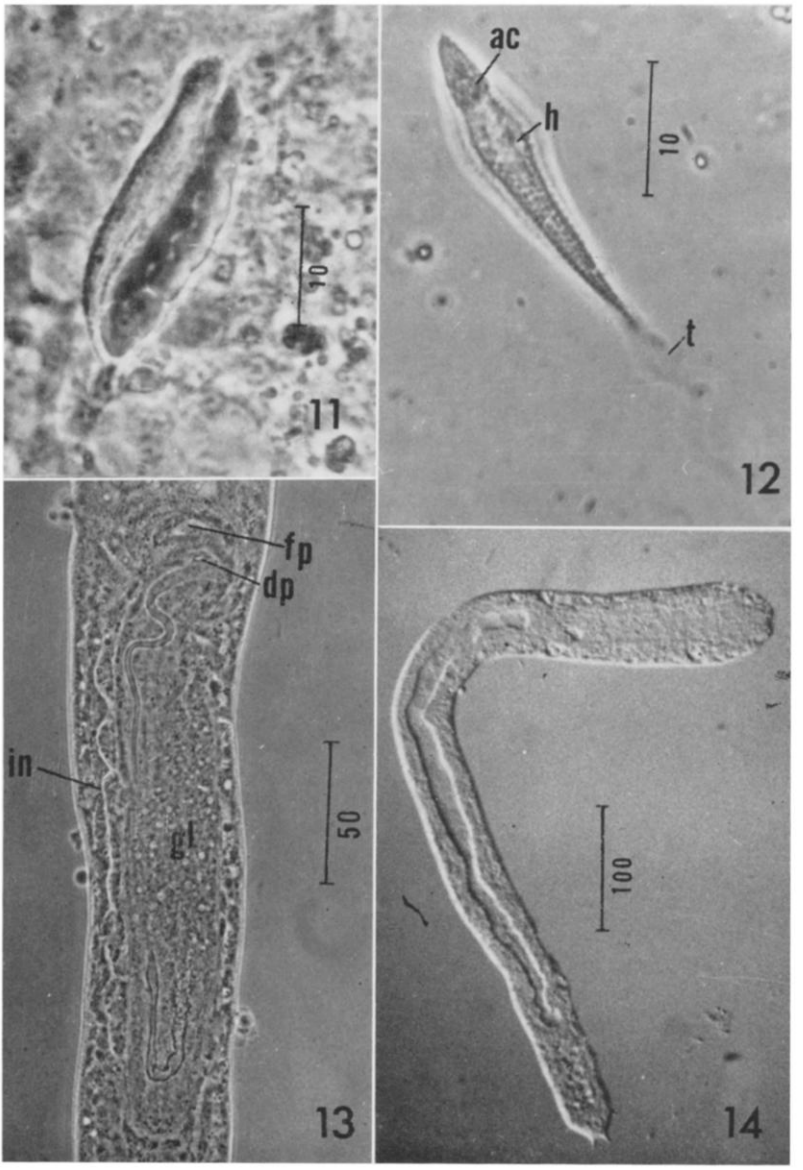

FIG. 11. Sperm with refractile body bundle, living. Fig. 12. Sperm, dorsal view, living. Fig. 13. Bursa, ventral view, living. Fig. 14. Juvenile, living.

The first sign of the developing reproductive system occurs in animals greater than 1.5 mm in length. These animals possess an elongated mass of cells situated on the left side of the intestine about 150 μm from the posterior end (Fig. 10E). These cells will form the bursa. A single small oocyte may also be seen at this stage. Both the male and female reproductive systems are fully developed in animals greater than 2 mm in length.

Habitat

Dolichodasys elongatus was found at Curlew Beach, a low energy sandy beach at Nahant, Massachusetts. The beach has a southern exposure and is thus protected from the force of easterly storms. Most specimens were found at −10 to +30 cm above the mean low tide level. The animals were found at depths greater than 2 cm, usually in grey sand. The grey color probably indicates a redox potential discontinuity (RPD) layer (see Fenchel & Riedl, 1970). They were never present in the black anaerobic layer, which usually begins at between 15 and 20 cm depth. The sediment consists mostly of fine and very fine sand (mean grain size 119–173 μm). The only other gastrotrich occurring regularly on the beach was *Turbanella cornuta* Remane, 1925.

Discussion

The name *Dolichodasys* refers to the extreme elongation of the animal. The presence of pharyngeal pores and the orientation of the pharynx lumen obviously place *D. elongatus* n.g., n.sp. within the order Macrodasyida. The order presently consists of six families. These are the Turbanellidae, Dactylopodolidae, Thaumastodermatidae, Macrodasyidae, and Lepidodasyidae, all defined by Remane (1927), and the Planodasyidae, defined by Rao & Clausen (1970). See Hummon (1974) for a recent revision of the marine and brackish water Gastrotricha.

The presence of an unpaired ovary and lack of a well-defined head or bilobed posterior end exclude the new genus from the Turbanellidae. The general body form, position of the male pore, and bilateral male reproductive system exclude it from the Thaumastodermatidae.

Dolichodasys does not have a pharynx which is almost entirely enclosed within an enlarged head region, does not possess a bifurcated posterior end, and lacks a paired ovary, excluding it from the Dactylopodolidae. The bursal structure of the new organism resembles that of some species of *Macrodasys* Remane, 1924. However, the absence of lateral adhesive tubules or of a well-developed penis and the presence of a single dorsal ovary rule out any close relationship to the Macrodasyidae.

Dolichodasys resembles the Planodasyidae in the absence of pestle organs, position of pharyngeal pores, absence of a penis, and presence of a posterior bursa. It, however, differs from members of this family in the structure of the female reproductive system, absence of lateral adhesive tubules, disposition of anterior tubules, and shape of the posterior end. It appears to be most closely related to the Lepidodasyidae. Lepidodasyid characteristics include the position of the pharyngeal pores, absence of a pestle organ, presence of a single dorsal ovary, and lack of a penis. Within this family, *Dolichodasys* most closely resembles *Paradasys* Remane, 1934. Both genera lack lateral adhesive tubules and may possess anterior adhesive tubules which are two per side and fused. *Dolichodasys* differs from *Paradasys* in sperm structure, the presence of a well-developed posterior bursa, and reduced number of posterior adhesive tubules.

The new genus also appears to be closely related to two recently described species whose systematic position is uncertain at best. These are *Megadasys pacificus* Schmidt, 1974 and *Thiodasys sterreri* Boaden, 1974. Both are extremely elongated forms, without a distinct head and lacking pestle organs or anterior adhesive tubules. Lateral adhesive tubules are present though reduced, and a tail lobe is present in both species (bilobed in *T. sterreri*). Both possess paired male and female sex organs and a well-developed posterior bursa. *Thiodasys* also possesses a complex receptaculum which receives sperm bundles transferred during copulation.

Schmidt (1974) places *M. pacificus* in the Macrodasyidae, recognizing that it also has affinities with the Lepidodasyidae. Boaden (1974) leaves the systematic position of *Thiodasys* as *incertae sedis,* though with close affinities to both the Planodasyidae and the Macrodasyidae. It is probable, as stated by Boaden (1974), that *M. pacificus* and *T. sterreri* are congeneric. *Dolichodasys* very closely resembles *Megadasys* and *Thiodasys* in body form. The total absence of lateral adhesive tubules in *Dolichodasys* is probably a continuation in the trend toward the reduction of lateral adhesive tubules evidenced by *Megadasys* and *Thiodasys.* The position and structure of the bursa in *Dolichodasys* and *Megadasys* are strikingly similar. Both have an elongated duct leading to a densely granular sac. The new genus is distinguishable from *Megadasys* and *Thiodasys* by the aberrant structure of its sperm and by the absence of a tail lobe.

Assignment of *Dolichodasys* to the Lepidodasyidae must be considered provisional. The systematics of the Macrodasyida is presently in a state of flux, particularly concerning the significance and function of various components of the reproductive system, for example, the bursa-penis complex of the Macrodasyidae (see Schoepfer-Sterrer, 1974). Ultrastructural studies may also alter the basis for the classification of many groups. Such evidence, together with the study of other related thiobiotic gastrotrichs should clarify the systematic position of *Dolichodasys.*

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