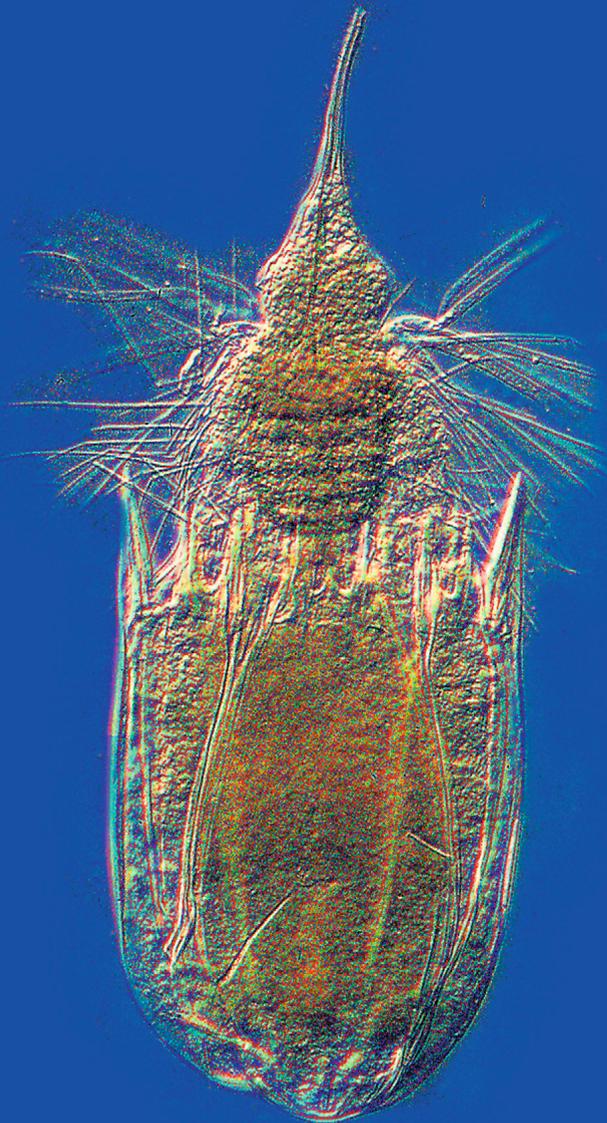


# MEIOFAUNA MARINA

Biodiversity, morphology and ecology  
of small benthic organisms

16



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# Gastrotricha of the North Atlantic Ocean: 1. Twenty four new and two redescribed species of Macrodasysida

William D. Hummon\*

## Abstract

New macrodasysid gastrotrichs are described from countries of the North Atlantic Ocean: Lepidodasyidae (4) – *Cephalodasys swedmarki*, *Mesodasys brittanica*, *Mesodasys rupperti*, *Paradasys bilobocaudus*; Macrodasysidae (3) – *Macrodasys cellticus*, *Macrodasys nobskaensis*, *Macrodasys plurosorus*; Planodasyidae (1) – *Crasiella azorensis*; Thaumastodermatidae (9) – *Acanthodasys algarvense*, *Acanthodasys carolinensis*; the genus name *Platydasys*, being preoccupied for a genus of Insecta, is renamed *Oregodasys*, yielding *Oregodasys kurnowensis*; *Pseudostomella triancra*, *Tetranchyroderma gausancrum*, *Tetranchyroderma interstitialis*, *Tetranchyroderma lameshurenensis*, *Tetranchyroderma longipedum*, *Thaumastoderma minancrum*, *Thaumastoderma natlanticum*; Turbanellidae (6) – *Dinodasys delawarensis*, *Paraturbanella manxensis*, *Paraturbanella pediballetor*, *Turbanella caledoniensis*, *Turbanella mikrogada*, and *Turbanella scilloniensis*. Two previously named species are redescribed: Planodasyidae – *Crasiella oceanica* d’Hondt, 1974 and Turbanellidae – *Turbanella bocqueti* Kaplan, 1958 sensu Boaden, 1974. In addition, *Macrodasys indicus* Rao, 1991, a junior homonym of *M. indicus* Kutty & Nair, 1969, is renamed *Macrodasys lakshadweepense* n. sp., and the subspecies *Paraturbanella pallida pacifica* is given the rank of species *P. pacifica* Schmidt, 1974.

Keywords: North Atlantic, British Isles, Europe, United States of America, Meiofauna, Systematics

## Introduction

As of October 2007 there are 258 described species of Macrodasysida, of which 121 belong to the Thaumastodermatidae. The species contained in this report come from two oceanic regions, the Atlantic North East (ANE) and the Atlantic North West (ANW), together with a few samples from the American Virgin Islands (AVI). ANE is one of the best sampled areas of the world, with 2500 species records from 430 locations sampled, yielding some 115 species of macrodasysid gastrot-

richs, the Thaumastodermatidae dominating with about 50 species. The British Isles was sampled most with nearly 1200 species records from 158 locations sampled, France came next with nearly 600 species records from 126 locations sampled, then Germany with nearly 340 species records from 44 locations sampled. ANW is less well sampled, with 1300 species records from 210 locations sampled, yielding some 110 species of Macrodasysid gastrotrichs, the Thaumastodermatidae again dominating with more than 40 species. Florida was sampled most with nearly

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570 species records from 81 locations sampled, Massachusetts came next with nearly 260 species records from 25 locations sampled, then North Carolina with nearly 180 species records from 37 locations sampled. The Caribbean Islands are promising for future research, the AVI presently having but 26 species records from 6 locations sampled. Of species being described here, 15 are from ANE, 6 from ANW and 2 from AVI.

This report considers material that is based on drawings and measurements made in the late 1960's through the late 1980's. An early version of Nomarski (DIC) optics was used, but even with a heat filter the taxonomic characters on the specimens being drawn were melting significantly under prolonged study; hence while type specimens are not extant the figures do accurately represent the morphology of the species being described. This is the first of two such manuscripts, this one on the Macrodasysida, the second forthcoming on the Chaetonotida. A dichotomous key to families and genera of Gastrotricha is being published in this volume (see Todaro & Hummon).

### Methods and Materials

Collections were made from whole-beach transects from about 1969 to 1989, with 8-10 sites spaced more or less equally from lowest water level to high spring tide level. The number of sites depended on the breadth of the beach perpendicular to the shoreline and the tidal amplitude during the spring tide series (breadth usually 30 to 60 m, amplitude 2 to 4 m, but ranging from breadth 4 to 1000+ m, amplitude 0.5 to 20 m). Sand flats are most interesting, as they can be sampled laterally as well as up and down. Sites were sampled at depth using a core tube (for wet samples) or shovel and plastic ice-cream scoop (for dry samples). Sampling depths in the sand were mostly continuous, ranging from 0-10 cm (low tide levels) to 0-50 to 100 cm (high tide levels), usually reaching ground water levels. Sand was placed in 250 ml whirl-pak bags, kept at temperatures from 5 °C (winter) to 20 °C (summer) and returned to the laboratory as soon as possible (1 to 5 days, ranging from day trips to expeditions) for analysis. In the lab, samples were kept at temperatures from 5 to 10 °C, where they will keep with little loss of living material for up to 10 days. Analysis was carried out as quickly as possible, beginning with earliest collected

samples or samples with heavy organic loads.

For analysis, about 20 ml of sand was placed in a 125 ml plastic cup, an equal amount of 6 to 7 %  $MgCl_2$  added, and after swirling the cup left for 10 minutes (a shorter time yields fewer specimens, a longer time results in blistering of delicate animals). After the relaxation period, about 30 ml of ambient sea-water was added, the contents swirled once again, and the supernatant poured into a 60 ml plastic Petri dish, followed by another 30 ml of sea-water and another decantation to fill the Petri dish, its contents then being split between that and another similar Petri dish. After a brief period during which the sedimentary and animal contents settled to the bottom, the dish was inspected for now-revived gastrotrichs using a Wild M5 stereo-microscope at 18 to 20× magnification. Many specimens could be identified to family or even genus, some to species, at this magnification, owing to shape or behavioral attributes, but only after repeated testing of one's predictions (the archaeannelid *Diurodrilus* generally proved false positives). Dishes were inspected up, over, down, over until a desired specimen was seen. It was transferred to a drop of  $MgCl_2$  on a microscope slide, oriented, covered with a 16 mm square coverslip with posts of non-toxic modeling clay at its corners. The small cover slip aided in finding the specimen by restricting the amount of surface over which one has to look. Often the specimen was moving, which meant that water must be carefully wicked from the glass sandwich using a small triangle of filter paper, the animal stopped without squashing it (or losing it along the edges of the cover slip), and its body reoriented using the first and second fingers of each hand on the corners of the cover slip. After marking the specimen's location with a fine felt tip marker (since the stage of my compound microscope moves fore and aft, I mark above the specimen), I transferred the slide to the stage of my microscope, looked for the mark, and (usually) moved directly to the animal. A rotating stage allowed orientation of the specimen as one wishes. Videotaping (only since 1990 in my lab, SVHS then Hi8 then digital, either directly or by conversion) began at the highest magnification that could show the entire specimen (4× objective for very long animals to 40× for short animals), working one's way up to higher magnifications. A numerical aperture (n.a.) of 1.00 to 1.25 at higher magnifications was as important as having a differential interference contrast (DIC) system.

Drawings were made using a drawing tube on the microscope or by mapping ocular micrometer units (millimeter ruler off a video display) onto graph paper. A finished drawing involves both dorsal and ventral views, a lateral view when possible, and composite dorsal/ventral views of juveniles and/or subadults when available, all with appropriate scale bars. Light table and variable magnification photocopier aided the production. These views were inked onto Albenene (100 % rag content) tracing paper, then photocopied and scanned onto the computer. In my illustrations, dorsal and ventral views are mirror images of one another; other illustrators may do dorsal and ventral views as if focusing down through the specimen.

When available, videos have been (are being) digitized, edited, and rendered into MPEG 2 and WMV (=MPEG 4) versions, to be placed on my server for read-only downloading by other workers (Hummon et al. 2005, Hummon 2007).

Many of the species described herein are based on subadults; this can be done because the subadults already show characters of the adults that distinguish them from other species. Where species are dominant, co- or sub-dominant in samples, they often include juvenile, sub-adult and adult specimens, while non-dominant species tend to occur in one collection or another, often to be seen only occasionally in repetitive collections, or not to be seen again because of their rarity. Latitude and longitude are given only for type localities (Ordnance Survey references are given for British locations); those for all other localities can be found in the Global Data Base (Hummon 2007). Where diversity measurements were made they are reported as H' values in bits, based S number of species and N number of individuals

Morphological symbols and conventions are as follows: Lt: Length, total: from anterior tip of head to posterior tip of caudum and its adhesive tubes; LPh: Length, pharynx from anterior tip of head to PhJIn; PhJIn: Junction between pharynx and intestine; WHd/WNk/WTr/WFrBs/WFrTp: Width of head, neck, trunk, furcal base and furcal tips; TbA/TbL/TbD/TbV/TbP/TbS: adhesive tubes of the anterior, lateral, dorsal, ventral, posterior (caudal), and **Seitenfüßchen** series; U: Percentage units of Lt from anterior to posterior X 100; Columns: longitudinal in orientation; Rows: transverse in orientation; The symbols: [**dom**] – dominant, [**cdom**] – co-dominant,

[**sdom**] – sub-dominant refer to those instances when a species made up a preponderance of specimens in a sample; the caret ^ refers to a type species or locality.

## Systematics

Order Macrodasysida Remane, 1929  
(Rao & Clausen, 1970)

Note: Remane's **-oidea** ending was first emended to an **-ida** ending by Brunson (1950), though without reference to the ICZN.

Family Lepidodasyidae Remane, 1927  
Genus *Cephalodasys* Remane, 1926

*Cephalodasys swedmarki* new species  
[Cfd swed]  
Fig. 1

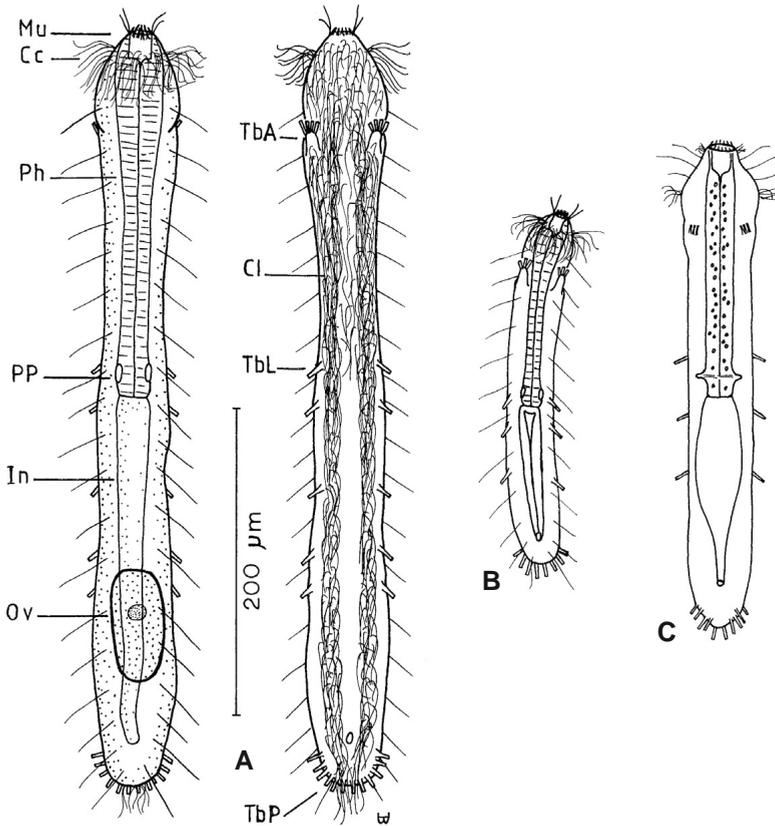
*Paradasys* sp. ? of Swedmark 1956a: p. 71, fig.1;  
Boaden, 1963: p. 494.

*Psammodasys* sp. of d'Hondt 1971: p. 161.

*Cephalodasys* ScoA of Hummon (2001, 2004, 2007)  
[NW Europe Database] & Cfd swed of Hummon (2001, 2004, 2007) [W Mediterranean Database].

**Diagnosis.** Adult Lt 500 µm; PhJIn at U47. Head ovoid, barely separated from the rest of the body by a neck constriction; trunk narrow, with a rounded caudum. Epidermis finely granular, without glands. TbA 4 per side, borne on fleshy hands; TbL 5 per side, inserted irregularly from U28 to U80, one in the rear pharyngeal region, the others in the fore- and midgut region; TbD/TbV absent; TbP 10-12, inserting ventrally on the rounded caudum. Locomotor ciliature: 2 longitudinal bands joining fore and aft, uniting in front with cilia of the transverse cephalic circler. Mouth surrounded by spines; buccal cavity cup-shaped; pharyngeal pores basal; foregut narrows to the rear; anus at U93. Probably parthenogenic; male system not seen; egg lies above the hindgut; frontal and caudal organs not seen.

**Description.** Adult Lt 500 µm; LPh 238 µm to PhJIn at U47. Body strap-shaped, dorsoventrally flattened, but vaulted dorsally and transparent; head ovoid, indistinctly separated from the rest



**Fig. 1.** *Cephalodasys swedmarki* n. sp. **A.** dorsal and ventral views of adult (Lt=498  $\mu\text{m}$ ) from Firemore Beach, Scotland, dorsal with digestive and reproductive tracts included, ventral with adhesive tubes and locomotor ciliary bands. **B.** composite dorsal/ventral view of juvenile (Lt=238  $\mu\text{m}$ ) from Glen Brittle, Scotland. **C.** original drawing of Swedmark, 1956, adolescent (Lt=315  $\mu\text{m}$ ) from Ile de Jarre, France. All are to the same scale. Symbols: **Mu**, mouth; **Cc**, ciliary corona; **Cl**, locomotor ciliary bands; **Ph**, pharynx; **PP**, pharyngeal pores; **In**, intestine; **TbA**, **TbL**, **TbP**, adhesive tubes of the anterior series, lateral tubes of the lateral series, and tubes of the posterior series; **Ov**, ovum.

of the body by a constriction; trunk narrow, widening slightly in the mid-to hindgut, and then narrowing again to a rounded caudum. Widths of head (max.)/neck (min.)/trunk (max.) and locations along the length of the body are as follows: 56/38/55  $\mu\text{m}$  at U10/U35/U80, respectively. Epidermis is finely granular, but lacking glands.

**Adhesive tubes.** TbA 4 per side (L=7-8  $\mu\text{m}$ ), borne on each of two fleshy hands; TbL 5 per side (L=16-21  $\mu\text{m}$ ), inserted somewhat irregularly from U28 to U80, one in the rear pharyngeal region, the others in the fore- and midgut region; TbD/TbV are absent; TbP 10-12 (L=9-10  $\mu\text{m}$ ), inserting ventrally on rounded caudum.

**Ciliation.** Paired cilia insert on each side of the mouth (L=9-17  $\mu\text{m}$ ); cephalic cilia (L=24-32  $\mu\text{m}$ )

form a single transverse row in front of (not over) the widest part of the head, with a tuft of cilia (L=6-34  $\mu\text{m}$ ) on each cephalic lobe; some 19 sensory hairs (L=24-36  $\mu\text{m}$ ) occur dorsolaterally along either side of the trunk (U10-U97). Ventral locomotor ciliation has two longitudinal bands over much of the body length, joining together to form a unified field beneath the head and pharynx, that unites anteriorly with cilia of the dorsal cirlet, the bands joining together again posteriorly behind the anus.

**Digestive tract.** Mouth diameter is 12  $\mu\text{m}$ ; mouth is surrounded by spines (L=9  $\mu\text{m}$ ); buccal cavity cup-shaped; pharynx narrowest in the middle, basal pharyngeal pores showing clearly; foregut broadest, narrowing to the rear; anus at U93.

Reproductive tract. Probably parthenogenic; male system not seen; egg solitary, lying above the hindgut; it is not known whether the ovarian material is located forward or rearward of the egg, or whether it forms one central or two bilateral clumps of oocytes; frontal and caudal organs not seen.

**Ecology.** Sparse in frequency of occurrence (less than 10 % of samples), rare in abundance (less than 1 % of a sample); littoral in fine to medium-fine/medium-well sorted, clean sand, at 0-10 cm depth, MLW-LWS (Scotland); sublittoral in fine/poorly-sorted shell sand at 8 m water depth (France).

#### Geographical distribution:

**ANE:** British Isles: Scotland: Highland {^Firemore Beach Transect A {57°49'N/05°41'W}{OS loc. NG-8188} April 1975 [max. H' diversity index=3.56, based on S=32, N=1485]}, Isle of Skye {Glen Brittle}.

**MED:** Europe: France: Provence {Ile de Jarre}.

**Remarks.** Fig. 1C of *Cephalodasys swedmarki* n. sp. is adapted from Swedmark's Fig. 1 (1956a), an adolescent of Lt=315 µm, LPh=164 µm, TbA=3 per side, TbL=3 per side and TbP=10, which is portrayed at the same scale as my Fig. 1a, a mature adult of Lt=498 µm (see above), and Fig. 1B, a juvenile of Lt=238 µm, LPh=127 µm, TbA=3 per side, TbL=3 per side and TbP=8, respectively.

**Etymology.** The species is named after Bertil Swedmark, who discovered it and though mystified by it was sufficiently courageous to draw it, trusting that someday someone else might find it.

**Taxonomic affinities.** Swedmark (1956a) listed this species as a *Paradasys*, with a question mark. Boaden (1963) rightly recognized the relationship between Swedmark's species and what he then described as *Paradasys cambriensis*, to accompany his previously described *Paradasys turbanelloides* Boaden, 1960. D'Hondt (1967) considered both *P. turbanelloides* and *P. cambriensis* to be within the genus *Paradasys*, but later (d'Hondt 1970, 1971, 1974) proposed a new genus *Psammodasys* for them, though it was thrice a *nomen nudum* until

properly published as a new genus (d'Hondt 1974), just months after Hummon (1974a), not yet knowing of d'Hondt's earlier work, transferred these two species into the genus *Cephalodasys* as *C. turbanelloides* (Boaden, 1960) and *C. cambriensis* (Boaden, 1963). The transfer of *Paradasys turbanelloides* to the genus *Cephalodasys* was accepted by Boaden (1976), who not having found *C. cambriensis* in the Netherlands samples did not mention it. Todaro et al. (2000) and Todaro et al. (2002) both accept *Cephalodasys* as the genus to which these species belong. Thus *Psammodasys*, while a beautiful and appropriate name, has no taxonomic standing other than as a junior synonym.\* To the nine species currently in the genus *Cephalodasys*: *C. cambriensis* (Boaden, 1963a); *C. caudatus* Rao, 1981; *C. hadrosomus* Hummon, Todaro & Tongiorgi, 1993; *C. littoralis* Renaud-Debyser, 1964; *C. maximus* Remane, 1926; *C. miniceraus* Hummon, 1974; *C. pacificus* Schmidt, 1974; *C. palavensis* Fize, 1963; and *C. turbanelloides* (Boaden, 1960), is added a 10<sup>th</sup>, *Cephalodasys swedmarki* n. sp. When mature, *C. swedmarki* has fewer TbL than any species in the genus other than *C. hadrosomus* (Hummon et al. 1993), which lacks them entirely; *C. swedmarki* also has fewer TbA and TbP than any other species thus far described.

Genus *Mesodasys* Remane, 1951

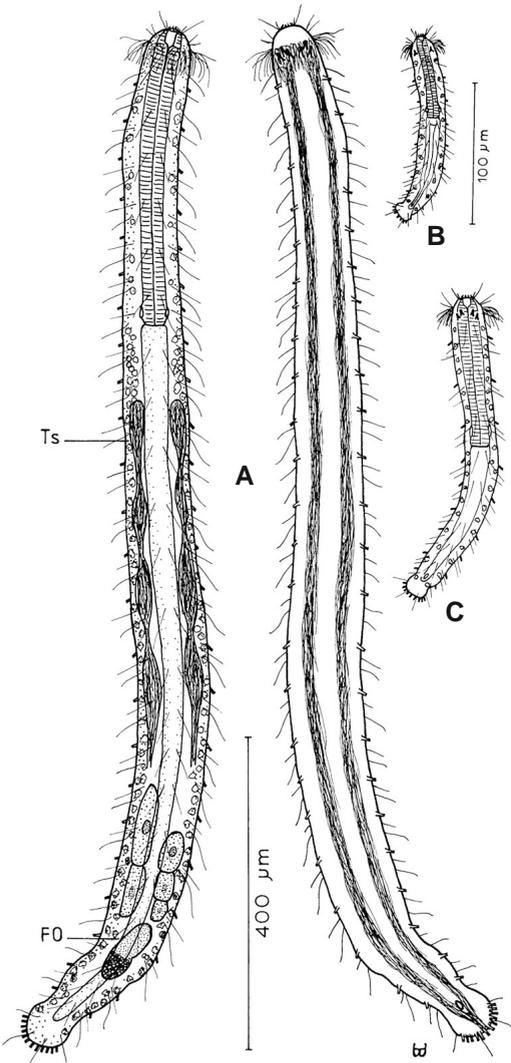
#### *Mesodasys brittanica* new species

[Msd brit]

Fig. 2

**Diagnosis.** Adult Lt 1375 µm; PhJIn at U28. Head bluntly rounded, un-demarcated from rest of body; trunk narrow; caudum rounded, slightly expanded. Cuticle naked, thin, flexible; glands 70-80 per side all along the body. TbA 3 per side, borne on the body in a triangular pattern, the mid-tube ahead of the other 2, a medial gap separating the bilateral sets; TbL 24 per side, even and symmetrical, at U05-U94, 3 in the fore-pharyngeal region, 4 in the rear-pharyngeal region, and 17 in the intestinal region; TbD/TbV absent; TbP 12 bordering the rounded caudum in a single, unseparated group. Locomotor ciliation: 2 longitudinal bands joining fore and aft, the fore

\* The genus name *Psammodasys* was used in Dewarumez, d'Hondt & Hummon (2004). Although being a co-author, I do not agree with its use.



**Fig. 2.** *Mesodasys brittanica* n. sp. **A.** dorsal and ventral views of adult (Lt=1375 µm) from Firemore Beach, Scotland, dorsal with digestive and reproductive tracts included, ventral with adhesive tubes and locomotor ciliary bands. **B, C.** composite dorsal/ventral view of juveniles (Lt=142 and 225 µm), with a separate scale bar, also from Firemore Bay. Symbols as in the previous figure, additionally with: **Ts**, testis; **FO**, frontal organ.

uniting with cilia of the transverse cephalic cirlet. Mouth terminal, buccal cavity cup-shaped; pharyngeal pores basal; foregut narrowing to the rear; anus at U96. Hermaphroditic; testes begin behind PhJIn at U35, with sperm-bearing dilations to U69, vasa deferentia continuing further rearward;

gonopore(s) not seen; ovaries paired, alongside the hindgut; one or more eggs per side, moving forward as they enlarge; ovoid caudal organ is finely granular in front and coarsely glandular in the rear; frontal organ not seen.

**Description.** Adult Lt 1375 µm; LPh 380 µm to PhJIn at U28. Body is transparent; head bluntly rounded, not demarcated from trunk, body with nearly parallel sides, widest in midgut region, gradually narrowing to the rear, becoming narrowest just before the rounded, slightly expanded caudum. Widths of body at rear buccal cavity/PhJIn/mid-body (max.)/caudal base (min.)/caudum (max.), and locations along the length of the body are as follows: 52/76/94/46/59 µm at U02/U28/U52/U95/U97, respectively. Cuticle is naked, thin, flexible; glands 70-80 per side (diam. 5-10 µm) over the entire length of the body, being particularly abundant in the intestinal region.

**Adhesive tubes.** TbA 3 per side (L 12-14 µm), inserting directly on the body surface at U01-U02 in a triangular pattern, the mid-tube ahead of the other two, with a medial gap separating the bilateral sets; TbL 24 per side (L 8-12 µm) evenly spaced and symmetrically inserted from U05 to U94, 3 per side in the fore-pharyngeal region, 4 per side in the rear-pharyngeal region, the other 17 in the intestinal region; TbD/TbV are absent; TbP 12 (L 10-12 µm) bordering the rounded caudum in a single, unseparated group.

**Ciliation.** Mouth is fringed by spines (L=4 µm), with paired cilia on either side (L=10-30 µm) in the buccal region; cephalic cilia (L=30-32 µm) form a single transverse row that surrounds the anterior end at U02 and joins the ventral locomotor ciliature laterally; some 26 sensory hairs (L=30-40 µm) occur in two dorsolateral columns along either side of the trunk at U04-U97 and U04-U93, while some 24 such hairs (L=30-55 µm) occur in a dorsal column on either side of the trunk at U03-U99. Ventral locomotor ciliature has two longitudinal bands over much of the body length, joining together to form a unified field beneath the head, which unites anteriorly with cilia of the dorsal head cirlet, the bands joining together again posteriorly behind the anus.

**Digestive tract.** Mouth diameter is 20 µm; mouth terminal, buccal cavity cup-shaped; pharynx of medium breadth, with basal pharyngeal pores; intestine broadest anteriorly, narrowing to the rear; anus at U96.

**Reproductive tract.** Hermaphroditic; testes

begin well behind the PhJIn at U35, continuing rearward with sperm bearing sack-like dilations to at least U69, after which vasa deferentia continue further rearward; male gonopore(s) not seen; sperm are elongate; ovaries paired, lying beside the hindgut; one or more eggs per side, each moving forward as it enlarges; caudal organ (L 90, fore-W 30  $\mu\text{m}$ ) at U71-U83 is ovoid, slightly indented on one side, finely granular in front and coarsely glandular in the rear; frontal organ not seen.

**Ecology.** Sparse to occasional in frequency of occurrence (less than 10 % to 30 % of samples), scarce to prevalent in abundance (less than 3-5 % to more than 30 % of a sample, usually a co-dominant or dominant); littoral in very fine to medium-fine, well to medium-well sorted (occasionally in very fine to very coarse, very poorly sorted), clean sand at 0-15 cm depth, LWN-LWS; sublittoral in very fine, very well to well sorted sand at 6-36 m water depth.

#### Geographical Distribution:

**ANE:** British Isles: Eire: Waterford {Ballyrisode [dom]}; – England: Dorset {Studland}, Norfolk {Hunstanton}; – Isle Of Man: {Derby Haven, Port Erin S}; N. Ireland: {Glenariffe}; – Scotland: Dumfries {Kirkcolm [sdom], Sandhead}, Fife {East Sands}, Highland {Achiltibuie, ^Firemore Beach Transect D [57°49'N/05°41'W] {OS Loc. NG-8188} August 1974 [Max. H' diversity Index = 3.25, Based On S = 24, N = 462], Samalaman}; – Shetland Islands {Fetlar}, Strathclyde {Gortnachulish}; – Wales: Gwynedd {Llanbedrog}.

**Remarks.** An adolescent and a juvenile of *Mesodasys brittanica* n. sp. are Lt = 225, LPh = 105  $\mu\text{m}$ , TbA = 2 per side, TbL = 9 per side and TbP = 9 total, and Lt = 145, LPh = 59  $\mu\text{m}$ , TbA = 1 per side, TbL = 8 per side and TbP = 7 total. These latter two are portrayed at the same scale, though the scale differs from that of the mature adult, Lt = 1375  $\mu\text{m}$ , referred to above.

**Etymology.** The species is named after the British Isles, throughout which it is found.

**Taxonomic affinities.** To the five species currently in the genus *Mesodasys*: *M. adenotubulatus* Hummon, Todaro & Tongiorgi, 1993; *M. hexapodus* Rao & Ganapati, 1968; *M. ischiensis* Hum-

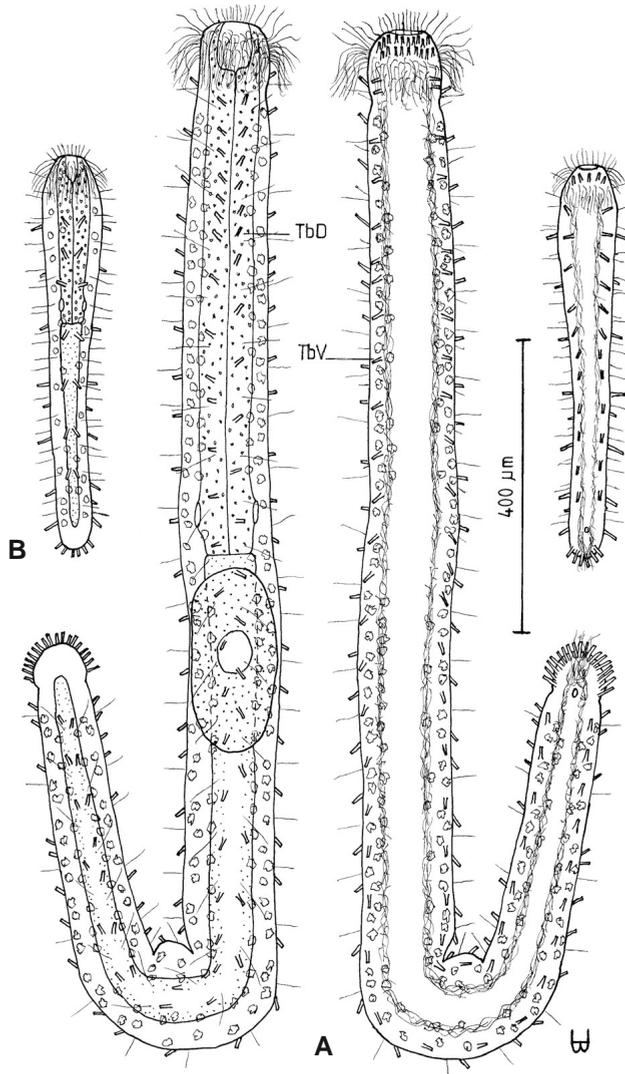
mon, Todaro & Tongiorgi, 1993; ^*M. laticaudatus* Remane, 1951; and *M. littoralis* Remane, 1951, is added a 6<sup>th</sup>, *Mesodasys brittanica* n. sp. *M. brittanica* is the only species thus far in the genus with a bilateral female reproductive system in the rear third of the body; it has fewer TbA than the other species, though *M. hexapodus* (Rao & Ganapati 1968) has only a few more; it has fewer TbL than most species, though *M. hexapodus* has a similar number; it has more TbP than *M. hexapodus*, but fewer than the other species; its LPh relative to Lt is less than any species save *M. littoralis* (Remane 1951); its rear end is only slightly flared, *M. ischiensis* (Hummon et al. 1993) being closest, the others either having a distinct flare or no flare at all; and its ventral ciliation of paired bands running nearly the length of the body differs from all but the following species.

#### *Mesodasys rupperti* new species

[Msd rupt]

Fig. 3

**Diagnosis.** Adult Lt 1970  $\mu\text{m}$ ; PhJIn at U38. Head bluntly rounded, un-demarcated from rest of body; trunk broad, narrowing to rear; caudum rounded, slightly expanded. Cuticle is naked, thin, flexible; glands nearly 100 per side all along the body. TbA 19 total, occur in 2 transverse rows of 10 and 9, without medial gap; TbL 29-33 per side, even but asymmetrical, at U03 to U95, 6 per side in the fore-pharyngeal region, 5-6 per side in the rear-pharyngeal region, the other 18-21 in the intestinal region, but none behind the anus; TbVL 31-34 per side, even but asymmetrical, at U03 to U94, 8 per side in the fore-pharyngeal region, 5 per side in the rear-pharyngeal region, the other 18-21 in the intestinal region; TbD 12-14 per side in the pharyngeal region, with another 16-17 in the intestinal region, even but asymmetrical; TbV absent; TbP 18 bordering the rounded caudum in a single unseparated group. Locomotor ciliature: 2 narrow longitudinal bands that join fore and aft, the fore uniting with cilia of the transverse cephalic circlet. Mouth terminal, buccal cavity mug-shaped; pharyngeal pores basal; foregut narrowing to the rear; anus at U96. Probably hermaphroditic; testes not seen; ovary may be paired; one or two eggs lie above the foregut, each moving forward as it enlarges; neither caudal nor frontal organs were seen.



**Fig. 3.** *Mesodasys rupperti* n. sp. **A.** dorsal and ventral views of adult (Lt=1970  $\mu\text{m}$ ) from Debidue, dorsal with digestive and reproductive tracts included, ventral with adhesive tubes and locomotor ciliary bands. **B.** composite dorsal/ventral view of juvenile (Lt=548  $\mu\text{m}$ ), also from Debidue, South Carolina. Symbols as in previous figures, additionally with: **TbD**, **TbV**. dorsal and ventral adhesive tubes of the lateral series.

**Description.** Adult Lt 1970  $\mu\text{m}$ ; LPh 728  $\mu\text{m}$  to PhJIn at U38. Body is strap-shaped, flattened ventrally, vaulted dorsally; head and caudum bluntly rounded, head barely demarcated from trunk, body with nearly parallel sides, widest in foregut region, gradually narrowing to the rear, with a rounded, slightly expanded caudum. Widths of body at head inflation (max.), constriction (min.)/-foregut (max.) /caudal base/TbPs of caudal expansion, and locations along the length

of the body are as follows: 98,91/126/66/98  $\mu\text{m}$  at U02,U05/U44/U96/U97, respectively. Cuticle is naked, thin, flexible; glands occur in 2-3 columns along either side, numbering nearly 100 per side, over the length of the body from U06 to U94.

Adhesive tubes. TbA 19 total, occur in two transverse rows of 10 and 9 respectively (L 12-15  $\mu\text{m}$ ), inserting directly on the body surface at U00-U01, without medial gap; TbL 29-33 per side (L 12-15  $\mu\text{m}$ ) evenly spaced but asym-

metrically inserted from U03 to U95, 6 per side in the fore-pharyngeal region, 5-6 per side in the rear-pharyngeal region, the other 18-21 in the intestinal region; TbVL 31-34 per side (L 12-15  $\mu\text{m}$ ) evenly spaced but asymmetrically inserted from U03 to U94, 8 per side in the fore-pharyngeal region, 5 per side in the rear-pharyngeal region, the other 18-21 in the intestinal region; TbD 12-14 per side in the pharyngeal region, with another 16-17 in the intestinal region, evenly spaced but asymmetrically inserted; TbV are absent; TbP 18 (L 20-24  $\mu\text{m}$ ) bordering the rounded caudum in a single row, not separated from one another by a gap, all inserting on the ventral surface of the caudum.

**Ciliation.** Cilia (L 14-20  $\mu\text{m}$ ) occur about the mouth opening; others (L 25-50  $\mu\text{m}$ ) occur along either side of the head to the rear of the buccal cavity, where a band of cephalic cilia (of similar L) runs transversely over the head and joins the locomotor ciliature ventrally; 23-27 sensory hairs (L 20-24  $\mu\text{m}$ ) each occur in lateral and dorsal columns along either side of the trunk. Ventral locomotor ciliature has two narrow longitudinal bands beneath the body, joining the transverse cephalic row anteriorly and joining one another behind the anus posteriorly.

**Digestive tract.** Mouth diameter is 33  $\mu\text{m}$ ; mouth terminal, buccal cavity mug-shaped, broader within than at its opening; pharynx relatively broad, with basal pharyngeal pores; intestine broadest anteriorly, narrowing gradually to the rear; anus at U96.

**Reproductive tract.** Probably hermaphroditic; testes not seen; ovaries may be paired; one or two eggs (reaching 250  $\times$  115  $\mu\text{m}$ ) lie above the foregut, each moving forward as it enlarges; neither caudal nor frontal organs were seen. Maturity may be reached at Lt=1700  $\mu\text{m}$ .

**Ecology.** Occasional in frequency of occurrence (10-30 % of samples), scarce in abundance (3-5 % of a sample); littoral in sand flat of medium fine, medium-well sorted, clean sand at 0-15 cm depth LWN-LWE.

#### **Geographical Distribution:**

**ANW:** North America: South Carolina {<sup>^</sup>Debidue {33°20'N/79°10'W} June 1977}.

**Remarks.** An adolescent of *Mesodasys rupperti* n. sp. is Lt=500, LPh=210  $\mu\text{m}$ , TbA=5 in one transverse row, TbVL=11-12 per side, TbL=8-9 per side, TbD=7 per side, and TbP=6 in a single

row; with no sign of a caudal expansion.

**Etymology.** The species is named after Edward E. Ruppert, retired invertebrate generalist and gastrotrich specialist, whom we thank for his tireless hours of research.

**Taxonomic Affinities.** *Mesodasys rupperti* n. sp. is the 7<sup>th</sup> species in the genus (for the other six, see above). It has an inflated caudum, along with *Mesodasys brittanica* n. sp., *M. ischiensis* (Hummon et al. 1993) and *M. laticaudatus* (Remane 1951), thus differing from the species that have narrowed or rounded caudal ends, *M. adenotubulatus* (Hummon et al. 1993) and *M. littoralis* (Remane 1951) or *M. hexapodus* (Rao & Ganapati 1968). *Mesodasys rupperti* has TbVL/TbL/TbD, whereas *M. brittanica* has only TbVL, *M. laticaudatus* has TbVL/TbDL, and *M. ischiensis* has TbV/TbL/TbDL/TbD. *Mesodasys rupperti* lacks the narrow pre-caudal section of *M. laticaudatus*, lacks the protruding mouth tube of *M. ischiensis*, and has many more TbA than *M. brittanica*.

Genus *Paradasys* Remane, 1934

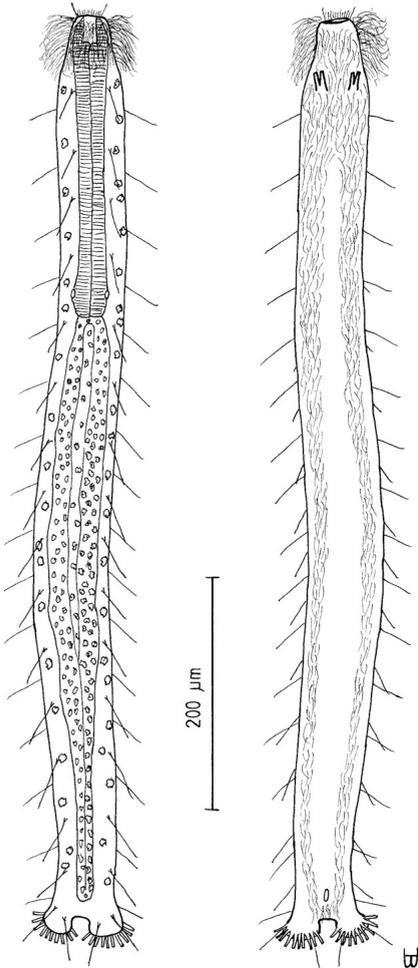
#### *Paradasys bilobocaudus* new species

[Prd blcd]

Fig. 4

**Diagnosis.** Subadult Lt 800  $\mu\text{m}$ ; Ph]In at U32 [adult <1000  $\mu\text{m}$ ; Ph]In ~U28]. Head bears a ciliated muzzle, body narrows gradually to the caudal base, then broadens to form two large semi-lunar caudal lobes, which indent medially to U97 and are separated by a gap of 14  $\mu\text{m}$ . Epidermis is finely granular, glands 18-20 per side. TbA 2 per side, united at their bases, inserting directly on the body; TbL/TbD/TbV absent; TbP 10 tubes per side, forming an arc around the rear of each caudal lobe. Locomotor ciliature: 2 narrow longitudinal bands that join fore and aft, the fore uniting with cilia of the dorsal cephalic circlet. Mouth terminal, buccal cavity elongate and spacious; pharynx broad both fore and aft, with inconspicuous basal pharyngeal pores; intestine broad, wavy and indistinct anteriorly, with coarse inclusions, narrow and more distinct posteriorly; anus at U94. Probably hermaphroditic; testes and ovaries not seen in immature specimens.

**Description.** Subadult Lt 800  $\mu\text{m}$ ; LPh 262  $\mu\text{m}$  to Ph]In at U32. Body is strap-shaped, flattened ven-



**Fig. 4.** *Paradasys bilobocaudus* n. sp. dorsal and ventral views of subadult (Lt=808  $\mu$ m) from Looe, England, dorsal with digestive tract included, ventral with adhesive tubes and locomotor ciliary bands. Symbols as in previous figures.

trally, vaulted dorsally; head narrows forward to form a ciliated muzzle, body is of much the same width, narrowing gradually to the caudal base, then broadening to form the two large semi-lunar caudal lobes, which indent medially to U97 and are separated by a gap of 14  $\mu$ m. Widths of muzzle/head (max.)/trunk (max., min.)/caudum (max.)/TbPs of caudal expansion, and locations along the length of the body are as follows: 28 to 52/60/65 to 24/72/88  $\mu$ m at U01 to U05/U10/U52 to U94/U97/U97, respectively. Epidermis is finely granular, with 18-20 glands (diameter 7-10  $\mu$ m) laterally on either side.

**Adhesive tubes.** Tubes are sparse and simple; TbA 2 per side, united at their bases and inserting directly on the body surface at U08; TbL/TbD/TbV are absent; TbP 10 tubes per side, forming an arc around the posteriolateral and lateral borders of each caudal lobe.

**Ciliation.** Short cilia (L=5  $\mu$ m) surround the mouth, more concentrated laterally; cephalic cilia form a broad band that surrounds the muzzle from U1 to U4; 16-18 sensory hairs occur in each of two columns, lateral and dorsolateral, along either side of the trunk, the last two of the dorsolateral series arising from the caudal lobes. Ventral locomotor ciliation has two longitudinal bands over much of the body length, joining together to form a unified field from the mid-pharyngeal region forward, which unites anteriorly with cilia of the muzzle, the bands each narrowing toward the rear and then joining together again behind the anus.

**Digestive tract.** Mouth diameter is 10  $\mu$ m, buccal cavity elongate and spacious; pharynx narrow throughout most of its length, being broader both fore and aft, though the basal pharyngeal pores are rather inconspicuous; intestine broad, wavy and somewhat indistinct in outline anteriorly, with coarse inclusions, narrow and more distinct posteriorly; anus at U94.

**Reproductive tract.** No information, specimens being reproductively immature.

**Ecology.** Sparse in frequency of occurrence (less than 10 % of samples), rare in abundance (less than 1 % of a sample); littoral in very fine to coarse, poorly sorted, clean sand, at 0-10 cm depth, LWS.

#### **Geographical Distribution:**

**ANE:** British Isles: England: Cornwall {^Looe {50°20'N/04°26'W} {OS loc. SX-2553} April 1989}.

**Remarks.** Specimens of *Paradasys bilobocaudus* n. sp. are difficult to handle, the cuticle being somewhat sticky and blistering readily in MgCl<sub>2</sub>. When active in a dish, they glide slowly, turning gradually in one direction or the other. The largest specimens found were subadults; the adult can be expected to be somewhat longer, reaching a length of perhaps 1000  $\mu$ m with the intestinal region growing more than the pharyngeal, so that the PhJn will tend to shift to lower U-numbers, perhaps U28, and to add marginally to the number of TbP on each caudal lobe.

**Etymology.** The species is named after the broad-bilobed caudum that it possesses.

**Taxonomic affinities.** To the six species currently in the genus *Paradasys*: *P. hexadactylus* Karling, 1954; *P. lineatus* Rao, 1980b; *P. littoralis* Rao & Ganapati, 1968; *P. nipponensis* Sudzuki, 1976; *P. pacificus* Schmidt, 1974; and *P. subterraneus* Remane, 1934, is added a seventh species *Paradasys bilobocaudus* n. sp. Although *Paradasys nipponensis* (Sudzuki 1976) is incompletely described and poorly figured, it does meet the minimum criteria for a species description. *Paradasys bilobocaudus* alone has a ciliated muzzle; *P. bilobocaudus* along with *P. lineatus* (Rao 1980) and *P. littoralis* (Rao & Ganapati 1968) have 2 TbA on each side, the others having but 1 TbA per side (unknown for *P. nipponensis*); none have TbL; only *P. bilobocaudus* and *P. pacificus* (Schmidt 1974) have truly bilobed posterior ends clearly incised in the middle, the lobes of *P. bilobocaudus* having a broader span than the maximum trunk width whereas those of *P. pacificus* are narrower than the maximum body width; *P. bilobocaudus* has as many TbP per lobe as any other species has in total.

Family Macrodasysidae Remane, 1927  
Genus *Macrodasys* Remane, 1924

***Macrodasys indicus* Kutty & Nair, 1969**  
[Mcd indic]

*Macrodasys indicus* Kutty & Nair, 1969: p. 632, fig. 5  
– **new species.** Naidu & Rao (2004: p. 25).

**Remarks.** *Macrodasys indicus* is the proper spelling of the species epithet (text), not *idicus* (fig. 5 legend) [ICZN Art. 24.2.2.]. If *Macrodasys indicus* (Kutty & Nair 1969) is validly placed in the genus *Macrodasys*, then *Macrodasys indica* Rao, 1991 with its suffix corrected to *Macrodasys indicus* [ICZN Arts. 34.2. and 52.6.] is a **junior primary homonym** of *Macrodasys indicus* Kutty & Nair, 1969 and its specific epithet must be replaced [ICZN Arts. 23.3.5. and 60.1.]. The data are not wholly one-sided. By shape the animal drawn in Fig 5 is more *Mesodasys*-like than *Macrodasys*-like, since it has TbL the length of the body and lacks a tail flap. Other drawings by these same authors that are attributed to known species have the appearance of poor copies of the original figures, and Fig. 5 looks most like Boaden's *Macrodasys remanei* (1963,

Fig. 8), without tail flap, long lateral tubes or pestle organs. What to my mind makes it a *Macrodasys*, if indeed it can ever be identified again, is that the pharyngeal pores (not shown in Fig. 5) are said to be at four-fifths of the pharynx length, just in front of where Boaden has drawn them for his species, somewhere between the basal pores of *Mesodasys* and the sub-basal pores of most *Macrodasys*. The reproductive system looks almost patterned after that of *M. remanei*, with a penis structure lying in front of the largest egg, and not where the frontal organ is expected, just behind the largest egg (Schoepfer-Sterrer 1974, Ruppert 1978a, Evans 1994), though the male system was also figured this way in *M. remanei* by Boaden (1963: Fig. 8) and *M. hexadactylus* by Rao (1970: Fig. 1). They were all following Remane, who mistook what he called a penis that was attached to the testicular vasa deferentia, though a careful search of his figures (Remane 1924: Fig. 2 and 1927: Fig. 2) shows that he was mistaken only in the ductwork and not in the position. While uneasy with the decision, I see no sufficient evidence at this time to force a change in genus and therefore judge that *M. indicus* (Kutty & Nair 1969) is a valid species in the genus *Macrodasys*, and to rename the junior synonym *Macrodasys indica* (Rao, 1991) as *Macrodasys lakshadweepense* n. sp. [ICZN Art. 60.3.].

***Macrodasys lakshadweepense* new species**  
[Mcd lcsH]

*Macrodasys indica* Rao, 1991: p. 63, fig. 1 – **new species.** Naidu & Rao (2004: p. 23). Present paper – **junior homonym** of *Macrodasys indicus* Kutty & Nair, 1969.

**Etymology.** The species is named after the islands in which it was found.

***Macrodasys waltairensis* Rao & Ganapati, 1968**  
[Mcd wltr]

*Macrodasys waltairensis* Rao & Ganapati, 1968: p. 39, fig. 7 – **new species.** Rao (1989: p. 21).

**Remarks.** *Macrodasys waltairensis* is the proper spelling of the species epithet (text), not *waltaironsis* (fig. 7 legend) [ICZN Art. 24.2.2.].

*Macrodasys assimilis* Remane, 1936

*Macrodasys assimilis* Remane, 1936: fig. 142. – **nomen nudum.**

**Remarks.** This name appears only in this one figure; it does not appear among the species listed under *Macrodasys* on p. 167 ff. or in the index on p. 379. Neither does it appear elsewhere in the literature.

*Macrodasys celticus* new species

[Mcd celt]

Fig. 5

**Diagnosis.** Adult Lt 650 µm; PhJIn at U43. Head ovoid, without swelling, pestle organs at U04; trunk broad throughout, narrowing near the caudum. Glands inconspicuous. TbA 6 per side, in diagonal columns that insert directly on the body; TbL 22 per side, symmetrical but more closely spaced to the rear, at U14-U95, with 3 before the pharyngeal pores, 3 behind the pores, 14 in the intestinal region, and 2 behind the anus; TbD 9 per side, even and symmetrical, with 3 in the pharyngeal region at U16/U25/U36, and 6 in the intestinal region to U90; TbV absent; TbP 9 surrounding the caudum. Locomotor ciliature: a single field except just behind the oral opening, concentrated in front, continuing along the body sides and joining behind the anus, running onto the caudum, the medial trunk surface being but sparsely covered. Mouth terminal, rim bears a corona of fine hook-like projections; buccal cavity cylindrical, lightly cuticularized; prominent sub-basal pharyngeal pores; intestine broadest in front, narrowing quickly, circling around the reproductive structures to the rear; anus at U92. Probably hermaphroditic; testes not seen; eggs develop front to rear; ovoid caudal organ lies behind the largest egg; frontal organ not seen.

**Description.** Adult Lt 642 µm; LPh 277 µm to PhJIn at U43. Body medium in length as an adult, ventrally flattened, dorsally vaulted; head ovoid, without swelling, but bearing pestle organs at U04; trunk broad throughout, narrowing gradually to the caudum. Widths at pestle organs / PhJIn/caudum (min.) and locations along the length of the body are as follows: 42/59/10 µm at U04/U43/U98, respectively. Epidermis unarmored, glands not conspicuous.

Adhesive tubes. TbA 6 per side (L 7 µm),

forming diagonal columns, which insert directly on the postoral body surface at U02-U05 and project forward; TbL 22 per side (L 8-10 µm), symmetrically placed but becoming more closely spaced to the rear, begin at U14 and extend to U95, with 3 before the pharyngeal pores, 3 behind the pores, and 14 in the intestinal region, and 2 behind the anal aperture; TbD 9 per side, evenly spaced and symmetrically placed, with 3 in the pharyngeal region at U16, U25 and U36, and another 6 in the intestinal region to U90; TbV are absent; TbP 9 surrounding the caudum, all larger than the rearmost TbL but none predominating.

Ciliation. Sensory hairs (L 3-4 µm) occur on either side of the mouth; longer, hooked sensory hairs (L 15-26 µm) arise in three columns on either side of the body, lateral, dorsolateral and dorsal, with about 26 per column. Ventral locomotor ciliature forms a single field except just behind the oral opening, with heavy concentrations in the anterior pharyngeal region, continuing along the sides of the body and joining behind the anus, onto the caudum, the medial trunk surface having but a sparse covering.

Digestive tract. Mouth diameter is 9 µm; mouth rim bears a corona of some 12 fine hook-like projections (L 2 µm); buccal cavity is the same width from mouth to base and is lightly cuticularized; pharynx has prominent sub-basal pharyngeal pores at U31; intestine is broadest in front, narrowing quickly at about U60 and then circling around the reproductive structures to the rear; anus is at U92.

Reproductive tract. Testes not seen, perhaps developing after the ovigerous material; eggs appear to develop from front to rear, reaching 76 × 40 µm in size; an ovoid caudal organ occurs behind the largest egg at U78-U86, having spiraled musculature in the front two-fifths and glandular material with a central canal in the rear three-fifths; frontal organ not seen.

**Ecology.** Occasional in frequency of occurrence (10-30 % of samples), rare in abundance (less than 1 % of a sample); littoral in fine to medium/medium to medium well sorted, sand with small amounts of detritus, at 0-15 cm depth MLW-MTL; sublittoral in medium fine, medium sorted clean sand to 15 m water depth.

**Geographical distribution:**

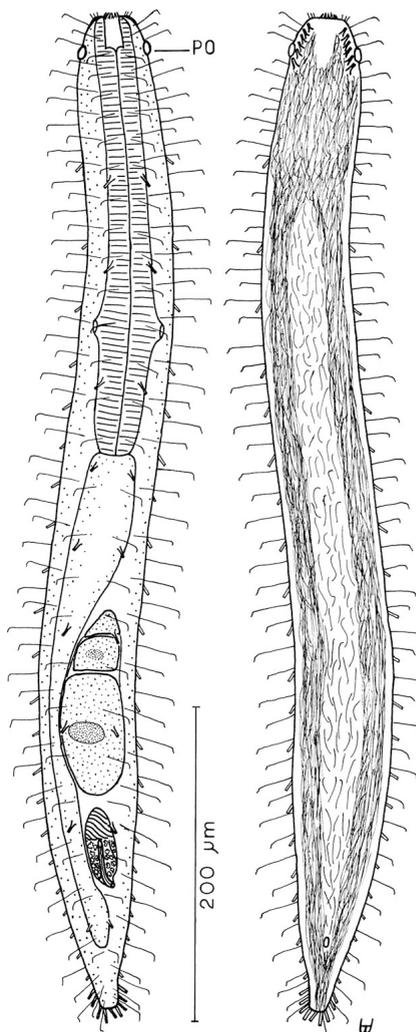
**ANÉ:** British Isles: Wales: Gwynedd {Llanbedrog}, West Glamorgan {Oxwich Beach {51°32'N

/04°04'W}{OS Loc. SS-5086} April 1979 [H' diversity Index=3.10, Based on S=17, N=195]}. – **Europe:** Germany: Helgoland {Loreley Bank}.

**Remarks.** Unusual is the female reproductive system of *Macrodasys celticus* n. sp., eggs developing front to rear, combined with a caudal organ that is located just behind the largest egg, along with an absence of any structure where the frontal organ would be found.

**Etymology.** The species is named after the celtic land of Wales in which it was found.

**Taxonomic affinities.** The most seminal work done on this genus to date is that of Evans (1994), which treated seven species of mature specimens in a consistent manner, based on caudal and frontal organ size and morphology, on body shape, disposition of adhesive structures, and ciliature, all evidenced by high resolution video sequences (1-5 for most species, 59 for *Macrodasys achradoctyalis* (Evans 1994) and 100 for *M. meristocytalis* (Evans 1994)). I have identified the *Macrodasys* sp. I that Ruppert used in his reproduction studies of 1978a with *M. blysoctyalis* Evans, 1994, and the *Macrodasys* sp. II with *M. meristocytalis* Evans, 1994. I am studying adhesive tube distribution, which though of lesser importance than reproductive structures, is pattern-stable with development and can be used for sub-adults as well as adults. To the 25 species currently in the genus *Macrodasys* are being added three new species *M. celticus* n. sp. and two to be described below, bringing the number to 28. Of these, three species - *Macrodasys balticus* Roszczak, 1939; *M. neapolitanus* Papi, 1957; and *M. waltairensis* Rao & Ganapati, 1968 lack any TbL in the pharyngeal region; four species - *M. africanus* Remane, 1950; *M. buddenbrocki* Remane, 1924; *M. cunctatus* Wieser, 1957; and *M. gerlachi* Papi, 1957 have 1 TbL at the very base of the pharynx; four species - *M. cephalatus* Remane, 1927c; *M. deltoctyalis* Evans, 1994; *M. meristocytalis* Evans, 1994; and *M. fornerise* Todaro & Rocha, 2004 have 2 TbL at the very base of the pharynx; five species - *M. achradoctyalis* Evans, 1994; *M. ancotocytalis* Evans, 1994; *M. caudatus* Remane, 1927; *M. dolichocytalis* Evans, 1994; and *M. thuscus* Luporini, Magagnini & Tongiorgi, 1970 (published in 1973) have 3-5 TbL at the very base of the pharynx. Of the remaining nine species, *Macrodasys lakshadweepense* n. sp. has 1 TbL lying about half the distance between the



**Fig. 5.** *Macrodasys celticus* n. sp. dorsal and ventral views of adult (Lt=642  $\mu$ m) from Oxwich Beach, Wales, dorsal with digestive and reproductive tracts included, ventral with adhesive tubes and locomotor ciliary bands. Symbols as in previous figures, additionally with: PO, pestle organ.

rear of the pharynx and the pharyngeal pores; *M. blysoctyalis* Evans, 1994; *M. pacificus* Schmidt, 1974; and *M. stenocytalis* Evans, 1994 have 2-3 TbL lying between the rear of the pharynx and the pharyngeal pores. The condition in *Macrodasys affinis* Remane, 1936 is unknown, since neither a full description or a figure of the whole-body of a mature specimen has ever been completed. The remaining four species: *Macrodasys andamanensis* Rao, 1993; *M. hexadactylus* Rao, 1970; *M. indicus*

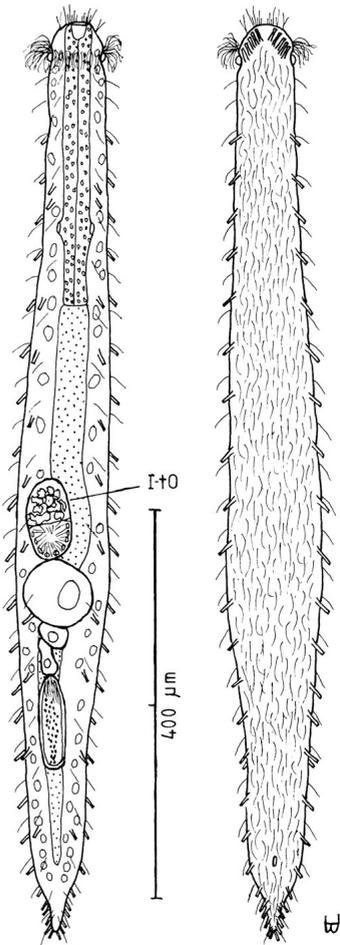


Fig. 6. *Macrodasys nobskaensis* n. sp. dorsal and ventral views of adult (Lt=942  $\mu$ m) from Nobska Beach, Massachusetts, dorsal with digestive and reproductive tracts included, ventral with adhesive tubes and locomotor ciliary bands. Symbols as in previous figures, additionally with: I+TO, idio-testicular organ.

Kutty & Nair, 1969; and *M. remanei* Boaden, 1963, along with the three here being described, all have TbL not only in the region between the rear of the pharynx and the pharyngeal pores, but also 1 or more TbL at or before the pores. These seven will be differentiated following the other two new species descriptions.

*Macrodasys nobskaensis* new species

[Msd nbsk]

Fig. 6

**Diagnosis.** Adult Lt 950  $\mu$ m; PhJIn at U31. Head with a bulb, pestle organs in a constriction at U04; trunk broadest in the mid-gut region, narrows to the anus, then more quickly to the caudum. Glands 28-31 per side. TbA 5 per side, in diagonal columns inserting directly on the body; TbL 18 per side at U12-U91, even and symmetrical, with 3 before the pharyngeal pores, 2 behind the pores, and 13 along the intestine, the last one at the anal aperture; TbD 11 per side, with 2 before the pharyngeal pores at U17/U19, and 9 even and symmetrical at U30-U88, 1 at the pharyngeal base and 8 along the intestine; TbV absent; TbP 6 per side on the caudum, the 1<sup>st</sup> separated from the others, all the same size. Locomotor ciliature: a field of sparse cilia beneath the entire body. Mouth terminal, buccal cavity cup-shaped and lightly cuticularized; prominent sub-basal pharyngeal pores; intestine narrow, circling the reproductive structures in the rear; anus at U91. Probably hermaphroditic; testes not seen; an ovoid structure at U50-U58 is glandular in front and has spermatocyte-like structures with inwardly directed tails in back; eggs develop rear to front; an elongate caudal organ occurs behind the smallest egg; frontal organ not seen.

**Description.** Adult Lt 942  $\mu$ m; LPh 293  $\mu$ m to PhJIn at U31. Body elongate as an adult, ventrally flattened, dorsally vaulted; head end slightly bulbar, bearing pestle organs in a constriction at U04; trunk enlarges gradually to the mid-intestinal region, then narrowing gradually to the anus, after which it narrows quickly to the caudum. Widths at bulb/constriction/PhJIn/mid-intestine (max.)/anus/caudal base and locations along the length of the body are as follows: 55/49/76/97/48/15  $\mu$ m at U03/U04/U31/U60/U91/U96, respectively. Epidermis unarmored, glands small, round (diam. 5-8  $\mu$ m) to ovoid (<8  $\times$  16  $\mu$ m), numbering 28-31 per side.

Adhesive tubes. TbA 5 per side (L 12-14  $\mu$ m), forming diagonal columns, which insert directly on the postoral body surface at U02-U04 and project diagonally forward. TbL 18 per side (L 8-10  $\mu$ m), symmetrically placed and regularly spaced to the rear, begin at U12 and extend to U91, with 3 before the pharyngeal pores, 2 be-

hind the pores, and 13 in the intestinal region, the last one at the anal aperture; TbD 11 per side (L 8-10  $\mu\text{m}$ ), with 2 before the pharyngeal pores at U17 and U19, and the other 9 evenly spaced and symmetrically placed from U30 to U88, one at the base of the pharynx and the other 8 in the intestinal region; TbV are absent; TbP 6 per side on the caudum, the first a bit separated from the others, all about the same size (L 8-10  $\mu\text{m}$ ).

**Ciliation.** Sensory hairs (L 5-20  $\mu\text{m}$ ) occur on either side of the mouth, and a circlet of cilia (L 16  $\mu\text{m}$ ) atop the head at U03; longer sensory hairs (L 10-16  $\mu\text{m}$ ) arise in two columns on either side of the body, lateral and dorsal, with 25 and 19 per column, respectively. Ventral locomotor ciliature forms a single field of sparse cilia beneath the entire body.

**Digestive tract.** Mouth diameter is 16  $\mu\text{m}$ ; buccal cavity is cup-shaped and is lightly cuticularized; pharynx has prominent sub-basal pharyngeal pores at U31; intestine is narrow throughout, circling around the reproductive structures to the rear; anus is at U91.

**Reproductive tract.** Testes not seen, perhaps developing after the ovigerous material, but a solitary ovoid structure, 82  $\times$  45  $\mu\text{m}$  in size, occurs at U50-U58, appearing glandular in front and to have spermatocyte-like structures with inwardly directed tails in back; eggs develop as usual from rear to front, reaching 65  $\times$  74  $\mu\text{m}$  in size; an elongate caudal organ occurs behind the smallest egg at U71-U81, having a distinct wall throughout, longitudinally striated in the front fifth and glandular in the rear four-fifths; frontal organ not seen.

**Ecology.** Occasional in frequency of occurrence (10% to 30% of samples), rare in abundance (less than 1% of a sample); littoral in very fine to very coarse, very poorly-sorted, clean morainal sand, at 0-15 cm depth MLW-MTL.

#### **Geographical distribution:**

**ANW:** North America: Massachusetts {^Nobska Beach [41°31'N/70°40'W] July 1969}.

**Remarks.** The reproductive structures of *Macrodasys nobskaensis* n. sp. are atypical, with the lack of normal testes, but the presence of a solitary ovoid body lying before the largest egg that appears to be male, and a caudal organ but no frontal organ.

**Etymology.** The species epithet is pronounced *nobskaënsis* and is named after Nobska Beach in Woods Hole, Massachusetts, where it was found.

**Taxonomic affinities.** See below.

#### *Macrodasys plurosorus* new species

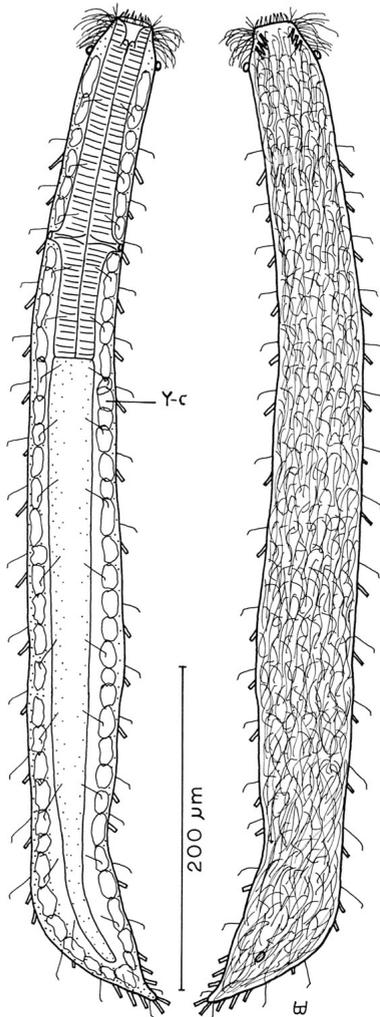
[Mcd plsr]

Fig. 7

**Diagnosis.** Subadult Lt 620  $\mu\text{m}$ ; PhJIn at U33 [adult < 750  $\mu\text{m}$ ; PhJIn ~ U28]. Head truncated, no constriction; pestle organs at U04; body broadest in the mid-gut region, narrowing quickly onto the caudum. Body has 33-36 sac-like Y-cells per side in lateral columns. TbA 3 per side, in diagonal columns inserting directly on the; TbL 14 per side at U14-U86, with 2 before the pharyngeal pores, 3 behind the pores, and 9-11 of similar size, unevenly and asymmetrical along the intestine; TbVL/TbD/TbV absent; TbP 4 per side on the caudum, 1 terminal, and 3 on each lateral margin. Locomotor ciliature: a field of sparse cilia beneath the entire body. Mouth terminal, rim bears a corona of fine hook-like projections; buccal cavity goblet-shaped and lightly cuticularized; pharynx broadest at the inconspicuous sub-basal pharyngeal pores; intestine narrows front to rear; anus at U92. Probably hermaphroditic; testes and ovaries not seen in immature specimens.

**Description.** Subadult Lt 620  $\mu\text{m}$ ; LPh 214  $\mu\text{m}$  to PhJIn at U33. Body probably medium in length as an adult, ventrally flattened, dorsally vaulted; head end truncated, with no neck constriction, but possessing pestle organs at U04; body is much the same width throughout, broadest in the mid-intestine region, and narrowing quickly onto the caudum. Widths at oral opening/pestle organs/PhJIn/ mid-intestine (max.)/beginning of TbP and locations along the length of the body are as follows: 22/41/51/58/24  $\mu\text{m}$  at U00/U04/U33/U64/U94, respectively. Epidermis unarmored, body containing 33-36 elongate sac-like Y-cells per side (12-25 by 6-8  $\mu\text{m}$ ) lying adjacent to one another in lateral columns.

**Adhesive tubes.** TbA 3 per side (L 7-8  $\mu\text{m}$ ), forming diagonal columns, which insert directly on the postoral body surface at U01-U03 and project anteriolaterally; TbL 14 per side (L 8-12  $\mu\text{m}$ ), begin at U14 and extend to U86,



**Fig. 7.** *Macrodasys plurosorus* n. sp. dorsal and ventral views of subadult (Lt=620 μm) from Gruinard Bay, Scotland, dorsal with digestive tract included, ventral with adhesive tubes and locomotor ciliary bands. Symbols as in previous figures, additionally with: Y-c, Y-cell.

with 2 before the pharyngeal pores, 3 behind the pores, and 9-11 of similar size unevenly spaced and asymmetrically inserted in the intestinal region; TbVL/TbD/TbV are absent; TbP 4 per side on the caudum, 1 terminal (L 12 μm), and 3 on each lateral margin (L 12 μm).

**Ciliation.** Sensory hairs (L 12-24 μm) are most numerous on either side of the head anterior to the pestle organs; hooked sensory hairs arise in two columns on either side of the body, lateral from U12 to U98 and dorsal from U08 to U95,

with about 15-17 per column (L 15 μm in front gradually increasing to 24 μm in the rear). Ventral locomotor ciliature forms a single field of sparse cilia beneath the entire body.

**Digestive tract.** Mouth diameter is 20 μm; mouth rim bears a corona of some 12 fine hook-like projections (L 5 μm); buccal cavity is goblet-shaped and is lightly cuticularized; pharynx broadens to and from the inconspicuous sub-basal pharyngeal pores at U22; intestine is broadest in front, narrowing gradually to the rear; anus is at U92.

**Reproductive tract.** No information, specimens being reproductively immature.

**Ecology.** Sparse in frequency of occurrence (less than 10% of samples), numerous in abundance (10-20% of a sample, often a sub-dominant); littoral in fine, medium well-sorted, sand with small amounts of detritus, at 0-15 cm depth MLW-MTL.

#### **Geographical distribution:**

**ANE:** British Isles: Scotland: Highland {^Gruinard Bay [sdom] {57°51'N/05°28'W} {OS Loc. NG-9490} July 1978 [H' Diversity Index = 3.87, Based On S = 23, N = 139]}.

**Remarks.** The only specimens of *Macrodasys plurosorus* n. sp. found were subadults; adults can be expected to differ in being proportionately larger in all dimensions, reaching a length of perhaps 700-750 μm with the intestinal region growing more than the pharyngeal, so that the PhJIn will tend to shift to lower U-numbers, perhaps U28-U30; the body also will have additional sensory hairs, lateral Y-cells and adhesive tubes. In the main, the eidostic pattern seen here is not expected to change; a mature adult will be recognizable as belonging to this species. The columns of Y-cells are not to be confused with the blistering that occurs when animals are subjected to MgCl<sub>2</sub> for periods in excess of 10-15 min. The specimens examined were in the best of health and the cells appeared to be a true morphological feature of the species.

**Etymology.** The species is named after the lateral columns of multiple sac-like Y-cells. They remind one of the vacuolated glands that were observed by Clausen (2000, p. 378, fig. 19) in a solitary living specimen that defied classification to genus.

**Taxonomic affinities.** All four previously described species lack TbD. *M. andamanensis* (Rao 1993) has but 2 TbL per side in the pharyngeal region, 1 at and 1 behind the pharyngeal pores; TbA form arcs, the tail is long and segmented, and the reproductive system has all of the typical features, though in detail they are unique. *Macrodasys indicus* (Kutty & Nair 1969) has only 14 TbL per side that insert all along its body length, with 7 in the pharyngeal region, probably 6 before and 1 behind the pores; TbA form diagonals, there is no tail, and the reproductive anatomy while atypical is shared with *M. hexadactylus* (Rao 1970) and *M. remanei* (Boaden 1963). Two species, *Macrodasys hexadactylus* and *M. remanei* share another feature, both having Seitenfüsschen (elongate tube sets of unequal length that are fused at their bases) just before the pharyngeal pores, unique thus far within the genus. *Macrodasys hexadactylus* has basal pores, with 4 TbL per side before and none behind the pores in the pharyngeal region; TbA form arcs, the tail is long but unsegmented. *Macrodasys remanei* has sub-basal pores (less basal in my specimens than that figured by Boaden (1963, Fig. 8)), with 8-10 TbL per side in the pharyngeal region, all before the pharyngeal pores according to Boaden (all but 2 before the pores in my specimens); TbA form arcs, the tail is short, unsegmented and flap-like. Of the three new species, *Macrodasys celticus*, *M. nobskaensis*, and *M. plurosorus*, all have TbA forming diagonals: *M. celticus* has 3 TbL per side before and 2 after the pores, 2 TbD per side before and 1 after the pores. *Macrodasys nobskaensis* also has 3 TbL per side before and 2 after the pores, 2 TbD per side before and none after the pores. *Macrodasys plurosorus* has 2 TbL per side before and 3 after the pores, but lacks TbD.

Family Planodasyidae Rao & Clausen, 1970  
Genus *Crasiella* Clausen, 1968

***Crasiella oceanica* d'Hondt, 1974**  
[Crs oncn]

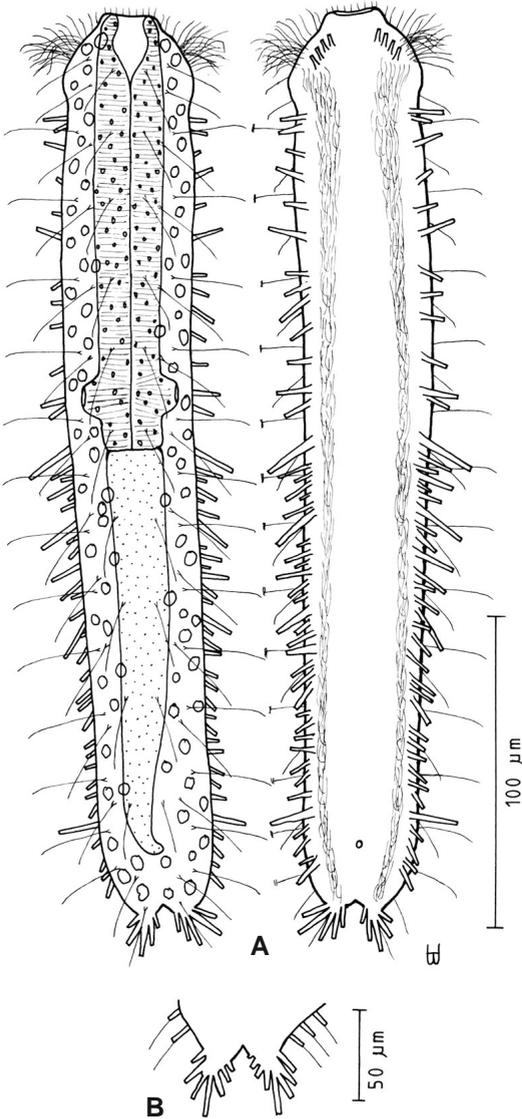
*Crasiella oceanica* of d'Hondt (1970, p. 8). – **no-men nudum.**

*Crasiella oceanica* d'Hondt, 1974: pp. 677-679; fig. 1. – **new species.**

*Crasiella oceanica* d'Hondt, 1974. Present paper (Fig. 8). – **redescription.**

**Diagnosis.** Adult Lt 800  $\mu\text{m}$ ; PhJIn at U37 (subadult [SAd] shown in fig. 8: Lt 300  $\mu\text{m}$ ; PhJIn at U46). Head trapezoidal, with plural development; sensory pits and ciliary tufts absent; trunk narrows from pharyngeal pores to anus (adult mid-trunk W = 80  $\mu\text{m}$ ), then more quickly to base of caudum (adult caudal base W = 41  $\mu\text{m}$ ); caudal lobes paired, not fleshy, joining medially at an angle; caudum indents medially to the caudal base at U92. Glands 150-200 per side in an adult (42-45 in SAd). TbA of unknown number in adult (4 per side in SAd) form diagonal column, inserting directly on the body; TbL ca. 25 per side in adults, each tipped with a cilium [d'Hondt], extending from the TbA nearly to the caudum (43 ps in SAd, lacking the ciliary tip, with 5 of these in the fore-pharyngeal region, 9 in the rear-pharyngeal region, with 2 in the post-anal region, and the remainder along the intestine; tubes are dissimilar in length and irregularly spaced, all being independent of sensory cilia); TbD/TbV absent; TbP 7-8 on each adult caudal lobe (5 in SAd), the apical 2 tubes on each side being the longest, and the number in the medial margin exceeding that of the lateral margin, by 3-4 to 2 (2 to 1 in SAd). Locomotor ciliature: 2 narrow longitudinal bands (in SAd) run separately from the TbA to the caudum. Mouth terminal, rim bears tiny hairs, but no hook-like projections; buccal cavity conical, lightly cuticularized; pharynx rust-colored, with prominent basal pharyngeal knobs; broad straight foregut leads to narrow sinuous hindgut, becoming more and more sinuous with maturity; anus ventral (at U89 in SAd). Probably hermaphroditic; an oval caudal organ occurs laterally in the posterior trunk region of the adult, probably on the left side; no other information is available.

**Description.** Adult Lt 800  $\mu\text{m}$ ; LPh 295  $\mu\text{m}$  to the PhJIn at U37 (for the subadult [SAd] that is shown in fig. 8: Lt 300  $\mu\text{m}$ ; LPh 138  $\mu\text{m}$  to the PhJIn at U46). Head trapezoidal, with slight plural development, behind which the pharyngeal region expands slightly; the "head" lacks lateral sensory pits and ciliary tufts that arise from them; trunk tapers gradually to the level of the anus, with an adult trunk width of 80  $\mu\text{m}$  in the midintestinal region, after which it narrows quickly to the base of the caudum, 41  $\mu\text{m}$  in width; caudal lobes paired, but not fleshy, joining one another medially at a distinct angle; caudum indents medially to the level of the caudal base at U92. (Widths of



**Fig. 8.** *Crasiella oceanica* d'Hondt, 1974. **A.** dorsal and ventral views of subadult (Lt=300 µm) from Trezen ar Skoden, France, dorsal with digestive tract included, ventral with adhesive tubes and locomotor ciliary bands. **B.** original schematic drawing by d'Hondt of adult caudum of a specimen from Ile de Batz, France. A and B are rendered at the same scale, though having different scale bars.

pluria/trunk (max., min.)/caudum (max., min.) and locations along the length of the body in SAd are as follows: 42/39 to 42/25, 18 µm at U07/U20 to U25/U95, respectively.) Epidermis unarmored, glands are small and numerous, 150-200 per side

in an adult (42-45 in SAd), forming two columns on either side.

**Adhesive tubes.** TbA with paired diagonal columns, of unknown adult tube number and disposition (4 per side in SAd, each 4 µm in length, located from U04 to U06), tubes inserting directly on the post-oral body surface; TbL in adults have ca. 25 per side, each tipped with a cilium [d'Hondt], beginning just behind the TbA series and extending nearly to the caudum (43 per side in SAd, lacking the ciliary tip, 5 of these following a small gap occurring rearward in the fore-pharyngeal region, being continuous with 9 in the rear-pharyngeal region, with 2 in the post-anal region, and the remainder in the intestinal region; of very dissimilar length and irregular spacing, all being independent of sensory cilia); TbD/TbV are absent; TbP 7-8 on each adult caudal lobe (5 in SAd), with an angular surface separating the two groups medially, the apical 2 tubes on each side being the longest, <13 µm (<10 µm in SAd), and those of the medial margin exceeding in number those of the lateral margin, by 3-4 to 2 (2 to 1 in SAd).

**Ciliation.** Sensory hairs arise in three rows all along the body sides, two dorsolateral and one dorsal, but they are most numerous at the front of the head. Locomotor ciliation forms two narrow longitudinal bands (in SAd) that run separately from just behind the TbA to the caudum, at U95; they diverge most from one another beneath the cephalic bulb where they are broadest and in the midtrunk region.

**Digestive tract.** Buccal cavity is lightly cuticularized, conical but with a narrowed mouth (diameter is 10 µm in SAd), the mouth rim bearing numerous tiny hairs, 2-3 µm in length, but no corona of hook-like projections; pharynx rust-colored, with prominent basal pharyngeal knobs (U39-U43 in SAd); intestine has a broad straight foregut and narrow, sinuous hindgut, becoming more and more sinuous with maturity; foregut intensely colored in adults; anus ventral (at U89 in SAd).

**Reproductive tract.** An oval caudal organ is located laterally in the posterior trunk region of the adult, probably on the left side; no other information is available.

**Ecology.** Sparse in frequency of occurrence (less than 10 % of samples), rare in abundance (less than 1 % of a sample); littoral in coarse poorly sorted sand with shell and small to moderate

amounts of organic detritus, at 10-20 cm depth, ELW-MLW; sublittoral in very poorly sorted shell hash, at 50 m water depth.

#### Geographical Distribution:

ANE: Europe: France: Brittany {<sup>^</sup>lle De Batz [48°44'N/04°00'W], Trezen Ar Skoden}.

**Remarks.** The terminal sensory hairs, which d'Hondt (1974) found on TbL of *Crasiella oceanica*, were not present in my specimens. I have rendered d'Hondt's figure of the adult caudum (the only part he figured) so as to be at the same scale as the redescribed SAD, while retaining his scale bar (note differences in scale bars for the two figures). This species may have to be redescribed yet again when adult specimens are seen again and its morphology can be figured in total.

**Taxonomic affinities.** There are four species currently in the genus *Crasiella*: *C. diplura* Clausen, 1968, *C. indica* Rao, 1981, *C. oceanica* d'Hondt, 1974; and *C. pacifica* Schmidt, 1974. *C. oceanica* is the only species in the genus that has a trapezoidally inflated anterior end, with lateral pluria, rather than having a constricted, a rounded or a blunt fore end. Only *Crasiella oceanica* (d'Hondt 1974) has TbA in diagonal rows, lacks cephalic ciliary sensory pits, and has caudal lobes that are joined at their bases rather than being separated by a gap.

#### *Crasiella azorensis* new species

[Crs azor]

Fig. 9

**Diagnosis.** Subadult Lt 285  $\mu$ m; PhJIn at U43 [adult <500-600  $\mu$ m; PhJIn ~U35]. Head has an ovoid muzzle without dense ciliation; cephalic bulb lies behind the buccal cavity; sensory pits and ciliary tufts absent; trunk narrow throughout; caudal lobes paired, minute and not fleshy, separated from one another by a flattened median border, indenting medially to U95. Glands 60-70 per side. TbA 5 per side form longitudinal columns that insert directly on the body at U-6-U16; TbVL 8 per side at U26-U82, with 1 at the rear of the fore-pharyngeal region, 1 at the rear of the hind-pharyngeal region, and 6 of similar size but irregularly spaced along the intestine, and none in the lateral postanal region; TbL/TbD/TbV absent; TbP 3 per side on the caudum,

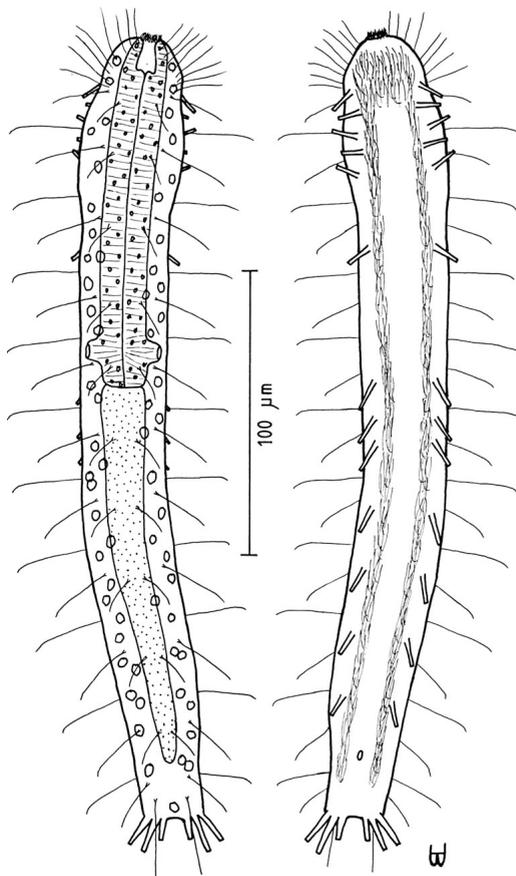


Fig. 9. *Crasiella azorensis* n. sp. dorsal and ventral views of subadult (Lt=285  $\mu$ m) from Porto Pim, Faial, Azore Islands, dorsal with digestive tract included, ventral with adhesive tubes and locomotor ciliary bands.

2 terminal, and 1 shorter tube on the inner margin. Locomotor ciliation: a single field in the muzzle region, separating into 2 bands that parallel one another back to the caudal base. Mouth terminal, rim bears hook-like projections; buccal cavity a truncated cone, lightly cuticularized; pharynx is rust-colored, with prominent basal pharyngeal knobs; intestine narrows gradually front to rear; anus at U87. Probably hermaphroditic; testes and ovaries not seen in immature specimens.

**Description.** Subadult Lt 285  $\mu$ m; LPh 123  $\mu$ m to PhJIn at U43. Body probably medium in length as an adult, ventrally flattened, dorsally vaulted; head end with an ovoid muzzle that is not surrounded by dense ciliation; head slightly swollen into a cephalic bulb behind the region of the buccal

cavity at U07-U22; the “head” lacks lateral sensory pits and ciliary tufts that arise from them; trunk narrow throughout; caudal lobes paired, minute and not fleshy, separated from one another by a flattened median border, indenting medially to U95. Widths of muzzle (max.)/ fore- and rear pharyngeal regions (max., min.)/ mid-body (max.)/caudal base (min.) and locations along the length of the body are as follows: 28/36 to 30/26/21  $\mu\text{m}$  at U07/U14 to U23/U50/U95, respectively. Epidermis unarmored, containing 60-70 glands per side (2-5  $\mu\text{m}$  diam.), scattered in lateral and dorsal columns.

Adhesive tubes. TbA 5 per side (L 12  $\mu\text{m}$ ), forming longitudinal columns, which insert directly on the postoral body surface at U06-U16 and project laterally; TbVL 8 per side (L 8-10  $\mu\text{m}$ ), begin at U26 and extend to U82, with 1 at the rear of the fore-pharyngeal region at U26, 1 at the rear of the hind-pharyngeal region at U40, and 6 of similar size but irregularly spaced along the intestinal region, and none in the lateral postanal region; TbL/TbD/TbV are absent; TbP 3 per side on the caudum, 2 terminal (L 12  $\mu\text{m}$ ), and 1 on the inner margin (L 7  $\mu\text{m}$ ), with a flat surface of 5-6  $\mu\text{m}$  separating the two groups medially.

Ciliation. Sensory hairs are most numerous at the front of the head, others often hooked arise in three columns along each side of the body, one lateral (L 23-26  $\mu\text{m}$ ), a one dorsolateral (L 21-24  $\mu\text{m}$ ) and one dorsal (L 8-10  $\mu\text{m}$ ), numbering 10-11 each. Ventral locomotor ciliation forms a single field in the constricted peribuccal muzzle region, separates into paired bands that parallel one another back to the caudal base, at U90, just behind the anus.

Digestive tract. Mouth diameter is 6  $\mu\text{m}$ ; mouth rim bears a corona of some 20 fine hook-like projections (L 2  $\mu\text{m}$ ); buccal cavity expands slightly from mouth to base and is lightly cuticularized; pharynx is rust-colored, with prominent basal pharyngeal knobs at U37-U40; intestine is broadest in front, narrowing gradually to the rear; anus is at U87.

Reproductive tract. No information, specimens being reproductively immature.

**Ecology.** Occasional in frequency of occurrence (10-30 % of samples), rare in abundance (less than 1 % of a sample); littoral in fine to medium, well-sorted, sand with small amounts of detritus, at 0-15 cm depth MLW-MTL.

**Geographical distribution:**

ANE: Europe: Portugal: Azore Islands: {Faial: ^Porto Pim (38°30'N/28°17'W) May 1989}.

**Remarks.** The only specimen of *Crasiella azorensis* n. sp. found was a subadult; the adult can be expected to differ in being proportionately larger in all dimensions, reaching a length of perhaps 500-600  $\mu\text{m}$  with the intestinal region growing more than the pharyngeal, so that the PhJIn will tend to shift to lower U-numbers, perhaps U35; the body also will have additional sensory hairs and adhesive tubes, at least in the TbVL and TbP series; and the TbP will likely arise from better developed lobes. In the main, the eidostic pattern seen here is not expected to change; a mature adult will be recognizable as belonging to this species.

**Etymology.** The species is named after the Portuguese Azore Islands in which it was found.

**Taxonomic affinities.** To the four species of *Crasiella* mentioned in the previous account can be added a fifth: *Crasiella azorensis* n. sp. This is the only species in the genus with an anterior muzzle, its cephalic bulb being sub-terminal; this condition contrasts with those having a rounded, a bluntly flattened, or a terminally inflated front end. Only *Crasiella azorensis* lacks both cephalic ciliary sensory pits and pluria, while having TbA in longitudinal columns, the tubes projecting laterally, having TbVL in such a pattern, and having miniscule caudal lobes that are separated by a flattened border of the posterior trunk.

Family Thaumastodermatidae Remane, 1927

Subfamily Diplodasyinae Ruppert, 1978

Genus *Acanthodasys* Remane, 1927

*Acanthodasys algarvense* new species

[Acd algv]

Fig. 10

**Diagnosis.** Subadult Lt 580  $\mu\text{m}$ ; PhJIn at U38 [adult <700-800  $\mu\text{m}$ ; PhJIn ~U32]. Head end nearly squared off; trunk narrows over its length, with a slight bulge behind the anus and a rounded caudum. Epidermis has small unianeres, smaller ventrally (L 6  $\mu\text{m}$ ) than dorsally (L 8  $\mu\text{m}$ ), with no intervening cuticular elements; glands 35-40 per side, most dense behind the anus. TbA 1 per side, inserting directly on the body, project forward;

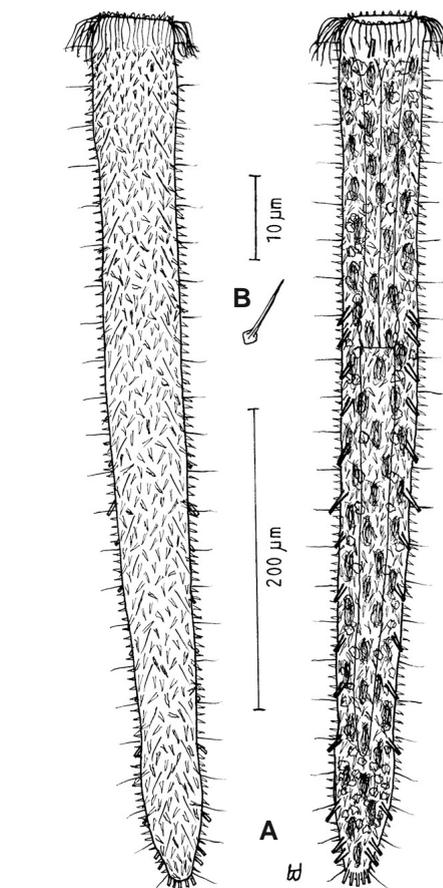
TbVL 14 per side at U33-U95, with 2 at the rear of the pharynx, and 9 of similar size and spacing along the intestine, the last 3 being in the postanal region; TbL/TbD/TbV absent; TbP 5 smaller, but of similar size to one another, occur on the rounded rear of the caudum. Locomotor ciliature: a field of ciliary patches, interspersed with the ventral uniancres. Mouth terminal, as broad as the fore end of the body, rim bears elongate cilia that flow to the rear; non-cuticularized buccal cavity narrows quickly; narrow pharynx has inconspicuous basal pharyngeal pores; intestine narrowing gradually fore to aft; anus at U87. Probably hermaphroditic; testes and ovaries not seen in immature specimens.

**Description.** Subadult Lt 580  $\mu\text{m}$ ; LPh 221  $\mu\text{m}$  to PhJIn at U38. Body probably medium in length as an adult, ventrally flattened, dorsally vaulted; head end nearly squared off; trunk narrows gradually throughout its length, with a slight bulge behind the anus and a rounded caudum. Widths at and just behind mouth /PhJIn/anus/bulge/caudum and locations along the length of the body are as follows: 53,56/50/37,40/15  $\mu\text{m}$  at U00,U01/U38/U84,U89/U98, respectively. Epidermis is covered with small uniancres, smaller ventrally (L 6  $\mu\text{m}$ ) than dorsally (L 8  $\mu\text{m}$ ), with no intervening cuticular elements such as simple scales; glands 35-40 per side (4-6  $\mu\text{m}$  diam.) are scattered in lateral and dorsal columns, most densely clustered behind the anus.

**Adhesive tubes.** TbA 1 per side (L 10  $\mu\text{m}$ ), inserting directly on the postoral body surface at U05 and project forward; TbVL 14 per side (L 12-18  $\mu\text{m}$ ), begin at U33 and extend to U95, with 2 near one another at the rear of the pharynx, and 12 of similar size and spacing in the intestinal region, except for the last 2 which again lie near one another, the last 3 of the 12 being in the lateral postanal region; TbL/TbD/TbV are absent; TbP 5 smaller, but of similar size to one another, occur on the rounded rear of the caudum.

**Ciliation.** Mouth rim bears a corona of elongate cilia (L 24  $\mu\text{m}$ ) that flow to the rear; sensory hairs arise in two columns on either side of the body (L 24  $\mu\text{m}$ ), one lateral and one dorsal, numbering 22-23 each. Ventral locomotor ciliature forms a field of ciliary patches (cilia L 12  $\mu\text{m}$ ), interspersed with the ventral uniancres.

**Digestive tract.** Mouth terminal, as broad as the fore end of the body; non-cuticularized buccal cavity narrows quickly; narrow pharynx has



**Fig. 10.** *Acanthodasys algarvensis* n. sp. **A.** dorsal and ventral views of subadult (Lt=580  $\mu\text{m}$ ) from Belliche, Portugal, dorsal with uniancrous surface, ventral with digestive tract, adhesive tubes and uniancrous surface with locomotor ciliary patches. **B.** dorsal uniancre, with a separate scale bar.

inconspicuous basal pharyngeal pores; intestine is broadest in front, narrowing gradually to the rear; anus is at U87.

**Reproductive tract.** No information, specimens being reproductively immature.

**Ecology.** Sparse in frequency of occurrence (less than 10% of samples), scarce in abundance (3-5 % of a sample); littoral in fine to medium, well-sorted, clean sand, at 0-15 cm depth MLW-MTL.

#### **Geographical distribution:**

**ANE:** Europe: Portugal: Algarve {^Belliche {37°01'N/08°57'W} September 1988}.

**Remarks.** The only specimens of *Acanthodasys algarvensis* n. sp. found were subadults; the adult can be expected to differ in being proportionately larger in all dimensions, reaching a length of perhaps 700-800  $\mu\text{m}$  with the intestinal region growing more than the pharyngeal, so that the PhJIn will tend to shift to lower U-numbers, perhaps U32; the body also will have additional sensory hairs and adhesive tubes, at least in the TbVL and perhaps the TbP series. In the main, the eidostic pattern seen here is not expected to change; a mature adult will be recognizable as belonging to this species.

**Etymology.** The species is named after the Portuguese region where the beach in which it was found was located.

**Taxonomic affinities.** There are five described species of *Acanthodasys*: *A. aculeatus* Remane, 1927; *A. arcassonensis* Kisielewski, 1987; *A. fibrosus* Clausen, 2004; *A. lineatus* Clausen, 2000; and *A. silvulus* Evans, 1992. Clausen's key to species of the genus (2004: p. 141) is most helpful. Five additional species have been proposed by Ruppert (1978b), three with collection information and some data: *Acanthodasys tetranchyrodermatoides* [p. 94; fig. 1b,f], *A. thrinax* [pp. 94, 98; figs. 7, 9a,b], and *A. vermiformis* [pp. 94, 105; fig. 12a-d, 13, 14a-c], and two that are just names (p. 113): *A. diplodasyoides* and *A. platydasyoides*. The first three of Ruppert's names do not fulfill the requirements for publication under the ICZN, and the last two are clearly *nomen nuda*. To those described is here added another species: *Acanthodasys algarvensis* n. sp., which is the only species, except perhaps *A. tetranchyrodermatoides*, to have a rounded rather than a furcated caudum; *A. algarvensis*, along with *A. silvulus* (Evans 1992), alone have but a single TbA on each side; but while *A. algarvensis* has small uniancres above and below, *A. silvulus* has small uniancres above but not below, neither species having simple scales between the ancres.

*Acanthodasys carolinensis* new species

[Acd crln]

Fig. 11

**Diagnosis.** Subadult Lt 1060  $\mu\text{m}$ ; PhJIn at U32 [adult < 1200  $\mu\text{m}$ ; PhJIn ~ U30]. Head end nearly squared off; slight expansion behind the mouth;

trunk narrows over its length, ending in short, naked pedicles, with a concave margin that indents medially to U97. Epidermis bears medium uniancres, smaller ventrally (L 10  $\mu\text{m}$ ) than dorsally (L 12  $\mu\text{m}$ ), with no intervening cuticular elements; glands 20 per side are scattered irregularly along the body. TbA 5 per side form columnar arcs, inserting directly on the body; TbVL 10-11 per side, with 1 near the rear of the pharynx, 9-10 of diminishing size and irregular spacing along the intestine, but none in the postanal region; TbL/TbD/TbV absent; TbP 3 per pedicle, forming the typical thaumastodermatid pattern of two terminal 'fingers' that are fused at their bases and a smaller interior 'thumb', but without a cirratum inserting from between the 'fingers'. Locomotor ciliature: forms a field of ciliary patches, interspersed with the ventral uniancres. Mouth terminal, as broad as the fore end of the body, scalloped mouth bears short hairs, with elongate cilia laterally flowing to the rear; non-cuticularized buccal cavity narrows quickly; narrow pharynx has inconspicuous basal pharyngeal pores; intestine narrows gradually fore to aft; anus at U95. Probably hermaphroditic; testes and ovaries not seen in immature specimens.

**Description.** Subadult Lt 1060  $\mu\text{m}$ ; LPh 351  $\mu\text{m}$  to PhJIn at U32. Body elongate, ventrally flattened, dorsally vaulted; head end nearly squared off; trunk narrows gradually behind the mouth, then expands slightly and then narrows throughout the rest of its length, ending in pedicles typical for the genus, short (L 34  $\mu\text{m}$ ), naked, with a concave margin separating the two that indents medially to U97. Widths at the mouth, the expansion, constriction, and expansion /PhJIn/anus/caudal base and locations along the length of the body are as follows: 50,56,50,59/50/37,40/15  $\mu\text{m}$  at U00,U01,U04,U08/U38/U84,U89/U98, respectively. Epidermis covered with medium sized uniancres, smaller ventrally (L 10  $\mu\text{m}$ ) than dorsally (L 12  $\mu\text{m}$ ), with no intervening cuticular elements such as simple scales; glands 20 per side (6-8  $\mu\text{m}$  diam.) are scattered irregularly in lateral columns along the length of the body.

Adhesive tubes. TbA 5 per side (L 10  $\mu\text{m}$  in front, 20  $\mu\text{m}$  behind), forming a broad arc on each side, projecting anteriorly to laterally and inserting directly on the postoral body surface at U02-U08; TbVL 10-11 per side (L 16-32  $\mu\text{m}$ ), begin at U26 and extend to U93, with 1 located toward the rear of the pharynx, 9-10 of diminishing size

and somewhat irregular spacing in the intestinal region, and none in the lateral postanal region; TbL/TbD/TbV are absent; TbP 3 per side of the pediculated caudum forming the typical thaumastodermatid pattern of two terminal 'fingers' that are fused at their bases and an interior 'thumb' (L terminal tubes 12 and 17  $\mu\text{m}$ , L tube on the inner margin 12  $\mu\text{m}$ ), but without a cirratum inserting from between the 'fingers'; a concave margin separates the two pedicles medially.

**Ciliation.** Scalloping of mouth rim bears short hairs (L 4  $\mu\text{m}$ ) and a partial corona of elongate cilia (L 24  $\mu\text{m}$ ) that flow to the rear, but are absent on the ventral surface; sensory hairs arise in a lateral column on either side of the body (L 18-24  $\mu\text{m}$ ), numbering 10 each. Ventral locomotor ciliature forms a field of patches of cilia (L 12  $\mu\text{m}$ ), interspersed with the ventral uniancres.

**Digestive tract.** Mouth terminal, as broad as the fore end of the body, diameter is 48  $\mu\text{m}$ ; mouth rim is lightly scalloped; non-cuticularized buccal cavity narrows quickly; narrow pharynx has inconspicuous basal pharyngeal pores; intestine is broadest in front, narrowing gradually to the rear; anus is at U95.

**Reproductive tract.** No information, specimens being reproductively immature.

**Ecology.** Sparse in frequency of occurrence (less than 10 % of samples), scarce in abundance (3-5 % of a sample); littoral in a sand flat of medium-fine, medium-well sorted, clean sand at 0-15 cm depth LWN-LWE.

#### Geographical distribution:

ANW: North America: South Carolina { $\wedge$ Debidue {33 $^{\circ}$ 20'N/79 $^{\circ}$ 10'W} June 1977}.

**Remarks.** The only specimens of *Acanthodasys carolinensis* n. sp. found were subadults; the adult can be expected to differ in being proportionately larger in all dimensions, reaching a length of perhaps 1200  $\mu\text{m}$  with the intestinal region growing more than the pharyngeal, so that the PhJIn will tend to shift to lower U-numbers, perhaps U30; the body also will have additional sensory hairs and TbVL adhesive tubes. In the main, the eidostic pattern seen here is not expected to change; a mature adult will be recognizable as belonging to this species.

**Etymology.** The species is named after the region of the Carolinas in which it was found.

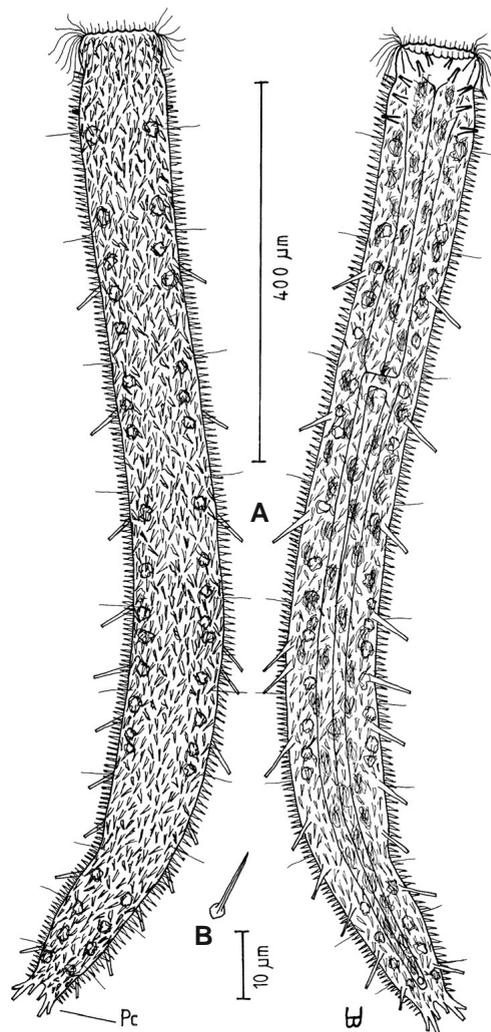


Fig. 11. *Acanthodasys carolinensis* n. sp. A. dorsal and ventral views of subadult (Lt=1060  $\mu\text{m}$ ) from Debidue, South Carolina, dorsal with uniancrous surface, ventral with digestive tract, adhesive tubes and uniancrous surface with locomotor ciliary patches. B. dorsal uniancre, with a separate scale bar. Symbols as in previous figures, additionally with: Pc, caudal pedicle.

**Taxonomic affinities.** To the five published species, along with the above described *Acanthodasys algarvense* n. sp., is now added a second new species: *Acanthodasys carolinensis* n. sp., which like the first five has a pediculated caudum. *Acanthodasys aculeatus* (Remane 1927) and *A. arcassonensis* (Kisielewski 1978) both have spineless scales amid the uniancres and TbA that form paired transverse arcs; spineless scales are lacking in *A. algarvense*,

*A. carolinensis*, *A. fibrosus* (Clausen 2000), *A. lineatus* (Clausen 2000), and *A. silvulus* (Evans 1992). TbA 1 per side occurs in *Acanthodasys algarvensis* and *A. silvulus*, the latter alone has tiny dorsal uniancres, lacks ventral uniancres, and with *A. fibrosus* has paired locomotor ciliary bands. *Acanthodasys fibrosus* and *A. lineatus* alone lack TbL in the pharyngeal region; they also have clustered TbA, whereas *A. carolinensis* has a prominent TbL per side in the pharyngeal region and TbA that form paired longitudinal arcs.

Subfamily Thaumastodermatinae Ruppert, 1978

### Genus *Platydasys* Remane, 1927

is preoccupied by *Platydasys* Butler, 1892, a member of the Lepidopteran insect order Noctuoidea, family Noctuidae, a synonym of *Callopietria* Hubner; hence a new genus name is proposed:

### Genus *Oregodasys* gen. nov.

**Etymology.** *orego*, Gr. stretched, spread out; *dasys*, Gr. hairy, shaggy (originally in *Hemidasys* Claparède, 1867, the first use of the term, referring to the ventral locomotor ciliation, which was only half hairy, the ciliary field being restricted to the front half of the body, now a common part of generic names in Gastrotricha, Macrotrichida.)

### *Oregodasys kurnowensis* new genus, new species

[Ord krnw]

Fig. 12

*Platydasys* sp. A of Hummon & Warwick, 1990: p. 522.

**Diagnosis.** Adult Lt 380 µm; PhJIn at U48. Head with broad ovoid mouth, oral hood scalloped, with reinforcing papillae, but lacking either pestle organs or ciliated sensory pits; neck narrows somewhat, then swells in the mid-trunk regions, before narrowing to a broadly ovate caudum, lacking lobes or pedicles. Laterally at U12 and U14 are two sensory structures, a protuberance with an elongated tactile cilium and a heavy tactile bristle that emerges from a conical base. Epidermis has warts, 20 in the oral hood, about 60 scattered along the pharynx and another 18-20 along the

trunk. TbA 32-34 bordering the ventral rim, with a single row of 8-9 tubes medially and clusters of 11-12 laterally, all inserting directly on the body at U13-U19; TbVL 5-6 per side at U47-U93, of similar size but irregularly spaced along the intestine TbV 52-54 per side, at U22-U95, of similar size and closely spaced, with about 5 of these in the post-anal region; TbL/TbD absent; TbP 20, closely spaced, bordering the caudal surface. Locomotor ciliature: forms a transverse field behind the TbA, with a medial band that runs back to the pharyngeal pores, and two lateral bands that run the length of the body, merging behind the anus. Mouth terminal, as broad as the fore end of the body, rim bears tactile hairs; non-cuticularized buccal cavity narrows quickly; broad pharynx has inconspicuous basal pharyngeal pores at U41; intestine narrows slightly front to rear; anus at U88. Hermaphroditic; testis on the right side as seen from above, left as seen from below; vas deferens opens into the rear of the caudal organ, above the anus; female system not seen; ovate caudal organ a canted hyaline structure, containing sperm; frontal organ not seen.

**Description.** Adult Lt 370-380 µm; LPh 176 µm to PhJIn at U48. Body medium in length as an adult, ventrally flattened, dorsally vaulted; head end with broad ovoid mouth, oral hood scalloped and bearing reinforcing papillae that can be seen from above or below, but head lacking either pestle organs or ciliated sensory pits; trunk narrows somewhat behind the ventral rim, then swells in the rear pharyngeal to hindgut regions, before narrowing to a broadly ovate caudum, lacking caudal lobes or pedicles. Widths at ventral rim/PhJIn/caudal base (last TbL) and locations along the length of the body are as follows: 113/104/118/80 µm at U15/U24/U48/U93, respectively. Epidermis with warts (3-5 µm diam.), 20 in the oral hood, about 60 scattered on either side and another 18-20 that can be seen along the lateral profiles.

Adhesive tubes. TbA 32-34 bordering the ventral rim (L 8 µm), with a single row of 8-9 tubes medially that project forward and clusters of 11-12 laterally that project increasingly anteriolaterally, all inserting directly on the postoral body surface at U13-U19. TbVL 5-6 per side (L 11-13 µm), begin at U47 and extend to U93, all being of similar size but irregularly spaced in the intestinal region; TbV 52-54 per side (L 7-10 µm), begin at U22 and extend to U95, all being of similar size and closely spaced in the mid-pharyngeal

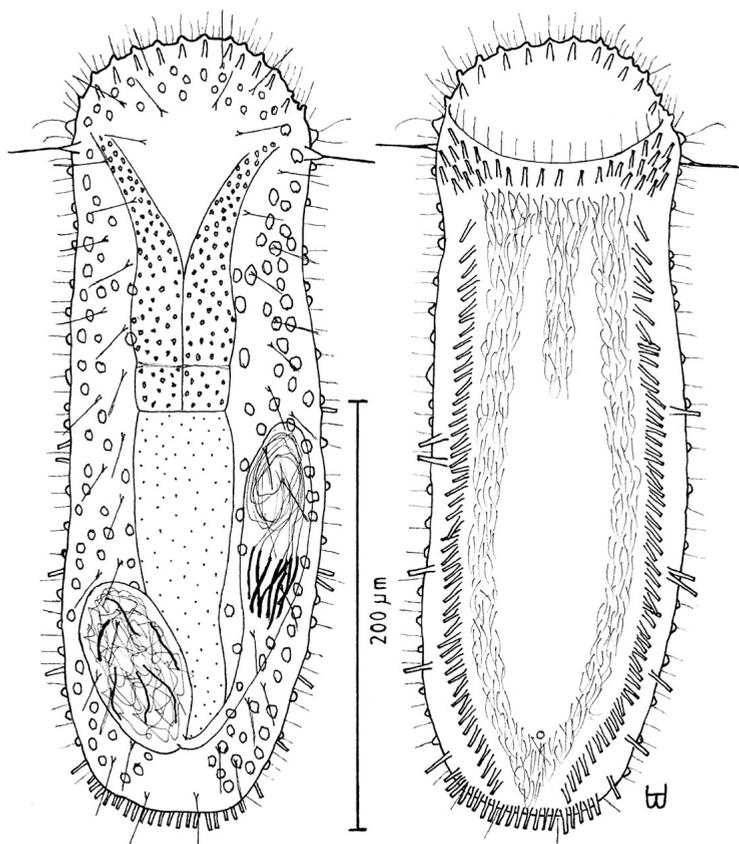


Fig. 12. *Oregodasys kurnowensis* n. sp. dorsal and ventral views of adult (Lt=380  $\mu$ m) from Pentle Bay, Tresco, Isles of Scilly, England, dorsal with digestive and reproductive tracts included, ventral with adhesive tubes and locomotor ciliary bands. Symbols as in previous figures, additionally with: Wc, cuticular wart.

and intestinal regions, with about 5 of these per side in the post-anal region; TbL/TbD are absent; TbP 20 (L 8-11  $\mu$ m), closely spaced, bordering on the caudal surface, none predominating.

**Ciliation.** Sensory hairs (L 5-12  $\mu$ m) are most numerous at the front of the oral hood, the longest arising on the outer scalloped edges; laterally at U12 and U14 are two structures, the first being a protuberance with an elongated tactile cilium (L 16  $\mu$ m) and the second being a heavy tactile bristle that emerges from a conical base (L 33  $\mu$ m); other sensory hairs arise in three columns on either side of the body, one lateral (L 6-10  $\mu$ m), one dorsolateral (L 20-24  $\mu$ m), and one dorsal (L also 20-24  $\mu$ m), numbering 30-33, 11-12, and 11-12, respectively, some appearing to insert in or beyond the warts of the lateral profile. Ventral locomotor ciliation forms a transverse field behind the TbA, with a medial band that runs back nearly

the length of the pharynx, and two lateral bands that run the length of the body, merging behind the anus.

**Digestive tract.** Mouth terminal, as broad as the fore end of the body, width 98  $\mu$ m; mouth rim bears a corona of some 30 tactile hairs (L 5-10  $\mu$ m); non-cuticularized buccal cavity narrows quickly; broad pharynx has inconspicuous basal pharyngeal pores at U41; intestine is broadest in front, narrowing slightly to the rear; anus is at U88.

**Reproductive tract.** Testis is on the right side as seen from above, left as seen from below; vas deferens appears to open into the rear of the caudal organ, above the anus; developing egg not seen; caudal organ a canted ovate hyaline structure (86  $\times$  42  $\mu$ m) that had sperm within; frontal organ not seen; sperm movement was seen in both testis and caudal organ by the spiral screwing of sperm heads (L head 26, tail 80  $\mu$ m).

**Ecology.** Occasional in frequency of occurrence (10-30 % of samples), rare in abundance (less than 1 % of a sample); littoral in very fine, medium-sorted, clean sand, at 0-15 cm depth MLW-MTL; sublittoral in fine to very coarse, very poorly sorted, sand at 8 m water depth.

**Geographical distribution:**

**ANE:** British Isles: England: Cornwall: {Coresound Buoy}, Isles Of Scilly: {Tresco: ^Pentle Bay {49°56'N/06°19'W} {OS Loc. SV-9014} May 1988}.

**Remarks.** The Coresound Buoy is probably the typical habitat for *Oregodasys kurnowensis* n. sp., but the type locality at Pentle Bay illustrates the position of the Scilly Isles as a littoral haven for what would normally be a sublittoral species (Hummon & Warwick 1990).

**Etymology.** The species is named after the ancient designation for the southwestern part of England.

**Taxonomic affinities.** With *Platydasys brachycephalus* Lévi, 1954 recently shifted to the genus *Ptychostomella* by Clausen (2004), the 10 species currently in the preoccupied genus *Platydasys* must be renamed according to the replacement genus *Oregodasys*; thus they become: *O. itoi* (Chang, Kubota & Shirayama, 2002); *O. mastigurus* (Clausen, 1965c); ^*O. maximus* (Remane, 1927); *O. ocellatus* (Clausen, 1965c); *O. pacificus* (Schmidt, 1974); *O. phacellatus* (Clausen, 1965c); *O. rarus* (Forneris, 1961); *O. ruber* (Swedmark, 1956a); *O. styliferus* (Boaden, 1965a); and *O. tentaculatus* (Swedmark, 1956a); to these is added an 11<sup>th</sup> species *Oregodasys kurnowensis*. This new species can be separated from the others, because the others either bear pestle organs: *Oregodasys maximus* (Remane 1927), tentacles: *O. tentaculatus* (Swedmark 1956a) and *O. rubber* (Swedmark 1956a), eye spots: *O. ocellatus* (Clausen 1965) and *O. ruber* (Swedmark 1956a), a deeply scalloped oral hood, the scallops being digit-like: *O. rarus* (Forneris 1961), tufts or clusters of elongate bristle-like cirri: *O. itoi* (Chang et al. 2000), *O. pacificus* (Schmidt 1974) and *O. phacellatus* (Clausen 1965), linear columns of such cirri: *P. mastigurus* (Clausen 1965), reddish body color: *O. ruber* and *O. styliferus* (Boaden 1965), or a cuticularized penis associated with the vas deferens: *O. mastigurus* and *O. styliferus*.

Genus *Pseudostomella* Swedmark, 1956

***Pseudostomella trianetra* new species**

[Pss tran]

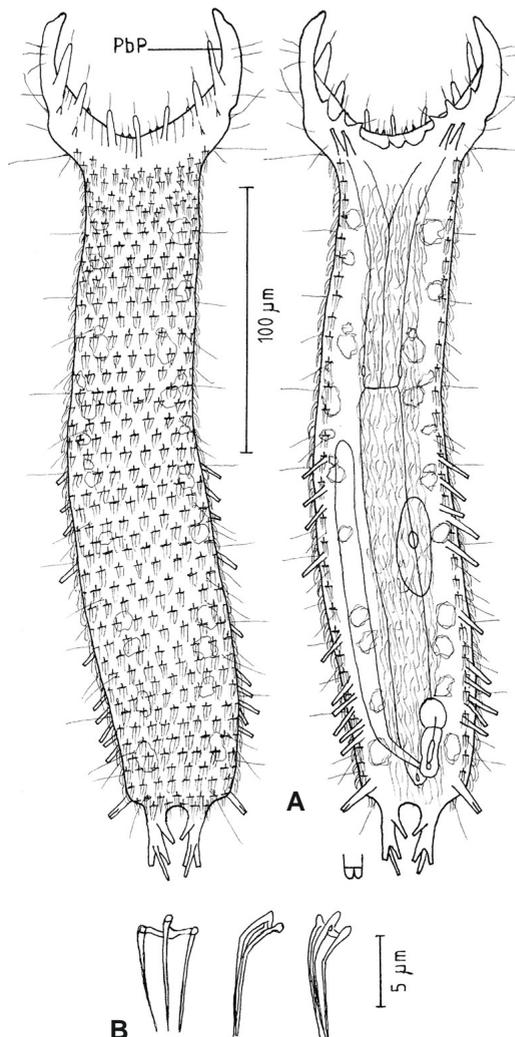
Fig. 13

**Diagnosis.** Adult Lt 480 µm; PhJIn at U34. Head end has pre-buccal palps with many sensory structures; trunk narrows slightly to the PhJIn and then expands slightly to the caudum, where the body appears to be abruptly truncated, ending in long, naked pedicles, with a concave margin that indents medially to U92. Palps swollen proximally, thinner distally, the dorsal surface overhanging the ventral slightly to form a shallow oral hood (Note: measurements down the body in this genus are made from the mid-line of the dorsal rim, not from the tips of the buccal palps); the dorsal rim has 7 hair-tipped sensory papillae (L 10-18 µm) and 5 small hair-tipped cones per side, 3 interspersed between the papillae and 2 occurring on the dorsal surface; the ventral rim has 4 hair-tipped scallops per side, the 2 larger ones being encompassed by the 2 smaller ones. Epidermis is covered by trianctres, which lack the rear base and tine that would make it a tetranctre; the forward and paired lateral tines bending sharply to the rear to parallel the cuticular surface and inclining toward one another distally; anctres occur in 46 rows of 10 anctres each. Glands 13-14 per side. TbA 2 per side, inserting directly on the body; TbVL 11-12 per side at U43-U87, none along the pharynx, all irregular in size and spacing along the intestine, with the largest being duo-gland, having a post-anal location at U87; TbL/TbD/TbV absent; TbP 3 per side on the caudal pedicles, forming the fused 'two fingers and a thumb' typical of the family, being supplemented by a blind cirrata-like structure projecting posteriodorsally from between the 'fingers'. Locomotor ciliature: a single field of transverse rows, at U06-U87. Mouth nearly terminal, as broad as the fore end of the body, non-cuticularized buccal cavity narrows quickly; pharynx has inconspicuous basal pharyngeal pores at U32; intestine similar in width throughout, narrowing just before the anus at U87. Hermaphroditic; testis is on the right side as seen from above, left as seen from below; vas deferens opens separately near the anus; developing egg is at mid-gut level on the opposite side; caudal organ is small, thick-walled, with a central canal that seems to connect in the rear with the male gonopore; frontal organ, a hyaline sphere, without sperm.

**Description.** Adult Lt 477  $\mu\text{m}$ ; LPh 97  $\mu\text{m}$  to PhJIn at U34. Body elongate as an adult, ventrally flattened, dorsally vaulted; head end has paired pre-buccal palps that bear a multitude of sensory structures; trunk narrows slightly to the PhJIn and then expands slightly to the caudum, where the body appears to be abruptly truncated; caudal pedicles paired, not fleshy, with a concave medial border, indenting medially to U92. Widths of head behind PbP (min.)/PhJIn/-mid-intestine (max.)/rear trunk before constricting/caudal base and locations along the length of the body are as follows: 45/46/53/37/23  $\mu\text{m}$  at U04/U34/U62/U91/U92, respectively. Epidermis is covered by triancres (L 10  $\mu\text{m}$ ) emerging from triancrous bases, lacking the posterior base and tine that would be present in a tetrancre, forming some 46 rows of 10 ancras each, with needle-like tines that project outward (3  $\mu\text{m}$ ) at an angle and then backwards (7  $\mu\text{m}$ ) parallel to the cuticle surface, the tines approaching one another at their tips. Glands 13-14 per side (3-9  $\mu\text{m}$  diam.) are scattered in lateral and dorsal columns.

**Pre-buccal palps.** The palps, swollen proximally, thinner and smoother distally, are symmetrical left to right, but not ventral to dorsal, the dorsal overhanging the ventral slightly to form a shallow oral hood and having different sensory structures. (Note: measurements down the body in this genus are made from the mid-line of the dorsal rim, not from the tips of the buccal palps, since they are quite mobile and sometimes are held open, most of the time as they are shown in Fig. 13, and sometimes closed.) In their relaxed condition, the palps extend 47  $\mu\text{m}$  forward from the dorsal rim, have maximal widths of 76  $\mu\text{m}$  (outside), 63  $\mu\text{m}$  (inside), and 55  $\mu\text{m}$  (at the tips). From the dorsal rim project 7 hair-tipped sensory papillae (L 10-18  $\mu\text{m}$ ) and 5 small hair-tipped cones per side, 3 interspersed between the papillae and 2 occurring on the dorsal surface. The ventral rim bears 4 hair-tipped scallops per side, the 2 larger ones being encompassed by the 2 smaller ones. Laterally on the palps and palp bases are several tactile cilia (L 7-18  $\mu\text{m}$ ) both dorsally and ventrally, some with small conical bases.

**Adhesive tubes.** TbA 2 per side (L 10  $\mu\text{m}$ ), inserting directly on the postoral body surface at U03 and projecting diagonally forward; TbVL 11-12 per side (L 9-15  $\mu\text{m}$ ), begin at U43 and extend to U87, with none in the pharyngeal region, all irregular in size and spacing in the intestinal region, the largest (L 15  $\mu\text{m}$ ) with a post-anal loca-



**Fig. 13.** *Pseudostomella triancra* n. sp. **A.** dorsal and ventral views of adult (Lt=477  $\mu\text{m}$ ) from Belliche, Portugal, dorsal with triancrous surface, ventral with digestive tract, adhesive tubes and locomotor ciliary band. **B.** triancres in various views, with a separate scale bar. Symbols as in previous figures, additionally with: **PbP**, pre-buccal palp.

tion at U87 obviously of the duo-gland type; TbL/TbD/TbV are absent; TbP 3 per side on the caudal pedicles, forming the fused 'two fingers and a thumb' typical of the family, (L terminal tubes 8  $\mu\text{m}$ , L tube on the inner margin 12  $\mu\text{m}$ ), being supplemented in this case by a blind cirrata-like structure (L 14  $\mu\text{m}$ ) that projects posteriodorsally from between the 'fingers'; a concave medial margin separates the two pedicels.

**Ciliation.** Sensory hairs arise in two columns on either side of the body, one lateral (L 10-12  $\mu\text{m}$ ) at U13-U82 and one dorsal (L 15-22  $\mu\text{m}$ ) at U06-U88, numbering 8 and 7 respectively. Ventral locomotor ciliation forms a single field of overlapping transverse rows beneath the gut, extending from U06 to the anus at U87; individual cilia are 12-15  $\mu\text{m}$  in length.

**Digestive tract.** Mouth nearly terminal, as broad as the fore end of the body, width 45  $\mu\text{m}$ ; non-cuticularized buccal cavity narrows quickly; pharynx has inconspicuous basal pharyngeal pores occur at U32; intestine is of similar width throughout, narrowing just before the anus at U87.

**Reproductive tract.** Testis is on the right side as seen from above, left as seen from below; vas deferens opens separately near the anus; developing egg is at mid-gut level on the opposite side; the one figured is small; caudal organ is thick-walled (8  $\times$  20  $\mu\text{m}$ ), with a central canal that seems to connect in the rear with the male gonopore; frontal organ, a hyaline sphere (10  $\mu\text{m}$  diam.), had no sperm within.

**Ecology.** Sparse in frequency of occurrence (less than 10 % of samples), may be prevalent in abundance (more than 30 % of a sample, usually a co-dominant or dominant); littoral in fine to medium, well-sorted, clean sand, at MLW-MTL.

**Geographical distribution:**

**ANE:** Europe: Portugal: Algarve {^Belliche [dom] [37°01'N/08°57'W] September 1988}.

**Remarks.** Unexpectedly, *Pseudostomella triancra* n. sp. was the numerically dominant gastrotrich in the collection from Belliche. Having two new species and two range extensions to the south and west indicates the importance of the Algarve as a suture zone between the North Atlantic and Mediterranean faunae, with *Heteroxenotrichula wilkiae* (Ruppert 1979) [sdom] from the north and *Tetranchyroderma papii* (Gerlach 1953) from the east.

**Etymology.** The species is named after the three tines that form the triancra.

**Taxonomic affinities.** Keys to species of this genus are available from Lee & Chang (2002, p. 213) and Hochberg (2002, p. 578). To the 13 species currently in the genus *Pseudostomella*:

*P. andamanica* Rao, 1993; *P. cataphracta* Ruppert, 1970; *P. cheraensis* Priyalakshmi, Menon & Todaro, 2007; *P. etrusca* Hummon, Todaro & Tongiorgi, 1993; *P. faroensis* Clausen, 2004; *P. indica* Rao, 1970; *P. klauserae* Hochberg, 2002; *P. koreana* Lee & Chang, 2002; *P. longifurca* Lee & Chang, 2002; *P. malayica* Renaud-Mornant, 1967; *P. megapalpatator* Hochberg, 2002; *P. plumosa* Ruppert, 1970; and ^*P. roscovita* Swedmark, 1956b, is added a 14<sup>th</sup> species *Pseudostomella triancra* n. sp. Most species have tetrancrous spines: *P. andamanica* (Rao 1993), *P. indica* (Rao 1970), *P. koreana* (Lee & Chang 2002), *P. longifurca* (Lee & Chang 2002), *P. malayica* (Renaud-Mornant 1967), and *P. roscovita* (Swedmark 1956b). A few species have pentancrous spines: *P. cataphracta* (Ruppert 1970) and *P. etrusca* (Hummon et al. 1993). Several species have a variety of different triancres: *P. faroensis* (Clausen 2004), *P. klauserae* (Hochberg 2002), *P. megapalpatator* (Hochberg 2002), and *P. plumose* (Ruppert 1970). A key to this group of species is available from Clausen (2004, p. 448). To this latter group is added the new species: *Pseudostomella triancra* n. sp. It differs from the others in the group in being a bent tetrancre with three needle-like tines that lacks the rear basal bar and its tine, whereas the other four species all have blade-like foliate tines emerging from varied bases.

Genus *Tetranchyroderma* Remane, 1926

*Tetranchyroderma gausancrum* new species

[Tet gsan]

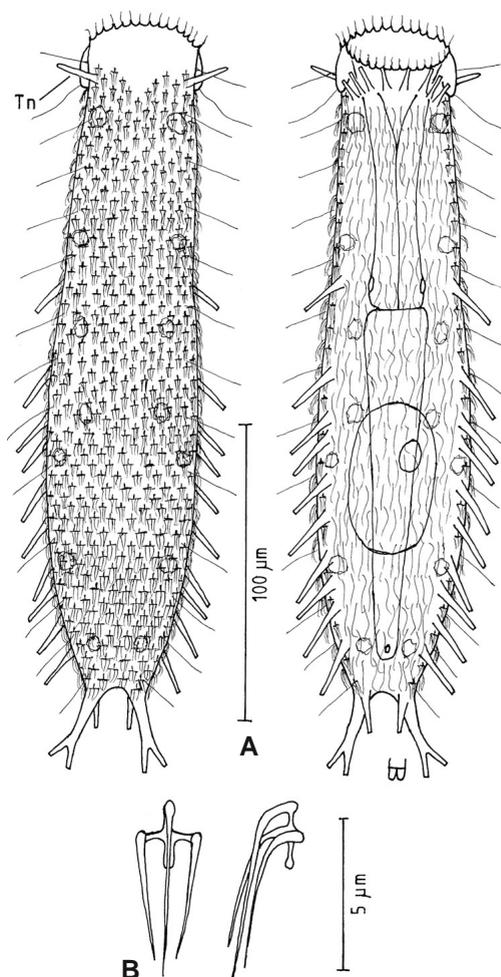
Fig. 14

**Diagnosis.** Adult Lt 275  $\mu\text{m}$ ; PhJIn at U38. Head end bears auricles and an elongate rod-shaped tentacle on either side; trunk broadest in the mid-gut region, narrowing to the caudal base; naked caudal pedicles elongate, with a concave medial border indenting to U88. Epidermis covered with triancres that emerge from tetrancrous bases, the forward and paired lateral tines bending sharply to the rear to parallel the cuticular surface and inclining toward one another distally; ancrens occur in 60-62 rows of 11 ancrens each, all of similar size, but absent from the oral hood. Glands 7 per side. TbA 4 per side, form a shallow transverse arc, tubes inserting directly on the body, the most medial separated from the 3 more lateral by a small gap; TbVL 10 per side at U32-U83, 1 at the pharyngeal pores, the others of similar size but

irregularly spaced along the intestine at U46-U83, none inserting behind the anus; TbL/TbD/TbV absent; TbP 3 per side on the elongate caudal pedicles, forming the fused 'two fingers and a thumb' typical of the family, but lacking any element inserting between the 'fingers'. Locomotor ciliation: a single field narrower than the body width at U16-U85. Mouth subterminal, as broad as the fore end of the body, non-cuticularized buccal cavity narrows quickly; pharynx broadens to the basal pharyngeal pores; intestine narrows front to rear; anus at U83. Presumably hermaphroditic, perhaps protogenous; testis not seen; developing egg lies above midgut; caudal and frontal organs not seen.

**Description.** Adult Lt 250-275  $\mu\text{m}$ ; LPh 96  $\mu\text{m}$  to PhJIn at U38. Body small to medium in length as an adult, ventrally flattened, dorsally vaulted; head end bears auricles on either side at U03-U08, and an elongate rod-shaped tentacle (L 12  $\mu\text{m}$ ) at U07; trunk broadens gradually to the midgut region, then narrows more quickly to the caudal base; caudal pedicles elongate (L 28  $\mu\text{m}$ ) naked, with a concave margin separating the two groups, indenting medially to U88. Widths at auricles/behind auricles/midgut/caudal base and locations along the length of the body are as follows: 41/35/51/20  $\mu\text{m}$  at U07/U14/U57/U88, respectively. Epidermis armored with triancres that emerge from quasi-tetrancrous bases, the forward and paired lateral tines bending sharply to the rear to parallel the cuticular surface and inclining toward one another distally (L middle tine 6  $\mu\text{m}$ , L lateral tines 5  $\mu\text{m}$ ); ancre cover dorsal and lateral surfaces in some 60-62 rows of 11 ancre each, being absent from the oral hood, but extending onto the caudal base; ancre are constant in size from one location to another. Glands 7 per side (4-5  $\mu\text{m}$  diam.) are scattered in lateral and dorsal columns.

**Adhesive tubes.** TbA 4 per side (L 12  $\mu\text{m}$ ), forming a shallow transverse arc, the tubes inserting directly on the postoral body surface at U06-U16, the most medial pointing forward, and after a small separation the three more lateral pointing obliquely forward; TbVL 10 per side (L 16-18  $\mu\text{m}$ ), begin at U32 and extend to the anus at U83, with 1 at the rear of the hind-pharyngeal region, and the others of similar size but irregularly spaced in the intestinal region at U46-U83, none inserting behind the anus; TbL/TbD/TbV are absent; TbP 3 per side on the elongate caudal



**Fig. 14.** *Tetranchyroderma gausancrum* n. sp. **A.** dorsal and ventral views of adult (Lt = 250  $\mu\text{m}$ ) from Firemore Beach, Scotland, dorsal with semi-tetrancrous surface, ventral with digestive tract, adhesive tubes and locomotor ciliary band. **B.** quasi-tetrancre, with a separate scale bar. Symbols as in previous figures, additionally with: Tn, tentacle.

pedicles, forming the fused 'two fingers and a thumb' typical of the family, (L terminal tubes 8  $\mu\text{m}$ , L tube on the inner margin 12  $\mu\text{m}$ ), but lacking any element inserting between the 'fingers'.

**Ciliation.** Short sensory hairs (L 3  $\mu\text{m}$ ) surround the entire oral opening, borne on the scallop tips, with a longer one (L 16  $\mu\text{m}$ ) on each side extending laterally and a second laterally directed vibratile cilium (L 20  $\mu\text{m}$ ) arising from the rear of the palps; other hairs (L 18  $\mu\text{m}$ ) occur regularly along the dorsolateral body surfaces, numbering

12 per side. Ventral locomotor ciliature forms a single field of transverse rows beneath the gut, extending from U16 to the anus at U85; individual cilia are 12-15 µm in length.

**Digestive tract.** Mouth subterminal, as broad as the fore end of the body, width 33 µm; non-cuticularized buccal cavity narrows quickly; pharynx broadens again to the rear and has basal pharyngeal pores at U34; intestine is broadest in front, narrowing gradually to the rear; anus is at U83.

**Reproductive tract.** Presumably hermaphroditic, perhaps protogynous; testis not seen; developing egg (30 x 50 µm) lies above the midgut; neither caudal nor frontal organs were seen.

**Ecology.** Occasional in frequency of occurrence (10-30 % of samples), rare in abundance (less than 1 % of a sample); littoral in very fine to medium fine, medium to medium-well sorted, sand with small amounts of detritus, at 0-10 cm depth MLW-MTL.

**Geographical distribution:**

**ANE:** British Isles: Scotland: Fife {Tentsmuir Sands, West Sands}, Highland {Farr, ^Firemore Beach Transect A {57°49'N/05°41'W} [OS Loc. NG-8188] November 1974 [Max. H' Diversity Index=3.56, Based On S=32, N=1485], Gruinard Bay}, Tayside {Monifieth}.

**Remarks.** The ancrs of *Tetranchyroderma gausancrum* n. sp. are unique, among described species, but those of *Pseudostomella trianra* n. sp. (above) can be considered comparable. Further, an undescribed species of *Tetranchyroderma* found in Massachusetts and North Carolina, had a diamond base and a set of bars connecting the corners within, with the needle-like tines bent as in *Tetranchyroderma gausancrum* and also approaching one another at their tips, but with no fourth tine emerging from the rear of the diamond. The variants had a square base and a rectangle base, with a set of bars connecting the corners within and four bent needle-like tines emerging and approaching one another at their tips.

**Etymology.** The species is named after the Greek: *gausos*, meaning bent and Greek: *ankyra* (L. *ancora*), meaning anchor.

**Taxonomic affinities.** *Tetranchyroderma gausancrum* n. sp. becomes the 61<sup>st</sup> described species in this genus. Its ancrs covering is unique to the

genus, there being no other with abbreviated tetrancres each with 3 bent tines; the pattern of auricles, cephalic tentacle, robust TbVL and elongate pedicles that lack any element inserting between the 'fingers' is also unparalleled.

*Tetranchyroderma interstitialis* new species

[Tet inst]

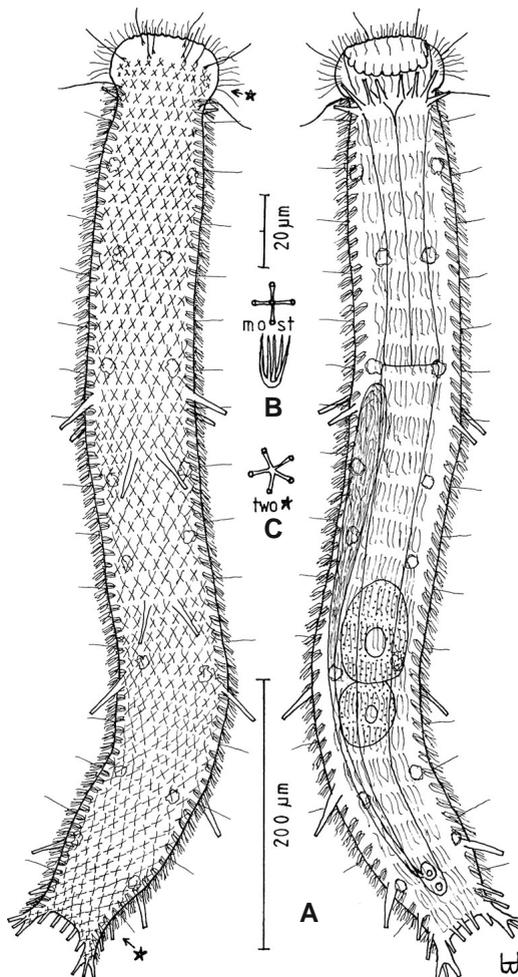
Fig. 15

**Diagnosis.** Adult Lt 710 µm; PhJIn at U35. Head end swells beside the oral opening on either side; trunk has nearly parallel sides, before narrowing to the caudal base; pedicles short, with a flattened concave margin separating the lobes, indenting medially to U96. Epidermis covered with pentancres, of similar size throughout, that emerge from crossed tetrancrous bases and lean backwards as they emerge from the body; ancrs occur in 48-50 rows of 10 ancrs each, being absent from the front of the oral hood, but extending onto the caudal lobes. Glands 8 per side. TbA 3 per side, forming a transverse row, tubes inserting directly on the body, the medial 2 pointing forward, the more lateral 1 pointing obliquely; TbVL 6 per side, 1 in the fore-pharyngeal region at U06 immediately lateral to the TbA, a second in the fore-gut region at U39, 2 in the hind-gut region at U78 and U86, and 2 located behind the anus at U93/U95; TbDL 2 per side located in the fore-gut/mid-gut regions at U37/U67; TbD 2 per side located in the fore-gut/mid-gut regions at U43/U59; TbL/TbV absent; TbP 3 per side forming the caudal pedicles, the fused 'two fingers and a thumb' typical of the family, being supplemented by a blind cirrata-like structure projecting posteriodorsally from between the 'fingers', and 3 tubes along the medial margin separating the two lobes. Locomotor ciliature: a single field narrower than the body width, at U18-U98. Mouth subterminal, nearly as broad as the fore end of the body, non-cuticularized buccal cavity narrows quickly; pharynx broadens in the rear to inconspicuous basal pharyngeal pores; intestine narrows gradually fore to aft; anus at U91. Presumably hermaphroditic; testis on right side as seen from above, left side as seen from below; vas deferens appears to open into the rear of the caudal organ, in front of the anus; eggs develop back to front, lying above the mid-gut; caudal organ is tiny, thick-walled; frontal organ not seen.

**Description.** Adult Lt 710  $\mu\text{m}$ ; LPh 246  $\mu\text{m}$  to PhJIn at U35. Body length large as an adult, ventrally flattened, dorsally vaulted; head end bears swellings beside the oral opening on either side; trunk broadens gradually to the midgut region, then narrows more quickly to the caudal base; caudal pedicles short (L 10  $\mu\text{m}$ ) borne on ancre covered lobes, with a flattened concave margin separating the two lobes, indenting medially to U96. Widths at swelling/neck/PhJIn/midgut/caudal base and locations along the length of the body are as follows: 81/64/79/80/53  $\mu\text{m}$  at U04/U06/U35/U62/U94, respectively. Epidermis armored with pentancre of much the same size throughout that emerge from crossed tetrancrous bases and lean backwards as they attach to the body (L 15  $\mu\text{m}$ ); ancre cover dorsal and lateral surfaces in some 48-50 rows of 10 ancre each, being absent from the anterior of the oral hood, but extending beneath the ventrolateral borders and onto the caudal lobes. Glands 8 per side (10  $\mu\text{m}$  diam.) are scattered in lateral and dorsal columns.

**Adhesive tubes.** TbA 3 per side (L 18  $\mu\text{m}$  medial to 24  $\mu\text{m}$  lateral), forming a transverse row, the tubes inserting directly on the postoral body surface at U06, the medial two pointing forward, and the more lateral pointing obliquely forward; TbVL 6 per side (L 18-40  $\mu\text{m}$ ), 1 in the fore pharyngeal region at U06 immediately lateral to the TbA, another in the foregut region at U39, 2 in the hindgut region at U78 (present on one or both sides) and U86, and 2 located behind the anus at U93 and U95; TbDL 2 per side (L 36  $\mu\text{m}$ ) located in the foregut and midgut regions at U37 and U67; TbD 2 per side (L 33-36  $\mu\text{m}$ ) located in the foregut and midgut regions at U43 and U59; TbL/TbV are absent; TBP 3 per side on the caudal pedicles, forming the fused 'two fingers and a thumb' typical of the family, (L terminal tubes 8  $\mu\text{m}$ , L tube on the inner margin 12  $\mu\text{m}$ ), being supplemented in this case by a blind cirrata-like structure (L 12  $\mu\text{m}$ ) that projects dorsoposteriorly from between the 'fingers', and 3 tubes along the margin separating the two groups medially.

**Ciliation.** Short sensory hairs (L 5-9  $\mu\text{m}$ ) surround the entire oral opening, short ones borne on the scallop tips, and longer ones between the tips of the dorsal oral hood, with ones of intermediate length borne on the scallop tips ventrally; 4-5 longer sensory hairs (L 21-36  $\mu\text{m}$ ) per side occur on the frontal half of the oral hood, with a laterally directed vibratile cilium (L 48  $\mu\text{m}$ ) occurring at



**Fig. 15.** *Tetranchyroderma interstitialis* n. sp. **A.** dorsal and ventral views of adult (Lt = 710  $\mu\text{m}$ ) from Debidue, South Carolina, dorsal with pentancrous surface, ventral with digestive and reproductive tracts, adhesive tubes and locomotor ciliary band. **B.** usual pentancre, side and top view of four tines surrounding one, and **C.** unusual pentancre, top view of five tines in a circle. B and C with a common scale bar.

the rear of the oral swelling; other hairs (L 18  $\mu\text{m}$ ) occur regularly along the lateral body surfaces, numbering 15 per side. Ventral locomotor ciliature forms a single field of transverse rows beneath the gut, extending from U07 onto the caudal base at U95; individual cilia are 12-15  $\mu\text{m}$  in length.

**Digestive tract.** Mouth subterminal, nearly as broad as the fore end of the body, width 60  $\mu\text{m}$ ; non-cuticularized buccal cavity narrows quickly; pharynx broadens again in the rear and has in-

conspicuous basal pharyngeal pores; intestine is broadest in front, narrowing gradually to the rear; anus is at U91.

Reproductive tract. Testis on right side as seen from above, left side as seen from below; vas deferens appears to open into the rear of the caudal organ, in front of the anus; eggs develop back to front, lying above mid-gut ( $48 \times 42$  and  $80 \times 51 \mu\text{m}$ ); caudal organ is tiny ( $8 \times 14 \mu\text{m}$ ), thick-walled; frontal organ not seen.

**Ecology.** Sparse in frequency of occurrence (less than 10 % of samples), rare in abundance (less than 1 % of a sample); littoral in a sand flat of medium fine, medium-well sorted, clean sand at 0-15 cm depth LWN-LWE.

#### Geographical distribution:

**ANW:** North America: South Carolina { $^{\wedge}$ Debidue [ $33^{\circ}20'N/79^{\circ}10'W$ ] June 1977}.

**Remarks.** Two variant pentancre occurred on the whole body of *Tetranchyroderma interstitialis* n. sp., one each, at levels noted by the \*asterisk, were identical to one another in having five bases radiating from a center with tines at the ends of the bases, but with the center itself bearing no tine.

**Etymology.** The species is named after the interstitial habitat in which it lives.

**Taxonomic affinities.** *Tetranchyroderma interstitialis* n. sp. becomes the 62<sup>nd</sup> described species in this genus. Treatment of this and the following two species is enhanced by the excellent dichotomous key of Todaro 2002 (p. 560). *Tetranchyroderma insulare* Balsamo, Fregni & Tongiorgi, 1994 and *T. tentaculatum* Rao, 1993 were not included in Todaro's key, while *T. australiense* Nicholas & Todaro, 2006, *T. faroense* Clausen, 2004, *T. monokerosum* Lee & Chang, 2007, *T. multicirratum* Lee & Chang, 2007, and *T. pentasperus* Nicholas & Todaro, 2006 all were published after the key was completed.

Of the 61 species in the genus *Tetranchyroderma*, *T. tribolosum* Clausen, 1965 has only triancre, *Tetranchyroderma gausancrum* n. sp. has triancre emerging from a quasi-tetrancrous base, while *T. paradoxum* Thane-Fenchel, 1970, *T. paralittoralis* Rao, 1991 and *T. tentaculatum* Rao, 1993 each have both tetrancres and pentancre.

Of the 32 described species that have only pentancre, two species: *Tetranchyroderma anoma-*

*losum* Hummon, Todaro, Balsamo & Tongiorgi, 1996 and *T. psilotopum* Hummon, Todaro, Tongiorgi & Balsamo, 1998 both lack full coverings of ancre.

Sixteen species: *T. antennatum* Luporini, Magagnini & Tongiorgi, 1970 (published in 1973); *T. bulbosum* Clausen, 2000; *T. enallosum* Hummon, 1977; *T. esarhabdophorum* Tongiorgi & Balsamo, 1984; *T. heterotentaculatum* Chang & Lee, 2001; *T. hystrix* Remane, 1926; *T. megastomum* (Remane, 1927c); *T. monokerosum* Lee & Chang, 2007; *T. multicirratum* Lee & Chang, 2007; *T. norvegicum* Clausen, 1996; *T. papii* Gerlach, 1953; *T. polyprobolostomum* Hummon, Todaro, Balsamo & Tongiorgi, 1996; *T. quadritentaculatum* Todaro, Tongiorgi & Balsamo, 1992; *T. sardum* Todaro, Balsamo & Tongiorgi, 1988; *T. suecicum* Boaden, 1960; and *T. swedmarki* Rao & Ganapati, 1968 all have cephalic tentacles or sensorial organs present.

Three species: *Tetranchyroderma polyacanthum* (Remane, 1927); *T. pentasperus* Nicholas & Todaro, 2006; and *T. tanymesatherum* Hummon, Todaro, Balsamo & Tongiorgi, 1996 all have pentancre, whose central tine is more elongate than the other four tines.

Three species: *Tetranchyroderma insulare* Balsamo, Fregni & Tongiorgi, 1994; *T. kontosomum* Hummon, Todaro, Balsamo & Tongiorgi, 1996; and *T. polypodium* Luporini, Magagnini & Tongiorgi, 1971 all lack both TbD and TbV. Six species: *Tetranchyroderma coeliopodium* Boaden, 1963; *T. faroense* Clausen, 2004; *T. inaequitubulatum* Todaro, Balsamo & Tongiorgi, 2002; *T. pacificum* Schmidt, 1974; *T. thysanophorum* Hummon, Todaro & Tongiorgi, 1993; and *T. weissii* Todaro, 2002 all have TbV. Three species: *Tetranchyroderma australiense* Nicholas & Todaro, 2006; *T. hirtum* Luporini, Magagnini & Tongiorgi, 1970 (published in 1973); and *T. interstitialis* n. sp. all have TbD or TbDL: *T. australiense* 1 TbD per side, *T. hirtum* several TbDL per side, while *T. interstitialis* has 2 TbDL and 2 TbD per side.

#### *Tetranchyroderma lameshurensis* new species

[Tet lmsH]

Fig. 16

**Diagnosis.** Adult Lt 235  $\mu\text{m}$ ; PhJIn at U40. Head end bears swellings beside the oral opening on either side and 2 short, thin tentacles per side dorsally at U02/U06; body broadens in the

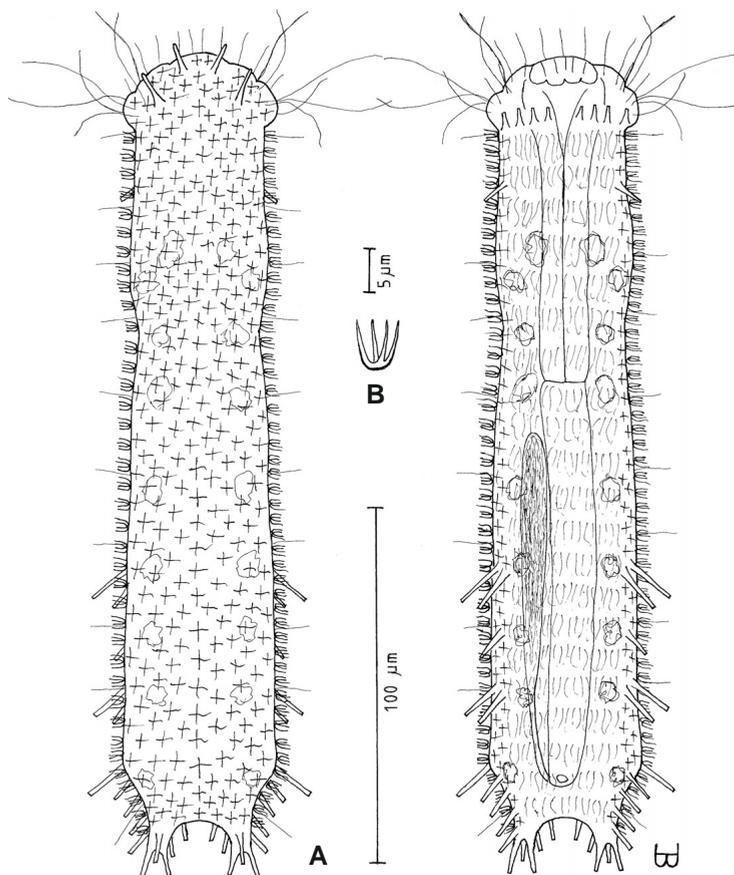


Fig. 16. *Tetranchyroderma lameshurensis* n. sp. A. dorsal and ventral views of adult (Lt = 230 µm) from Little Lameshur Bay, St. John, Virgin Islands, dorsal with tetrancous surface, ventral with digestive and reproductive tracts, adhesive tubes and locomotor ciliary band. B. tetrance, with a separate scale bar.

mid-pharynx, trunk forms hips in the hind-gut region, narrowing quickly to the caudal base; caudal pedicles medium, with a concave margin, indenting medially to U93. Epidermis covered with tetrances of similar size throughout; ancre occur in 50-55 rows of 8 ancre each, including the entire oral hood, but not the caudal lobes. Glands 9 per side. TbA 4 per side forming a transverse row, tubes inserting directly on the body; TbL 1 per side, borne on the hips at U85; TbVL 7 per side, 1 in the fore-pharyngeal region at U15, behind the TbA, 2 in the mid- and hind-gut regions at U61/U77, and 4 located at and behind the anus evenly spaced at U87-U93; TbV 3 per side located just inside the TbVL series in the mid- to hind-gut regions at U62/U70/U77; TbD/TbDL absent; TbP 3 per side on the caudal pedicles, forming the fused 'two fingers and a thumb' typical of the family,

being supplemented by a blind cirrata-like structure projecting posteriodorsally from between the 'fingers', and 2 tubes along the medial margin separating the peduncles. Locomotor ciliature: a single field that covers the entire ventral surface at U06-U92. Mouth subterminal, not as broad as the fore end of the body, non-cuticularized buccal cavity narrows from a bulbous mouth; basal pharyngeal pores inconspicuous; intestine of similar width throughout; anus at U93. Presumably hermaphroditic; perhaps protandric; testis on right side as seen from above, left side as seen from below; vas deferens appears to open near the anus; female system not seen.

**Description.** Adult Lt 232 µm; LPh 93 µm to PhJIn at U40. Body length small as an adult, ventrally flattened, dorsally vaulted; head end bears

swellings beside the oral opening on either side and 2 short, thin tentacles per side (L 8-10 µm) dorsally at U02 and U06; body broadens in the mid-pharyngeal region, trunk forms hips in the hindgut region, then narrows quickly to the caudal base; caudal pedicles medium (L 16 µm) borne on ancnous lobes, with a concave margin separating the two lobes, indenting medially to U93. Widths at swelling/neck/rear pharynx/hindgut/caudal base and locations along the length of the body are as follows: 44/37/39>34/44/29 µm at U06/U09/U30>U33/U86/U93, respectively. Epidermis armored with tetrancres (L 6 µm) that are of much the same size throughout; an cres cover dorsal and lateral surfaces in some 50-55 rows of 8 an cres each, being present on the entire oral hood, but not extending onto the caudal lobes. Glands 9 per side (4-7 µm diam.) are scattered in lateral columns from U23 to U88.

Adhesive tubes. TbA 4 per side (L 3-5 µm), forming a nearly transverse row, the tubes inserting directly on the postoral body surface at U07-U08, all pointing forward. TbL 1 per side (L 12 µm), borne on the hips at U85; TbVL 7 per side, 1 in the fore pharyngeal region (L 8 µm) at U15 inserting behind the TbA, 2 in the mid- and hind-gut regions (L 15 and 13 µm) at U61 and U77, and 4 located at and behind the anus (L 8-9 µm) evenly spaced at U87-U93; TbV 3 per side (L 10-13 µm) located just inside the TbVL series in the mid- to hind-gut regions at U62, U70 and U77; TbD/TbDL are absent; TbP 3 per side on the caudal pedicles, forming the fused 'two fingers and a thumb' typical of the family, (L terminal tubes 10 µm, L tube on the inner margin 5 µm), being supplemented in this case by a blind cirrata-like structure (L 8 µm) that projects dorsoposteriorly from between the 'fingers', and 2 tubes along the margin separating the two peduncles medially.

Ciliation. Short sensory hairs (L 4-10 µm) occur ventrally along the anterior border of the head, mostly projecting forward, with 6 longer vibratile hairs (L 15-34 µm) per side projecting forward to laterally from the dorsal (3) and ventral (3) surfaces of the pluria; other hairs (L 8-10 µm) occur regularly along the lateral body surfaces, numbering 9 per side from U09 to U77, with a longer one (L 14 µm) on each side at U91. Ventral locomotor ciliature forms a single field of transverse rows beneath the gut, extending from U09 onto the caudal base at U82; individual cilia are 8-10 µm in length.

Digestive tract. Mouth subterminal, not as broad as the fore end of the body, diameter 19 µm; non-cuticularized buccal cavity narrows from a bulbous mouth; pharynx has inconspicuous basal pharyngeal pores; intestine is nearly the same size throughout; anus is at U93.

Reproductive tract. Perhaps protandric; testis on right side as seen from above, left side as seen from below; vas deferens appears to open near the anus; female system not seen.

**Ecology.** Sparse in frequency of occurrence (less than 10 % of samples), rare in abundance (less than 1 % of a sample); sublittoral amidst a shallow bay of medium fine, well sorted, clean sand at 0.5 m water depth.

**Geographical distribution:**

**ANW:** Carribean: Virgin Islands {St.John: ^Little Lamasher Bay {18°19'N/64°44'W} March 1971}.

**Remarks.** The mouth of *Tetranchyroderma lameshurensis* n. sp. is much narrower than the pluria, reminding one most of members of the genus *Thaumastoderma* and perhaps of *Tetranchyroderma pugetensis* Wieser, 1957, though it may be an artifact of an unrelaxed specimen, as was the case in *Tetranchyroderma coeliopodium* Boaden, 1963 (Fig.), *T. polypodium* Luporini, Magagnini & Tongiorgi, 1971 (contrast adult Fig. 1.1, with juvenile Fig. 1.3), *T. thysanogaster* Boaden, 1965 (Fig. 1); *T. vera* Wilke, 1954 (contrast the photo Fig. 8, with the drawing Fig. 9), and *T. sp.* of Remane (1936), and all four of the undescribed species of Valbonesi & Luporini (1984, *Tetranchyroderma* species 4-7, Figs 8-11). Associated macrodasyids: *Xenodasy riedli* (Schoepfer-Sterrer, 1974) and the second tetrancre-bearing species of *Tetranchyroderma* to be described below.

**Etymology.** The species is named after the bay in which it was found.

**Taxonomic affinities.** *Tetranchyroderma lameshurensis* n. sp. becomes the 63<sup>rd</sup> described species in this genus. Discussion of *T. lameshurensis* will follow the description of the following species.

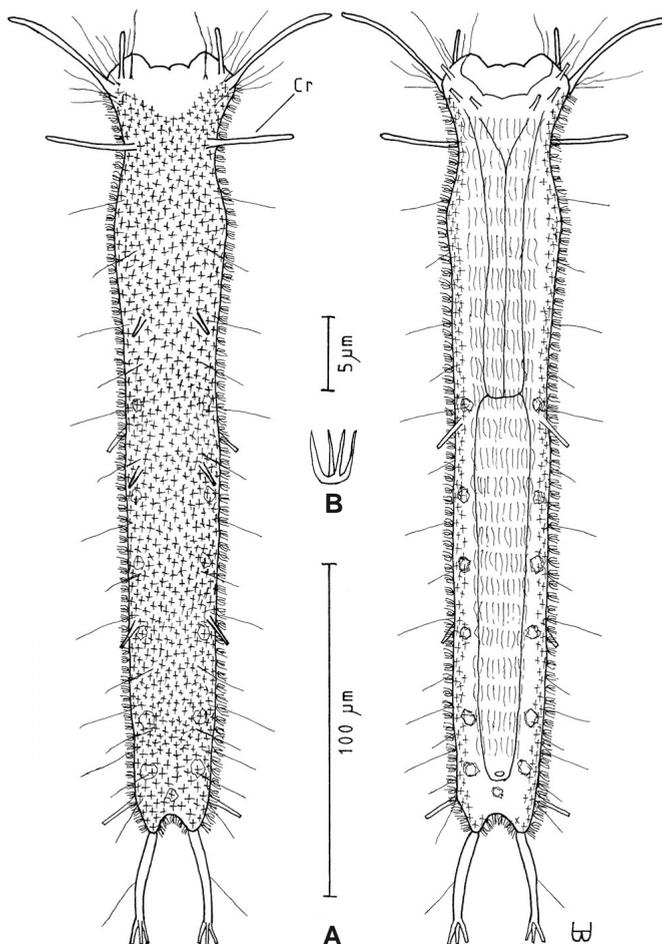


Fig. 17. *Tetranchyroderma longipedum* n. sp. A. dorsal and ventral views of subadult (Lt=268 µm) from Little Lameshur Bay, St. John, Virgin Islands, dorsal with tetrancreous surface, ventral with digestive tract, adhesive tubes and locomotor ciliary band. B. tetrancre, with a separate scale bar. Symbols as in previous figures, additionally with: Cr, cirratum (pl. cirrata).

*Tetranchyroderma longipedum* new species

[Tet lgpd]

Fig. 17

**Diagnosis.** Subadult Lt 270 µm; Ph]In at U44 [adult <450 µm; Ph]In ~U38]. Head end bears swellings beside the oral opening on either side, 2 cephalic tentacles per side borne dorsally at U02 and U04, the former short (projecting forward), the latter elongate (projecting anteriolaterally, and then curving laterally), and 1 cirratum per side of medium length, borne dorsolaterally at U10 and projecting laterally; body narrows at the cirratum, expands in the mid-pharynx, narrows gradually to the hindgut region, then more quickly from

there to the caudal base; caudal pedicles naked and quite elongate, with a concave margin separating the two lobes, indenting medially to U85. Epidermis covered with tiny tetrancre (L 4 µm) that are even smaller on the anterior border; ancre occur in 85-90 rows of 10-12 ancre each, being absent in a U-shaped pattern behind the oral hood and from the naked caudal pedicles. Glands 6 per side in the intestinal region at U44-U81, with a solitary medial gland behind the anus. TbA 3 per side, forming an arc that parallels the oral opening, the tubes inserting directly on the body at U03/U05/U06; TbL 1 per side, just behind the anus at U83; TbVL 1 per side, just behind the Ph]In; TbDL 3 per side located in the mid-body region

at U29/U46/U63; TbD/TbV absent; TbP 2 per side on the caudal pedicles, forming the fused 'two fingers' typical of the family, but without the 'thumb', the 'fingers' being supplemented by a blind cirrata-like structure projecting from between the 'fingers'. Locomotor ciliature: a single field at U06-U81. Mouth subterminal, not as broad as the fore end of the body, oral opening is polygonal, the oral hood being extended forward more laterally than medially; non-cuticularized buccal cavity narrows quickly; pharynx broadens to inconspicuous basal pharyngeal pores; intestine narrows gradually fore to aft; anus at U81. Probably hermaphroditic; testes and ovaries not seen in immature specimens.

**Description.** Subadult Lt 268  $\mu\text{m}$ ; LPh 103  $\mu\text{m}$  to PhJIn at U44. Body length medium as an adult, ventrally flattened, dorsally vaulted; head end bears swellings beside the oral opening on either side, 2 cephalic tentacles per side borne dorsally at U02 and U04, the former short (L 14  $\mu\text{m}$ ) and projecting forward, the latter elongate (L 38  $\mu\text{m}$ ) and projecting anteriolaterally and then curving laterally, and 1 cirratum per side of medium length (L 26  $\mu\text{m}$ ), borne dorsolaterally at U10 and projecting laterally; body narrows just behind the cirratum, then expands in the mid-pharyngeal region, and then narrows gradually to the hind-gut region, narrowing quickly from there to the caudal base; caudal pedicles naked and quite elongate (L 32  $\mu\text{m}$ ), with a concave margin separating the two lobes, indenting medially to U85. Widths at oral swelling/pharyngeal narrowing, swelling/PhJIn/TbL/caudal base and locations along the length of the body are as follows: 38/28/34/28/24/16  $\mu\text{m}$  at U03/U11/U18/U44/U83/U87, respectively. Epidermis armored with tiny tetrancores (L 4  $\mu\text{m}$ ) that are even smaller on the anterior border; ancores cover dorsal and lateral surfaces in some 85-90 rows of 10-12 ancores each, being absent in a U-shaped pattern back from the oral hood and from the naked caudal pedicles. Glands 6 per side (4  $\mu\text{m}$  diam.) are scattered in lateral columns in the intestinal region from U44 to U81, with a solitary medial gland that lies behind the anus.

Adhesive tubes. TbA 3 per side (L 5  $\mu\text{m}$ ), forming a convex arc that parallels the oral opening, the tubes inserting directly on the perioral body surface at U03, U05 and U06, all pointing obliquely forward; TbL 1 per side (L 13  $\mu\text{m}$ ), occurring just behind the anus at U83; TbVL 1 per

side (L 12  $\mu\text{m}$ ), occurring just behind the PhJIn at U41; TbDL 3 per side (L 6-8  $\mu\text{m}$ ) located in the midbody region at U29, U46 and U63; TbD/TbV are absent; TbP 2 per side (L 7  $\mu\text{m}$ ) on the caudal pedicles, forming the fused 'two fingers' typical of the family, but without the 'thumb', the 'fingers' being supplemented by a blind cirrata-like structure (L 7  $\mu\text{m}$ ) that projects posteriodorsally from between.

**Ciliation.** Sensory hairs (L 7-12  $\mu\text{m}$ ) occur on either side of the oral swelling, with longer ones borne dorsally on the oral hood (L 20-25  $\mu\text{m}$ ) and laterally on the perioral swellings (L 10-20  $\mu\text{m}$ ); other hairs (L 15-18  $\mu\text{m}$ ) occur regularly along the lateral (L 16-20  $\mu\text{m}$ ) and dorsolateral (L 14-16  $\mu\text{m}$ ) body surfaces, numbering 7-8 per column on each side, with 1 projecting laterally to the rear from mid-way out the length of each pedicle. Ventral locomotor ciliature forms a single field of transverse rows beneath the gut, extending from U06 to the anus at U81; individual cilia are 8-10  $\mu\text{m}$  in length.

**Digestive tract.** Mouth subterminal, not as broad as the fore end of the body, width 20  $\mu\text{m}$ ; oral opening is polygonal, the oral hood being extended forward more laterally than medially; non-cuticularized buccal cavity narrows quickly; pharynx broadens slightly in the rear and has inconspicuous basal pharyngeal pores; intestine is broadest in front, narrowing gradually to the rear; anus is at U81.

**Reproductive tract.** No information, specimens being reproductively immature.

**Ecology.** Sparse in frequency of occurrence (less than 10% of samples), rare in abundance (less than 1% of a sample); sublittoral amidst a shallow bay of medium fine, well sorted, clean sand at 0.5 m water depth.

#### **Geographical distribution:**

**ANW:** Carribean: Virgin Islands {St. John: ^Little Lamasher Bay {18°19'N/64°44'W} March 1971}.

**Remarks.** The only specimens of *Tetranchyoderma longipedum* n. sp. found were subadults; the adult can be expected to differ in being proportionately larger in all dimensions, reaching a length of perhaps 350-450  $\mu\text{m}$  with the intestinal region growing more than the pharyngeal, so that the PhJIn will tend to shift to lower U-numbers, perhaps U38; the body also will have additional sensory hairs and adhesive tubes. In the main,

the eidostic pattern seen here is not expected to change; a mature adult will be recognizable as belonging to this species. Associated macrodasyids: *Xenodasys riedli* (Schoepfer-Sterrer 1974) and *Tetranchyroderma lameshurensis* n. sp., described above.

**Etymology.** The species is named after the extreme length of its pedicles.

**Taxonomic affinities.** *Tetranchyroderma longipedum* n. sp. becomes the 64<sup>th</sup> described species in this genus. Two species were not included among the tetrancre-bearing species in the Todaro (2002: 560) key: *Tetranchyroderma arcticum* Clausen, 2000 and *T. symphorochetum* Hummon, Todaro, Tongiorgi & Balsamo, 1998; also not included because it had not yet been published was *T. canariense* Todaro, Ancona, Marzano, Gallo d'Addabbo & DeZio Grimaldi, 2003. Thus there are now 26 species that have only tetrancre, the 21 species listed by Todaro, the 3 species he did not include, and the 2 species being described here. Of these, two species: *Tetranchyroderma boadeni* Schrom, 1970 (in Riedl 1970) and *T. hypopsilancrum* Hummon, Todaro & Tongiorgi, 1993 do not have a full dorsal covering of tetrancre.

Ninespecies: *Tetranchyroderma aphenothigmum* Hummon, Todaro, Tongiorgi & Balsamo, 1998; *T. apum* Remane, 1927; *T. bunti* (Thane-Fenchel, 1970); *T. gracilium* Chang, Lee & Clausen, 1998; *T. hoonsooi* Lee & Chang, 2001; *T. indicum* Rao & Ganapati, 1968; *T. massiliense* Swedmark, 1956b; *T. sanctaecaterinae* Todaro, Tongiorgi & Balsamo, 1992; and *T. schizocirratum* Chang, Kubota & Shirayama, 2002 all have lateral cephalic sensorial organs present.

Four species: *Tetranchyroderma dendricum* Saito, 1937; *T. dragescoi* Swedmark, 1967; *T. pugetensis* Wieser, 1957; and *T. symphorochetum* Hummon, Todaro, Tongiorgi & Balsamo, 1998 have neither TbD nor TbV. Two species: *Tetranchyroderma boreale* Clausen, 2000 (not *borealis*) and *T. heterotubulatum* Hummon, Todaro & Tongiorgi, 1993 both have TbD, but not TbV; two species: *T. cirrophorum* Levi, 1950 and *T. verum* Wilke, 1954 both have TbC (dorsal sensory cirrata, not adhesive tubes), these four differing from one another in the number of TbP that occur between the pedicles. Two species: *Tetranchyroderma longipedum* n. sp. and *T. pachysomum* Hummon, Todaro & Tongiorgi, 1993 both have TbD and TbV, but differ from one another in the length of the pedicles and the number of TbP

that lie in between the pedicles: long and zero in the former, short and several in the latter.

Four of the remaining five species all have TbV in transverse rows: *Tetranchyroderma littoralis* Rao, 1981, with a rounded caudum that lacks pedicles; *T. arcticum* Clausen, 2000 and *T. canariense* Todaro, Ancona, Marzano, Gallo d'Addabbo & DeZio Grimaldi, 2003, having several TbP that lie in between the pedicles; and *T. thysanogaster* Boaden, 1965, having more TbP that lie in between the pedicles, while only *T. lameshurensis* n. sp. has its TbV in longitudinal columns and only 2 TbP that lie in between the pedicles.

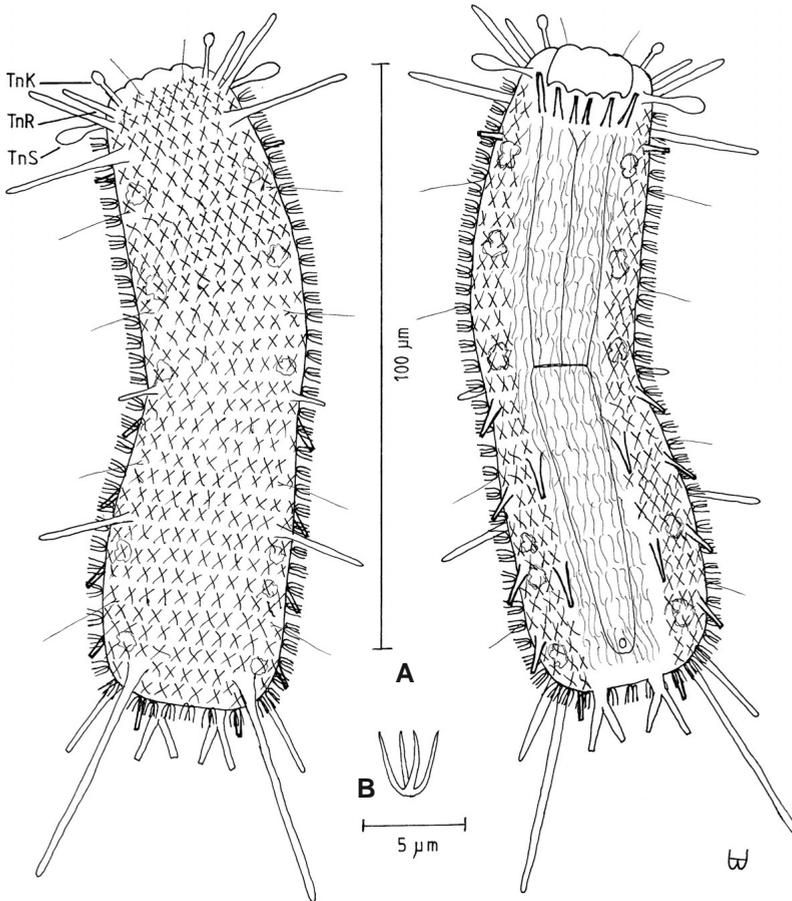
Genus *Thaumastoderma* Remane, 1926

### *Thaumastoderma minancrum* new species

[Thu mnan]

Figure 18

**Diagnosis.** Subadult Lt 120 µm; PhJIn at U54 [adult <150 µm; PhJIn ~U50]. Body small, oblong-rectangular; head end crenulated, with 3 dorsal cephalic tentacles per side at U02-U04, knob-shaped, rod-shaped, and spatulate; cirrata 5 per side of vastly varying lengths, dorsolateral at U04 (L 19 µm), U07 (L 27 µm), U47 (L 9 µm), U64 (L 20 µm) and U86 (L 45 µm); rear of trunk ovate, terminating medially at U92, short naked caudal pedicles lacking a caudal base. Epidermis armored with tiny tetrancre that are even smaller on the anterior border; ancre occur in 35 rows of 16-18 ancre each. Glands 5-6 per side are scattered from U16 to U83. TbA 3 per side, form a transverse column, the lateralmost the longest, all inserting directly on the body at U11; TbL 1 per side behind the TbA row at U14; TbVL 4 per side, all in the intestinal region, of similar size and spacing at U49-U82; TbV 2 per side at U57 and U72; TbD absent; TbP 4 per side, 2 forming the fused 'fingers' of the pedicles typical of the family, but without the 'thumb' or the blind cirrata-like structure that often accompanies a pedicle, none in the flat tube-free margin separating the pedicles medially, but 2 inserting lateral to the pedicles, a short, thin inner tube (L 6 µm) and a long, robust outer tube (L 19 µm). Mouth is crenulated above and below, 17 µm in width; buccal cavity lightly cuticularized; pharynx narrows slightly to inconspicuous basal pharyngeal pores; intestine narrows to the rear; anus is at U94. Locomotor ciliature: a single field at U12-U93.



**Fig. 18.** *Thaumastoderma minancrum* n. sp. **A.** dorsal and ventral views of subadult (Lt=120 µm) from Firemore Beach, Scotland, dorsal with tetrancrous surface, ventral with digestive tract, adhesive tubes and locomotor ciliary band. **B.** tetrancre, with a separate scale bar. Symbols as in previous figures, additionally with several (Tn) tentacle types: **TnK**, knobbed; **TnR**, rod-shaped; **Tn**, spatulate.

Probably hermaphroditic; testes and ovaries not seen in immature specimens.

**Description.** Subadult Lt 120 µm; LPh 65 µm to PhJIn at U54. Body probably small as an adult, ventrally flattened, dorsally vaulted, oblong-rectangular in shape; head end scalloped, bearing 3 cephalic tentacles per side borne dorsally from U02 to U04, 1 knob-shaped (TnK, L 9 µm) projecting diagonally forward, 1 rod-shaped (TnR, L 12 µm) also projecting diagonally forward, and 1 spatulate (TnS, L 13 µm) projecting laterally; cirrata 5 per side of vastly varying lengths, borne dorsolaterally at U04 (L 19 µm), U07 (L 27 µm), U47 (L 9 µm), U64 (L 20 µm) and U86 (L 45 µm), all projecting outward; rear of trunk ovate, end-

ing medially at U92, bearing short naked caudal pedicles (L 12 µm) that lack a caudal base. Widths at spatulate tentacles/PhJIn/anus and locations along the length of the body are as follows: 28/32/31 µm at U04/U54/U82, respectively. Epidermis armored with tiny tetrancres (L 4 µm) that are even smaller on the anterior border; an cres cover dorsal, lateral and ventrolateral surfaces in some 35 rows of 16-18 an cres each. Glands 5-6 per side (7-9 µm diam.) are scattered in lateral columns from U16 to U83.

**Adhesive tubes.** TbA 3 per side (L 6-8 µm), forming a transverse column, the lateralmost the longest, which insert directly on the postoral body surface at U11 and project anteriorly; TbL 1 per side (L 6 µm) behind the TbA row at U14; TbVL

4 per side (L 7-8  $\mu\text{m}$ ), all in the intestinal region, of similar size and spacing from U49 to U94; TbV 2 per side (L 9  $\mu\text{m}$ ) at U57 and U72; TbD are absent; TbP 4 per side, 2 (L 7-8  $\mu\text{m}$ ) forming the fused 'fingers' of the pedicles typical of the family, but without the 'thumb' or the blind cirrata-like structure that often accompanies a pedicle, none in the flat tube-free margin of 8  $\mu\text{m}$  separating the two pedicles medially, but 2 inserting laterally to the pedicles, a short, thin inner tube (L 6  $\mu\text{m}$ ) and a long, robust outer tube (L 19  $\mu\text{m}$ ).

**Ciliation.** Sensory hairs 5 per side, arising in a dorsolateral column. Ventral locomotor ciliation forms a single field of transverse rows beneath the gut, extending from U12 to the anus at U87; individual cilia are 7  $\mu\text{m}$  in length.

**Digestive tract.** Mouth rectangular, crenulated above and below, 17  $\mu\text{m}$  in width; buccal cavity is lightly cuticularized; pharynx narrows slightly toward its rear, with inconspicuous basal pharyngeal pores; intestine is broadest in front, narrowing gradually to the rear; anus is at U94.

**Reproductive tract.** No information, specimens being reproductively immature.

**Ecology.** Occasional in frequency of occurrence (10-30 % of samples), rare in abundance (less than 1 % of a sample); littoral in medium, medium-well sorted, sand with small amounts of detritus, at 0-10 cm depth MLW-MTL.

#### Geographical distribution:

**ANE:** British Isles: England: Northumbria {Tyne-mouth}; - Isle Of Man: {Derby Haven}; - Scotland: Dumfries & Galloway {Kirkcolm}, Highland {^Firemore Beach Transect A {57°49'N/05°41'W} {OS Loc. NG-8188} May 1975 [Max. H' Diversity Index = 3.56, Based On S = 32, N = 1485]}.

**Remarks.** The only specimens of *Thaumastoderma minancrum* n. sp. found were subadults; the adult can be expected to differ in being proportionately larger in all dimensions, reaching a length of perhaps 150  $\mu\text{m}$  with the intestinal region growing more than the pharyngeal, so that the PhJIn will tend to shift to lower U-numbers, perhaps U50; the eidostic pattern seen here is not expected to change; a mature adult will be recognizable as belonging to this species.

**Etymology.** The species is named after the minute size of ancre with which it is covered.

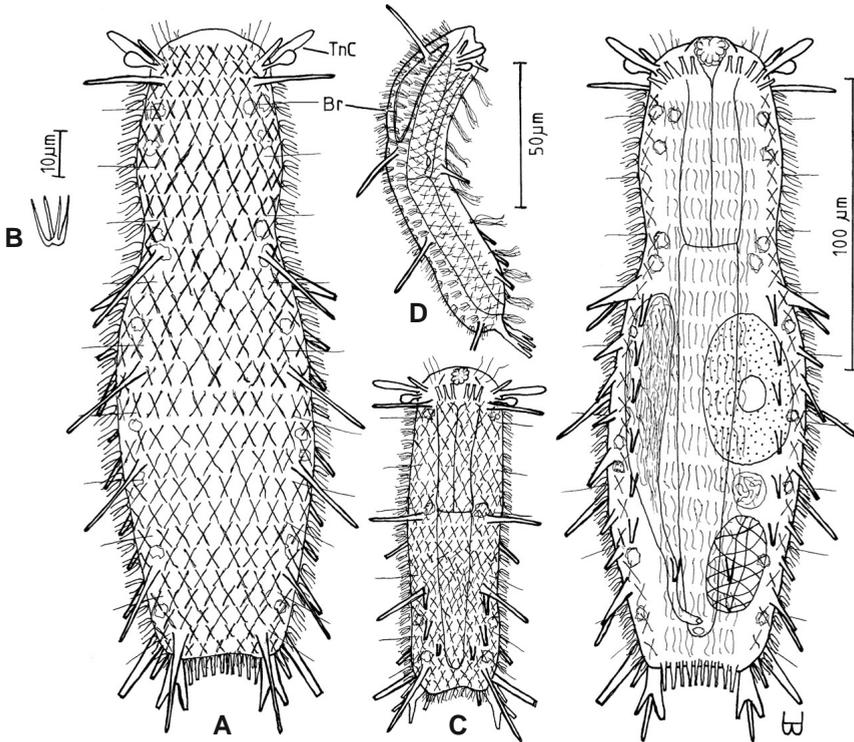
**Taxonomic affinities.** The tabular key of Clausen (2004, p. 444) is a wonderful aid to identification, but I will add another category, the number of TbP that lie between the caudal pedicles. For the 14 described species there are: 2 such tubes in *Thaumastoderma appendiculatum* Chang, Lee & Clausen, 1998 and *T. swedmarki* Lévi, 1950; 4 in *T. coronarium* Chang, Lee & Clausen, 1998 and *T. cantacuzeni* Lévi, 1958; 6 in *T. bifurcatum* Clausen, 1991, *T. clandestinum* Chang, Kubota & Shirahama, 2002, *T. copiophorum* Chang, Lee & Clausen, 1998, *T. heideri* Remane, 1926, *T. ramuliferum* Clausen, 1965, and *T. renaudae* Kisielewski, 1987; 7 in *T. mediterraneum* Remane, 1927; and 8 in *T. moebjergi* Clausen, 2004 and *T. truncatum* Clausen, 1991. *Thaumastoderma arcassonnense* d'Hondt, 1965 is problematic in that it was illustrated without pedicles; if one counts the outer 2 tubes on each side as belonging to pedicles, then its number of medial tubes is 6, but if only the outer tube per side is homologous with pedicles, then its number of medial tubes is 8. *Thaumastoderma minancrum* n. sp. is the only species in the genus with the combination of: 1 spatulate tentacle, 5 dorsolateral cirrata, lateral-most TbP much longer than other TbPs, and 2 TbV per side, along with the absence of any tubes between the caudal pedicles.

#### *Thaumastoderma natlanticum* new species

[Thu natl]

Fig. 19

**Diagnosis.** Lt 235  $\mu\text{m}$ ; PhJIn at U31. Body medium, bottle-shaped; head with 3 dorsal cephalic tentacles per side at U05-U06, rod-shaped, club-shaped, and spatulate; cirrata 6 per side of nearly similar lengths, dorsolateral at U11, U33, U47, U63, U82 and U88; rear of trunk slightly concave, indenting medially to U92, short naked caudal pedicles lacking a caudal base. Epidermis armored with tetrancres that are slightly smaller on the anterior and posterior borders; ancre occur in 27 rows of 10-13 ancre each. Glands 9-10 per side are scattered from U11 to U85. TbA 5 per side, form a single transverse arc, with a gap in the middle; TbVL 8 per side, all in the intestinal region, of dissimilar size but subequal spacing; TbVL 4 per side, all in the intestinal region, of similar size and spacing at U37-U83; TbV 6 per side laterally at U38-U71, and 1 per side at U76; TbL and TbD absent; TbP 18, 2 per side forming the



**Fig. 19.** *Thaumastoderma natlanticum* n. sp. **A.** dorsal and ventral views of adult (Lt=235 µm) from Debidue, South Carolina, dorsal with tetrancrous surface, ventral with digestive and reproductive tracts, adhesive tubes and locomotor ciliary band. **B.** tetrancre, with a separate scale bar. **C.** composite dorsal/ventral view of juvenile (Lt=125 µm) also from Debidue. **D.** composite lateral view of same juvenile. C and D with a common scale bar. Symbols as in previous figures, additionally with: **Br**, brain; another (Tn) tentacle type: **Tn**, club-shaped.

fused 'fingers' of the pedicles typical of the family, but without the 'thumb' or the blind cirrata-like structure that often accompanies a pedicle, 10 tubes in the flat tube-free margin separating the pedicles medially, and 2 per side inserting lateral to the pedicles, a short, thin inner tube (L 10 µm) and a long, robust outer tube (L 27 µm). Mouth is small, oval, 17 µm in width; buccal cavity lightly cuticularized; pharynx broad, with inconspicuous basal pharyngeal pores; intestine narrows to the rear; anus is at U87. Locomotor ciliature: a single field at U09-U87. Hermaphroditic; testis is on the right side as seen from above, left as seen from below; vas deferens opens separately near the anus; large developing egg is at mid-gut level on the opposite side; caudal organ a thick-walled, muscular; frontal organ a small hyaline sphere, containing mobile sperm within.

**Description.** Adult Lt 235 µm; LPh 72 µm to PhJIn at U31. Body medium, ventrally flattened,

dorsally vaulted, bottle-shaped; head end bluntly rounded, bearing 3 cephalic tentacles per side borne dorsally from U05 to U06, 1 rod-shaped (TnR, L 12 µm), 1 club-shaped (TnC, L 21 µm), and 1 spatulate (TnS, L 13 µm), all projecting diagonally forward; cirrata 6 per side of similar lengths (L 28-35 µm), borne dorsolaterally at U11, U33, U47, U63, U82 and U88, the first projecting laterally, the others posteriolaterally; rear of trunk slightly concave, indenting medially to U92, bearing short naked caudal pedicles (L 18 µm) that lack a caudal base. Widths at spatulate tentacles/PhJIn/widest part of trunk/pedicles and locations along the length of the body are as follows: 41/45/61/35 µm at U06/U31/U61/U92, respectively. Epidermis armored with tetrancres (L 10 µm) that are slightly smaller on the anterior and posterior borders; an cres cover dorsal, lateral and ventrolateral surfaces in some 27 rows of 10-13 an cres each. Glands 9-10 per side (4-6 µm diam.) are scattered in lateral columns from U11 to U85.

Adhesive tubes. TbA 5 per side (L 7-8  $\mu\text{m}$ ), forming a single transverse arc, separated in the middle, tubes inserting directly on the postoral body surface at U05-U07 and project anteriorly to anteriolaterally; TbVL 8 per side (L 12-20  $\mu\text{m}$ ), all in the intestinal region, of dissimilar size but subequal spacing from U37 to U83; TbV 6 per side (L 9  $\mu\text{m}$ ) laterally from U38 to U71, and 1 per side (L 9  $\mu\text{m}$ ) medially at U76; TbL and TbD are absent; TbP 18, 2 per side (L 9  $\mu\text{m}$ ) forming the fused 'fingers' of the pedicles typical of the family, but without the 'thumb' or the blind cirrata-like structure that often accompanies a pedicle, 10 in the flat tube-free margin of 27  $\mu\text{m}$  separating the two pedicles medially, and 2 per side inserting laterally to the pedicles, a short, thin inner tube (L 10  $\mu\text{m}$ ) and a long, robust outer tube (L 27  $\mu\text{m}$ ).

Ciliation. Sensory hairs 12 per side, arising in a dorsolateral column. Ventral locomotor ciliation forms a single field of transverse rows beneath the gut, extending from U09 to the anus at U87; individual cilia are 9  $\mu\text{m}$  in length.

Digestive tract. Mouth small, oval, only 14  $\mu\text{m}$  in diameter; buccal cavity is lightly cuticularized; pharynx broad throughout, with inconspicuous basal pharyngeal pores; intestine is broadest in front, narrowing gradually to the rear; anus is at U87.

Reproductive tract. Testis is on the right side as seen from above, left as seen from below; vas deferens opens separately near the anus; developing egg is at mid-gut level on the opposite side (32 x 53  $\mu\text{m}$ ); caudal organ is thick-walled, muscular (20 x 38  $\mu\text{m}$ ); frontal organ is a hyaline sphere (12  $\mu\text{m}$  diam.), containing mobile sperm within.

**Ecology.** Occasional in frequency of occurrence (10-30 % of samples), rare in abundance (less than 1 % of a sample); littoral in sand flat of medium fine, medium-well sorted, clean sand at 0-15 cm depth LWN-LWE.

#### Geographical distribution:

**ANW:** North America: South Carolina {<sup>^</sup>Debidue [33°20'N/79°10'W] June 1977}.

**Remarks.** Juvenile *Thaumastoderma natlanticum* n. sp.: Lt=125  $\mu\text{m}$ ; L to PhJIn=50  $\mu\text{m}$  at U43; LIn=54  $\mu\text{m}$ ; WTr=33  $\mu\text{m}$ . No head development; all 3 cephalic tentacles per side; cirrata 4 per side. TbA 3 per side; TbVL 2 per side; TbV 2 per side

laterally and 1 ps medially; TbP 10, the 2 per side of the pedicle, the 2 per side lateral to the pedicle, and but 2 total between the pedicles.

**Etymology.** The species is named after the North Atlantic ocean, in an arm of which it was found.

**Taxonomic affinities.** *Thaumastoderma natlanticum* n. sp. is the only species in the genus with the combination of: 1 spatulate tentacle, 6 dorsolateral cirrata, 7 TbV per side, and the lateral-most TbP much longer than other TbPs, along with 10 tubes lying between the caudal pedicles.

Family Turbanellidae Remane, 1927

Genus *Dinodasys* Remane, 1927

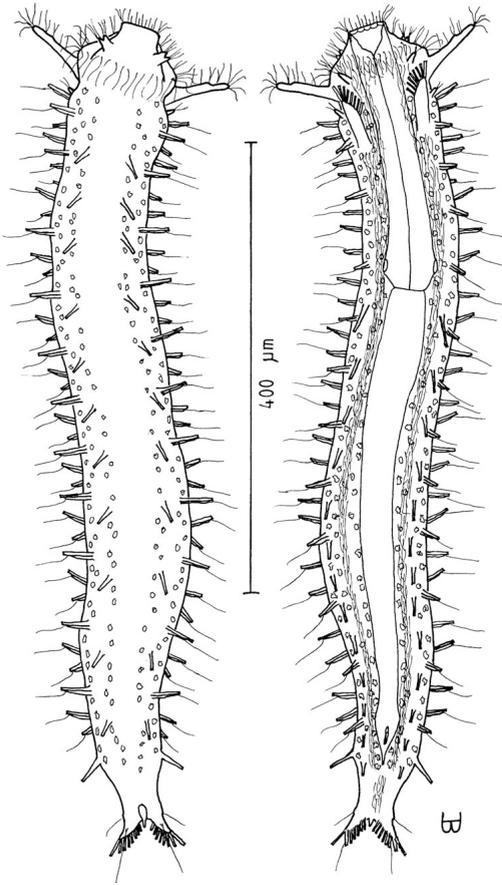
#### *Dinodasys delawarensis* new species

[Dnd delw]

Fig. 20

*Dinodasys* sp. A of Hummon, 1974c.

**Diagnosis.** Subadult Lt 740  $\mu\text{m}$ ; PhJIn at U32 [adult <800  $\mu\text{m}$ ; PhJIn ~U30]. Head narrowed in front and expanded behind, bearing elongate anteriolateral tentacles (narrower distally than proximally) at U08, 1 bilobed protuberance dorsally at U03 and 2 simple protuberances ventrally at U06/U10; trunk is of a similar width, narrowing over the rear third of the intestine, and then more quickly to the caudal base; caudum wide spread, moderately cleft, incised from its tips to U96, with a concave surface between the lobes that bears a small medial cone. Glands small, 40-44 per side. TbA 8 per side, decreasing in length apical to medial, borne on the medial borders of narrow fleshy hands that are moveable and insert at U14; TbL 14 per side, symmetrical and evenly spaced, at U10-U83, only the last one lying behind the anal opening; TbVL/TbDL each 11 per side, also symmetrical/even, inserted at U1-U80/U13-U84, none behind the anal opening; TbL/TbVL/TbDL (except the last TbL) all have accessory supports that extend along most of the tube, and bear a flexible hair at that juncture; TbD 11 per side, symmetrical/even, with 1 inserted in the fore half and 2 in the rear half of the pharynx, with 8 others along the intestine, none behind the anal opening; TbV 13 per side, posteriorly directed, symmetrical/even, decrease in length fore to aft, inserting at U35-U93, the first of which



**Fig. 20.** *Dinodasys delawarensis* n. sp. dorsal and ventral views of subadult (Lt=730  $\mu$ m) from Roosevelt Inlet, Delaware, dorsal with adhesive tubes, ventral with digestive tract, adhesive tubes and locomotor ciliary bands.

may be considered homologous to a 'cirrata' tube; TbD/TbV and the last TbL lack accessory supports/flexible hairs; TbP 8 per side, increasing in length medial to apical, form a series on the medial or inside edge of the lobe. Locomotor ciliature: runs from the circumcephalic ring rearward in 2 longitudinal bands that trace the lateral body margins to the last TbL, and with a medial post-anal patch lying beneath the caudal base. Mouth terminal, breadth medium; buccal cavity large, goblet-shaped; walls lightly cuticularized; pharynx broadening gradually to the conspicuous basal pharyngeal pores; intestine narrows fore to aft, but with an anal bulge, anus ventral at U85. Probably hermaphroditic; testes and ovaries not seen in immature specimens.

**Description.** Subadult Lt 738  $\mu$ m; L to PhJIn 237  $\mu$ m at U32. Body long; head narrowed in front and expanded behind, with ventrolateral lobes that bear elongate tentacles (L=54  $\mu$ m) at U08 (tentacles narrower distally than proximally over the outer 17  $\mu$ m), a bilobed protuberance occurs dorsally (L=10  $\mu$ m) at U03 and two simple protuberances ventrally (L=12  $\mu$ m and L=9  $\mu$ m) on the head and U06 and U10; trunk bulges a bit behind the neck constriction, then maintains a fairly constant width, until narrowing gradually over the rear third of the intestine, and then more quickly toward the caudal base, except for a slight bulge at the level of the last TbL; caudum is wide spread, moderately cleft, incised from its tips to U96, with a concave surface between the caudal lobes, bearing a small medial cone. Widths of apex/head bulb/tentacle tips/neck/body (at PhJIn to latter third of intestine)/furcal base-tips, and their locations along the body length are: 32/105/182/76/86-94/31 to 66 at U00/U05/U04/U08/U32-U63/U94 to U100. Epidermal glands form lateral and medial columns of 40-44 per side (diam. 3  $\mu$ m).

**Adhesive tubes.** TbA 8 per side, located from the apex half way down the medial borders of moveable narrow fleshy hands that insert at U14, decreasing in length (L=15>10  $\mu$ m) apical to medial; TbL 14 per side, symmetrically arranged and evenly spaced, inserted all along the body surface from U10 to U83, only the last one lying behind the anal opening; TbVL and TbDL each 11 per side, also symmetrically arranged and evenly spaced, inserted all along the body surface from U11 to U80 and U13 to U84, none behind the anal opening; TbL/TbVL/TbDL (except the last TbL) all have accessory supports that extend most of the way out the length of the tube, and bear a flexible hair at that juncture; TbD 11 per side, all symmetrically and evenly spaced, and pointing diagonally rearward, with 1 inserted in the fore half and 2 in the rear half of the pharyngeal region, with 8 others along the intestine, but none behind the anal opening; TbV 13 per side, posteriorly directed, are symmetrically and evenly spaced, but decrease in length fore to aft (L=27>10  $\mu$ m), inserting from U35 to U93, the first of which may be considered homologous to a 'cirrata' tube; TbD/TbV and the last TbL do not have either accessory supports or flexible hairs; TbP 8 per side, increasing in length (L=7<18  $\mu$ m) from medial to apical, forming a series around the lobe with the main tube posteriolateral and the

others on the medial or inside edge.

**Ciliature.** Mouth is surrounded with sensory hairs (L=9 µm), with several of longer vibratile hairs at each side (L=15 µm) and other sets of comparable length on the anterior surfaces of the cephalic lobes and the leading edge of the tentacles; the two lobes of the dorsal protuberance each have 3 hairs (L=12 µm), those of the 2 ventral protuberances each have 2 hairs (L=8 µm); ciliary hairs (L=22-25 µm) form a circumcephalic ring at U03; flexible sensory hairs occur near the tips of TbL/TbVL/TbDL (L=18-20 µm) and 2 per side on the caudum, 1 laterally from the caudal base (L=20 µm) and 1 dorsally from the caudal lobes (L=48 µm). Ventral locomotor cilia (L=15 µm) flow from the circumcephalic ring rearward in 2 longitudinal bands that trace the lateral body margins to the last TbL, remaining separate throughout except beneath the head, but with a medial post-anal patch that lies beneath the caudal base.

**Digestive tract.** Mouth terminal, diameter 27 µm; buccal cavity large, goblet-shaped; walls lightly cuticularized; pharynx broadening gradually toward the rear, with conspicuous basal pharyngeal pores; intestine widest in front, narrowing toward the rear, with an anal bulge, anus is ventral at U85.

**Reproductive tract.** No information, specimens being reproductively immature.

**Ecology.** Occasional in frequency of occurrence (10-30 % of samples), rare to few in abundance (1-3 % of a sample); littoral in medium, medium-well sorted, clean sand at 0-10 cm depth LWN-LWS.

#### **Geographical distribution:**

**ANW:** North America: Delaware {^Roosevelt Inlet Inside {38°47'N/75°09'W} December 1982}; Massachusetts {Plum Island SE}.

**Remarks.** The only specimens of *Thaumastoderмата natlanticum* n. sp. found were nearly mature subadults; adults can be expected to differ in being proportionately larger in all dimensions, reaching a length of perhaps 800-900 µm with the intestinal region growing somewhat more than the pharyngeal, so that the PhJIn will tend to shift to lower U-numbers, perhaps U28-U30; the body conformation can be expected to change little; the body also will have additional sensory hairs and adhesive tubes. In the main, the eidostic pattern

of the anterior and posterior ends is not expected to change; a mature adult will be recognizable as belonging to this species.

**Etymology.** The species is named after the state of Delaware, in which it was first found.

**Taxonomic affinities.** *Dinodasys delawarensis* n. sp. differs from the only other described species, *Dinodasys mirabilis* Remane, 1927, in being nearly twice the length: subadult L=738 µm compared with Potel (1986, p. 61, Figs. 37-41) adult L=450 µm, but with the PhJIn having a similar proportion: U32, compared with U27 (Remane 1927: p. 217, Fig. 8), U32 (Hummon, unpublished), and U33 (Kisielewski 1987: p. 854, Plate 1f., and Potel 1986: p. 63, Figs. 37-41). *Dinodasys delawarensis* is known from two locations in the US, while *D. mirabilis* is known from 7 countries in the ANE. Oral protrusion is less pronounced and less cuticularized in *Dinodasys delawarensis* than in *D. mirabilis*. The number and disposition of cephalic protuberances differ in *Dinodasys delawarensis* and *D. mirabilis*: (1 bilobed, dorsal and 2 simple, ventral, compared to 2 bilobed, and 2 simple, dorsal and unknown, ventral). Adhesive tubes of all series are more numerical in *Dinodasys delawarensis* than in *D. mirabilis*: TbA/TbP (8 compared to 6-7/8 compared to 5-6), TbL/TbDL/-TbVL (37 bearing sensory hairs compared to 16-21, with some, but not all, bearing sensory hairs) and TbD (11 not bearing sensory hairs compared to 7 bearing sensory hairs). Glands are smaller and more numerous in *Dinodasys delawarensis* than in *D. mirabilis*.

Genus *Paraturbanella* Remane, 1927

#### *Paraturbanella pacifica* Schmidt, 1974

[Ptb pacf]

*Paraturbanella pallida pacifica* Schmidt, 1974: p. 37; fig. 12 – **new subspecies**. Clausen, 1996: tab. 2. *Paraturbanella pacifica* Schmidt, 1974. Present paper – **new species**.

**Remarks.** *Paraturbanella pacifica* should be raised to full species status, since mature specimens lack pestle organs and are only about half the length of *P. pallida* Luporini, Magagnini & Tongiorgi, 1971, a magnitude that has importance in this genus. TbA and TbP may overlap in numbers in adults of

the two species, but the fleshy hands that bear TbA in *Paraturbanella pacifica* (Schmidt 1974) are not as well developed and hence bear tubes all along their curvatures, whereas in *P. pallida* (Luporini et al. 1971) the hands are narrow and elongate, bearing tubes on their lateral and particularly on their medial edges. The 'dohrni' tube complex (Seitenfüschen) insert immediately behind the hands in *Paraturbanella pacifica*, whereas in *P. pallida* they are separated somewhat to the rear.

***Paraturbanella stradbrokei* Hochberg, 2002**  
[Ptb stbk]

*Paraturbanella stradbrokei* Hochberg, 2002: p. 313,  
figs. 2, 3 – **new species.**

**Remarks.** *Paraturbanella stradbrokei* is the proper epithet (text) for this species, not *helicostoma* (figs. 2 and 3 legend) [ICZN Art. 24.2.2.].

***Paraturbanella manxensis* new species**

[Ptb manx]

Fig. 21

**Diagnosis.** Adult Lt 660 µm; PhJIn at U32. Head narrowed in front into a ciliated muzzle and expanded behind, lacking lateral lobes, piston pits and tentacles; trunk maintains a similar width, narrowing gradually over the rear third of the body to the caudal base; caudum wide spread, moderately cleft, incised from its tips to U96, with a concave surface between the caudal lobes, bearing a small medial cone. Glands 14-15 per side at U21-U92, with a large space between the first and the others. TbA 6 per side, of unequal length, occur on fleshy hands at U13, none on the medial edge; TbVL 10 per side, of similar size/regular intervals, all in the intestinal region; TbL/TbD/TbV absent; 2 posteriolaterally directed 'dohrni' [Seitenfüschen] tubes per side (L=26 and 16 µm), insert ventrolaterally at U14, immediately behind the hands; TbP 8 per side, in 2 rows, with 5 inserting on the posterior edge and 3 (the 3rd, 5th and 7th from the outside) inserting ventrally on the trailing edge; tubes in the posterior row increase in length medial to apical, tubes of the interdigitating row are of similar, intermediate size. Locomotor ciliature: runs from the circumcephalic ring rearward in 2 longitudinal bands that trace

the gut margins and join again behind the anus. Mouth terminal, breadth narrow; mouth ring smooth and outwardly flared, lips of the cuticular lining projecting a bit beyond the head proper; buccal cavity large, mug-shaped, walls heavily cuticularized; pharynx narrows to the rear, basal pharyngeal pores borne on conspicuous knobs; intestine narrows toward the rear; anus ventral at U92. Hermaphroditic, probably simultaneous; paired testes extend rearward from before the PhJIn at U31, its vasa deferentia recurving to the fore and exiting behind the PhJIn at about U35; the developing ovum lies above the mid-gut.

**Description.** Adult Lt <660 µm; L to PhJIn <212 µm at U32. Body of medium length. Head, lacking lobes, piston pits and tentacles, tapers sharply from U09 forward to U04, then a gradually tapering muzzle continues to the oral opening; the rear pharyngeal region narrows and then expands gradually on through the foregut region; trunk broadest in the midgut region, then narrows gradually to the caudal base; caudum has short widespread lobes, incised medially only to U97, bearing a small medial cone; distance between apices of outermost TbP on either side is 2.1 times the width of the caudal base. Widths of oral opening/head/neck/trunk/caudal base-tips, and their locations along the body length are: 19/50/45/60/33-68 at U00/U09/U23/U58/U95-U100. Epidermal glands occur laterally on either side, with a large space between the anteriormost and the other 13-14, which are distributed from mid-pharyngeal region to the anus at U21-92.

Adhesive tubes. TbA 6 per side of unequal length, occur on fleshy hands that insert at U13, but with none clearly inserting on the medial edge; TbL are lacking in the pharyngeal region, but 10 per side of similar size occur at regular intervals in the intestinal region; TbD/TbV are absent; two posteriolaterally directed 'dohrni' [Seitenfüschen] tubes (L longer tube = 26 µm, shorter = 16 µm), which occur immediately behind the fleshy hands, insert ventrolaterally on either side at U14; TbP number 8 per side, occurring in two rows, with 5 inserting on the posterior edge and 3 (the 3rd, 5th and 7th from the outside) inserting on the ventral surface of the trailing edge; of tubes in the posterior row, the lateralmost is the longest, the medialmost the shortest, the others being of intermediate size; all

3 tubes in the interdigitating row are of similar, intermediate size; none of the tubes occur on the lateral, leading edges of the lobes.

**Ciliation.** Several elongate cilia ( $L = 10\text{--}20\ \mu\text{m}$ ) occur on either side of the mouth and a broad circumcephalic ring of cilia of similar size occurs on the entire muzzle; sensory hairs form lateral and dorsolateral columns, with 32/21 per side respectively. Ventral locomotor cilia ( $L = 30\ \mu\text{m}$ ) flow from the circumcephalic ring rearward in 2 longitudinal bands that trace the gut margins and join again behind the anus.

**Digestive tract.** mouth diameter is  $12\ \mu\text{m}$ ; mouth ring smooth and outwardly flared, lips of the cuticular lining projecting a bit beyond the head proper; buccal cavity large, mug-shaped, walls heavily cuticularized; pharynx widest anteriorly, narrows over its middle and posterior portions; basal pharyngeal pores are borne on conspicuous knobs; intestine is widest anteriorly but overall is narrower than in most species of the genus; anus is ventral at U92.

**Reproductive tract.** hermaphroditic, probably simultaneous; paired testes extend rearward from before the PhJIn at U31, its vasa deferentia likely recurving to the fore and exiting behind the PhJIn at about U35; the developing ovum, lying above the fore-gut, may reach at least  $70 \times 40\ \mu\text{m}$ .

**Ecology.** Sparse in frequency of occurrence (less than 10% of samples), rare to few in abundance (1-3 % of a sample); littoral in medium sand at 0-10 cm depth, HWN-LWS.

#### Geographical distribution:

ANE: British Isles: Isle Of Man {^Derby Haven {54°05'N/04°39'W} {OS Loc. SC-2867} June 1978 [H' Diversity Index=2.71, Based On S=13, N=168]}.

**Remarks.** Juvenile *Paraturbanella manxensis* n. sp.: Lt=260  $\mu\text{m}$ ; L to PhJIn =102  $\mu\text{m}$  at U39; LIn=120  $\mu\text{m}$ ; WTr=36  $\mu\text{m}$ . TbA 3 per side, TbL 1 per side, TbP 3 per side.

**Etymology.** The species is named after the Isle of Man on which it was found.

**Taxonomic affinities.** The tabular key of Clausen (1996, p. 123) is quite helpful, though several species have been added since then. To the five species currently in the genus *Paraturbanella* that have

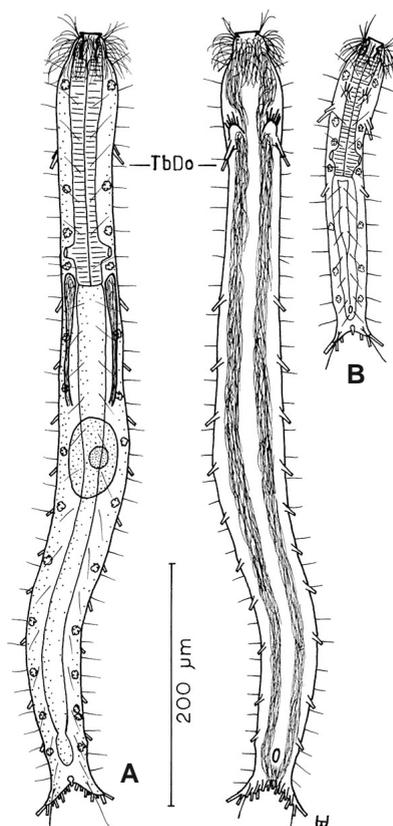
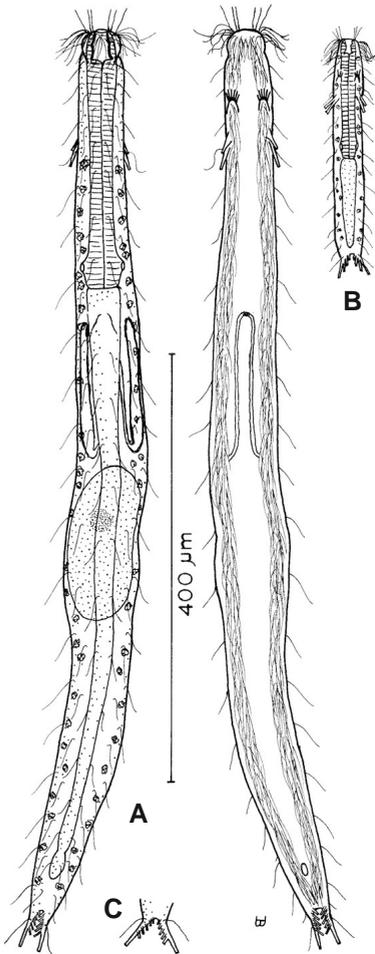


Fig. 21. *Paraturbanella manxensis* n. sp. A. dorsal and ventral views of early subadult (Lt=660  $\mu\text{m}$ ) from Derby Haven, Isle of Man, dorsal with adhesive tubes and digestive tract, ventral with adhesive tubes and locomotor ciliary bands. B. composite dorsal/ventral view of juvenile (Lt=260  $\mu\text{m}$ ), also from Derby Haven. Symbols as in previous figures, additionally with: TbDo, 'dohrni'-type [Seitenfüsschen] adhesive tubes.

TbL: *P. aggregotubulata* Evans, 1992; *P. armoricana* Swedmark, 1954; *P. eireanna* Maguire, 1976; *P. scanica* Clausen, 1996; and *P. stradbrokei* Hochberg, 2002, is added a sixth: *Paraturbanella manxensis* n. sp. Of these six species, only *Paraturbanella manxensis* n. sp. and *P. eireanna* (Maguire 1976) lack TbD, and only *P. manxensis*, *P. armoricana* (Swedmark 1954), *P. eireanna*, and *P. scanica* (Clausen 1996) have TbP forming double interdigitating rows on each caudal lobe.



**Fig. 22.** *Paraturbanella pediballeator* n. sp. **A.** dorsal and ventral views of early subadult (Lt=865 µm) from Hunstanton, England, dorsal with adhesive tubes and digestive tract, ventral with adhesive tubes and locomotor ciliary bands. **B.** composite dorsal/ventral view of juvenile (Lt=220 µm), also from Hunstanton. **C.** the small caudum is on occasion held wide-spread, as is more typical of the genus, rather than *en pointe* as is characteristic of this species, see A above.

***Paraturbanella pediballeator* new species**

[Ptb pdbl]

Fig. 22

**Diagnosis.** Adult Lt 865 µm; PhJIn at U28. Head, a bulblet, lacking lateral lobes, piston pits and tentacles; neck constriction slight at U3, trunk widens in the mid-pharynx region, then narrows gradually to the caudal base; caudum is slightly cleft, incised from its tips to U97, medial cone

absent; distance between apices of outermost TbP on either side varies considerably, depending on whether the caudal lobes are being held “*en pointe*” or in the more wide-spread position typical of the genus. Glands inconspicuous, ca. 30 per side. TbA 6 per side, the shortest inserting on the medial edge, occur on fleshy hands at U09; TbL/TbD/TbV absent; 2 posteriolaterally directed ‘dohrni’ [Seitenfüßchen] tubes per side (L=30 and 20 µm), occur ventrolaterally well behind the hands at U11 and are usually held close to the body; TbP 6 per side, the outermost being by far the longest, the others being shorter, of subequal length, and more medial in insertion. Locomotor ciliature: runs from the circumcephalic ring rearward in 2 longitudinal bands that trace the lateral body margins, joining again behind the level of the anus. Mouth terminal, breadth narrow; buccal cavity large, mug-shaped; walls heavily cuticularized; basal pharyngeal pores small but conspicuous; intestine elongate, narrow and indistinct; anus ventral at U90. Hermaphroditic, probably simultaneous; paired testes extend rearward from U31, well behind the PhJIn, its vasa deferentia recurving to the fore and exiting further behind at about U33; the developing ovum occurs in the mid-gut region.

**Description.** Adult Lt to 865 µm; L to PhJIn to 236 µm at U28. Body elongate. Head, a bulblet, lacking lateral lobes, piston pits and tentacles; neck constriction slight at U3, trunk widens in the mid-pharynx region, then thins gradually to the caudal base; caudum is slightly cleft, incised from its tips to U97; medial cone is absent; distance between apices of outermost TbP on either side varies considerably, from 1.0 to 2.3 times the width of the caudal base, depending on whether the caudal lobes are being held “*en pointe*” or in the more wide-spread position typical of the genus. Widths of head bulblet/neck/trunk/furcal base-tips, and their locations along the body length are: 35/32/70/20-22 to 50 at U02/U03/U58/U97-U100. Epidermal glands number ca. 30 per side along the lateral body margins, but are inconspicuous.

Adhesive tubes. TbA 6 per side (L=5-10 µm), the shortest one inserting on the medial edge, occur on fleshy hands that insert at U09; TbL/TbD/TbV are absent; two posteriolaterally directed ‘dohrni’ [Seitenfüßchen] tubes (L longer tube = 30 µm, shorter = 20 µm), which occur well behind the fleshy hands, insert ventrolaterally on

either side at U11, are usually held close to the body; TbP number 6 per side, the outermost being by far the longest ( $L=16\ \mu\text{m}$ ) and the others being much shorter ( $L=3-5\ \mu\text{m}$ ), more medial in insertion, and of subequal length, but with none occurring on the lateral, leading edges of the lobes.

**Ciliation.** Head is covered with sensory hairs ( $L=22-36\ \mu\text{m}$ ) that form a circumcephalic ring, with 3 others on each side of the mouth; sensory hairs of similar length occur on the trunk in lateral, dorsolateral and dorsal columns, with 22/18/20 per side. Ventral locomotor cilia ( $L=30\ \mu\text{m}$ ) flow from the circumcephalic ring rearward in 2 longitudinal bands that trace the lateral body margins, joining again behind the level of the anus.

**Digestive tract.** Mouth diameter is  $10\ \mu\text{m}$ ; buccal cavity large, mug-shaped; walls heavily cuticularized, but less so than in many species of the genus; basal pharyngeal pores are small but conspicuous; intestine broadest in front, but generally elongate, narrow and indistinct; anus is ventral at U90.

**Reproductive tract.** Hermaphroditic, probably simultaneous; paired testes extend rearward from U31, well behind the PhJIn, its vasa deferentia likely recurving to the fore and exiting further behind at about U33; the developing ovum, occurring in the mid-gut region, may reach  $150\ \mu\text{m}$ .

**Ecology.** Sparse (less than 10 % of samples) to locally common (30-60 % of samples) in frequency of occurrence, rare to few (1-3 % of a sample) in abundance; littoral in medium sand at 5-20 cm depth, MTL-LWN or locally HWN-LWS.

#### **Geographical distribution:**

**ANE:** British Isles: Channel Isles: {Guernsey: Petit Port, Vazon Bay, Jersey: Gorey, Ouaisne}; – England: Dorset {Studland}, Norfolk {^Hunstanton { $52^{\circ}56'N/00^{\circ}19'E$ }{OS Loc. Tf-6640} June 1979 [H' Diversity Index = 2.86, Based On  $S=13$ ,  $N=261$ ]}; – Scotland: Highland {Samalaman}. – Europe: France: Normandy {Courseules}.

**Remarks.** Juvenile *Paraturbanella pediballetor* n. sp.: Lt =  $220\ \mu\text{m}$ ; Lt to PhJIn =  $110\ \mu\text{m}$  at U50; LIn =  $80\ \mu\text{m}$ ; WTr =  $26\ \mu\text{m}$ . TbA 3 per side, TbP 4 per side.

**Etymology.** The species is named after its tendency like a ballet dancer to 'stand' *en pointe*.

**Taxonomic affinities.** To the 11 species currently in the genus *Paraturbanella* that lack TbL: *P. boadeni* Rao & Ganapati, 1968; *P. brevicaudata* Rao, 1991; *P. cuanensis* Maguire, 1976, ^*P. dohrni* Remane, 1927; *P. intermedia* Wieser, 1957; *P. mesoptera* Rao, 1970; *P. pacifica* Schmidt, 1974; *P. pallida* Luporini, Magagnini & Tongiorgi, 1971; *P. palpibara* Rao & Ganapati, 1968; *P. solitaria* Todaro, 1995; and *P. teissieri* Swedmark, 1954, is added a 12<sup>th</sup> species, *Paraturbanella pediballetor* n. sp. Of these 12 species, eight (*Paraturbanella boadeni* (Rao & Ganapati 1968), *P. brevicaudata* (Rao 1991), *P. dohrni* (Remane 1927), *P. intermedia* (Wieser 1957), *P. mesoptera* (Rao 1970), *P. pallida* (Schmidt 1974), *P. palpibara* (Rao & Ganapati 1968) and *P. solitaria* (Todaro 1995)) have pestle organs, one that lacks pestle organs (*P. pacifica* (Schmidt 1974)) has double rows of TbP, and two (*P. cuanensis* (Maguire 1976) and *P. teissieri* (Swedmark 1954)) have caudal cones, leaving *P. pediballetor* n. sp. as the only species of this group that lacks pestle organs, double rows of TbP, and a caudal cone. In addition, *Paraturbanella pediballetor* has a tiny caudum, with all but the exterior TbP being of similar size, and has a distinctive way as an adult of holding the caudum *en pointe*.

Genus *Turbanella* Remane, 1925

#### ***Turbanella bocqueti* Kaplan, 1958**

**sensu Boaden, 1974**

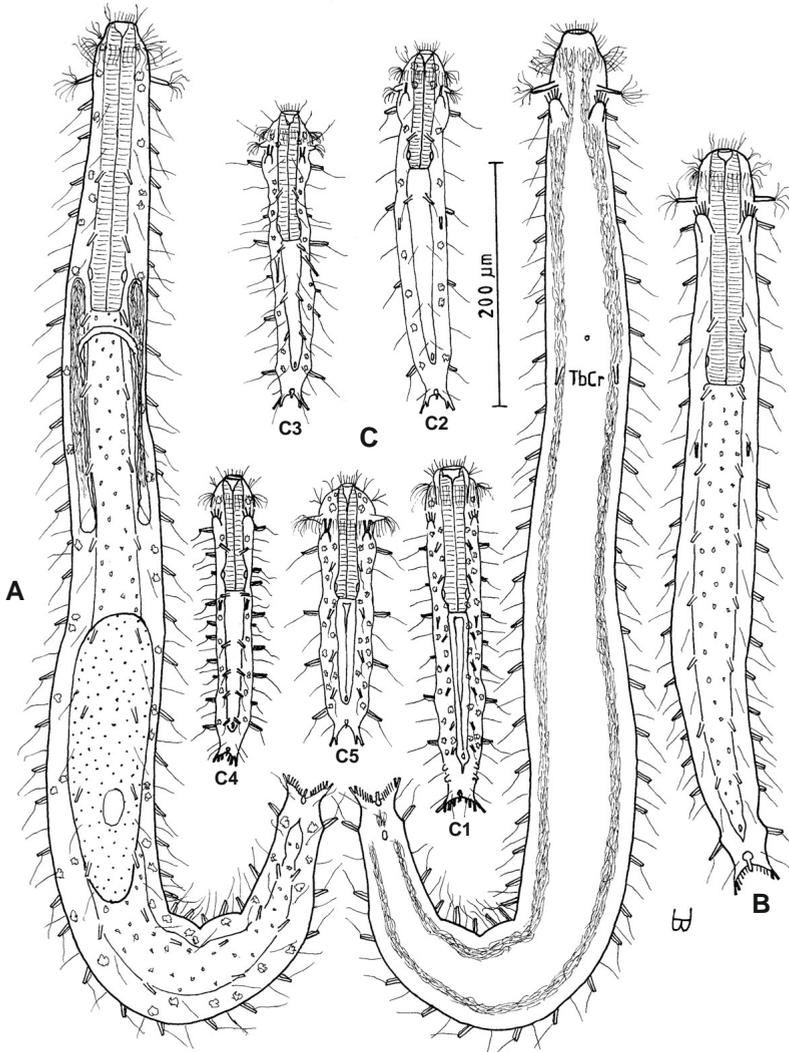
[Trb bocq]

*Turbanella bocqueti* Kaplan, 1958: p. 31; f. 2 – **new species**. Jouk et al. (1992: p. 87); Todaro et al (2000, p. 132).

*Turbanella thiophila* Boaden, 1974: p. 369; f. 2; Boaden (1975, f. 1h); Tongiorgi (1975, p. 276; f. 1); Hummon (1976, p. 319, Tables II, III); Potel (1986, p. 56, Figs. 34, 35); Potel & Reise (1987, p. 321, Table 1); Todaro (1992, p. 326); Todaro et al. (1992, p. 483); Balsamo et al. (1996, p. 177); Hummon in Jouk et al. (1992, p. 90). – **junior synonym**. Todaro et al. (2000, p. 132).

*Turbanella bocqueti* Kaplan, 1958 **sensu** Boaden (1974). Present paper (Figs. 23-24) – **redescription**.

**Diagnosis.** Adult Lt  $800-1320\ \mu\text{m}$ ; PhJIn at U02-U18. Body long, thick, but svelt; head narrowed in front, bears lateral rod-like tentacles



**Fig. 23.** *Turbanella boqueti* Kaplan *sensu* Boaden, 1974. **A.** dorsal and ventral views of adult (Lt=1060 µm) from Firemore Beach, Scotland, dorsal with digestive and reproductive tracts, and adhesive tubes, ventral with adhesive tubes and locomotor ciliary bands. **B.** composite dorsal/ventral view of subadult (Lt=615 µm), also from Firemore Beach. **C.** a set of juveniles of five *Turbanella* species in composite dorsal/ventral views: **C1**, *T. ambronensis* (Lt=290 µm), from Irvine Bay, Scotland; **C2**, *T. boqueti* (Lt=305 µm), from Firemore Beach; **C3**, *T. cornuta* (Lt=245 µm), from Firemore Beach; **C4**, *T. hyalina* (Lt=240 µm), from Hunstanton, England; and **C5**, *T. sp.* (Lt=216 µm), from Shinnecock Inlet, New York.

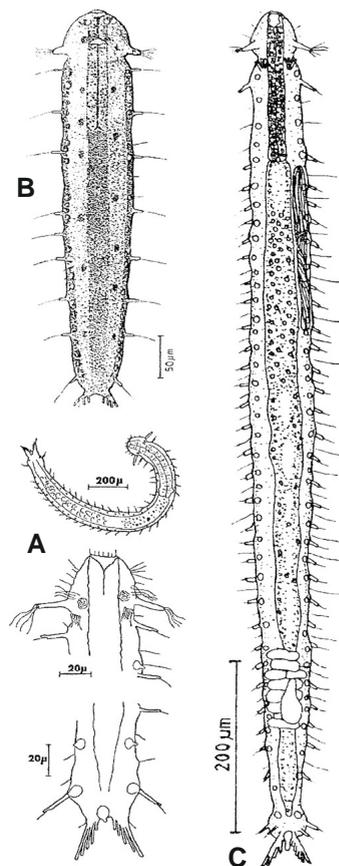
tipped with a loose tuft of sensory hairs at U04; neck constriction slight at the level of the TbA; trunk widest in the mid-gut region, thinning gradually to the caudal base; caudum is slightly cleft, incised from its tips to U95, with a concave surface between the caudal lobes that bears a medial cone. Glands 27-28 per side, small and inconspicuous. TbA 5-7 per side, medial-most being markedly

shorter than the others, on fleshy hands that insert at U07; TbL 12-29 per side (L=6-14 µm, the shorter ones just beginning to grow), evenly spaced but often asymmetrically arranged, with 5-6 along the pharynx and the others along the intestine, and 1 behind the anal opening, all bearing support structures; TbD 20 per side, with 2 in the rear half of the pharynx, 1 at the PhJIn and the others

along the intestine, none behind the anal opening; TbV absent; 'cirrata' tubes are short, but present at U26; TbP 5-10 per side, lengthening medial to lateral ( $L=6-10\ \mu\text{m}$ ), inserting along the trailing edge of each lobe. Locomotor ciliature runs from the circumcephalic ring rearward in 2 longitudinal bands that trace the lateral body margins, remaining separate throughout except in the head region, but with a post-anal ciliary patch. Mouth terminal, narrow; buccal cavity cup-shaped, shallow; walls lightly cuticularized; pharynx broad, with conspicuous basal pharyngeal pores; intestine broadest in the middle, narrow toward the rear, with a slight bulge at the anus; anus is ventral at U96. Hermaphroditic, probably simultaneous; paired testes extend back from the pharyngeal pores at U20, its vasa deferentia recurving to the fore and exiting behind the PhJIn at about U22; the developing ovum occurs in the mid-gut region.

**Description.** Adult Lt 800-1320  $\mu\text{m}$ ; L to PhJIn 182-293  $\mu\text{m}$  at U22-U18. Body long, thick but svelt; head narrowed in front, bears lateral rod-like tentacles ( $L=17-26\ \mu\text{m}$ ) tipped with a loose tuft of sensory hairs at U04; neck constriction slight at the level of the TbA; trunk widest in the mid-gut region, thinning gradually to the caudal base; caudum is slightly cleft, incised from its tips to U95, with a concave surface between the caudal lobes that bears a medial cone. Widths of apex/head at tentacles/trunk at PhJIn/mid-gut/furcal base, and their locations along the body length are: 23/47/51/90/27 at U00/U04/U22/U55/U92. Glands 27-28 per side, small (diam. 5-8  $\mu\text{m}$ ) and inconspicuous.

**Adhesive tubes.** TbA 5-7 per side ( $L=6-10\ \mu\text{m}$ , medial-most being markedly shorter than the others), occurring on fleshy hands that insert at U07; TbL 12-29 per side ( $L=6-14\ \mu\text{m}$ , the shorter ones just beginning to grow), evenly spaced but not always symmetrically arranged, with 5-6 along the entire pharynx and the remainder along the entire intestine, and 1 behind the anal opening, all bearing support structures; TbD 20 per side ( $L=10-15\ \mu\text{m}$ ), inserted 2 in the rear half of the pharynx, 1 at the PhJIn and the others along the intestine, none behind the anal opening, and none with support structures; TbV absent; 'cirrata' tubes are short, but present at U26; TbP 5-10 per side, lengthening medial to lateral ( $L=6-10\ \mu\text{m}$ ), forming a series along the trailing edge of each lobe.



**Fig. 24.** A. adult *Turbanella thiophila* Boaden, 1974; Fig. 2 (Lt=just over 1.2 mm) from Firemore Beach, Scotland, with head and tail regions magnified. B. early subadult *T. bocqueti* Kaplan, 1958; Fig. 2 (Lt=475  $\mu\text{m}$ ) from Cour-seules, France, dorso-ventrally compressed. C. adult *T. thiophila* (Lt=1285  $\mu\text{m}$ ) drawn by Potel, 1986; Fig. 56 from Litoralstation, Isle of Sylt, Germany. Note: B and C have a common scale.

**Ciliature.** Mouth is surrounded with short sensory hairs ( $L=5\ \mu\text{m}$ ), with 2 longer vibratile hairs at each side ( $L=8\ \mu\text{m}$ ); ciliary hairs ( $L=10\ \mu\text{m}$ ) form a circumcephalic ring at U06; sensory hairs of similar length ( $L=8-12\ \mu\text{m}$ ) occur on the trunk in lateral and dorsal columns, with 26-28 and 18-20 per side, respectively; in addition, each of the 27-29 TbL bears a cilium from the junction of the tube and its support. Ventral locomotor cilia ( $L=10\ \mu\text{m}$ ) run from the circumcephalic ring rearward in 2 longitudinal bands that trace the lateral body margins, remaining separate throughout except in the head region, but with a post-anal ciliary patch.

Digestive tract. Mouth terminal, width is 12  $\mu\text{m}$ ; buccal cavity cup-shaped, shallow; walls lightly cuticularized; pharynx broad throughout, with conspicuous basal pharyngeal pores; intestine broadest in the middle, narrow toward the rear, with a slight bulge at the anus; anus is ventral at U96.

Reproductive tract. Hermaphroditic, probably simultaneous; paired testes extend rearward from the pharyngeal pores at U20, its vasa deferentia recurving to the fore and exiting behind the PhJIn at about U22; the developing ovum, occurring in the mid-gut region, may reach 238 by 65  $\mu\text{m}$ .

**Ecology.** Occasional in frequency of occurrence (10-30 % of samples), scarce to prevalent in abundance (less than 3-5 % to more than 30 % of a sample in 20 % of samples where found, usually a co-dominant or dominant); littoral in fine to medium, medium to medium-well sorted (occasionally in very fine to very coarse, very poorly sorted), clean sand at 0-15 cm depth, MTL-LWS; sublittoral in fine, well sorted sand at 1-24 m water depth.

#### Geographical distribution:

**ANE:** British Isles: Channel Islands: {Guernsey: Vazon Bay}; – Ireland: {Castlegregory, Waterville}; – England: Cornwall {Enys, Looe, Whitesand Bay West}, Devon {Exmouth, Paignton, Saunton, Seaton Carew}, Norfolk {Brancaster}, Suffolk {Walton-On-The-Naze}, Yorkshire {Filey, Stoup Beck, Tynemouth}; – Isle Of Man: {Kirk Michael, Port Erin North}; – Northern Ireland: {Glenariff}; – Scotland: Dumfries & Galloway {Portlogan, Sandhead Beach, Turnberry}, Grampian {Collieston, Cruden, East Sands, Fraserburgh, Rattray Head}, Highland {Farr Beach, Firemore Beach Transect A, Gruinard Bay, Slaggan}, Strathclyde {Irvine Bay Transects A/C}, Tayside {Lunan Bay, Monifieth}; – Wales: {Borth, Llanbedrog, Morfa Nefyn}. – Europe: Belgium: {Bredene, Mariakerke, Zwin}; – France: Normandy {Ambleteuse, Courseules [49°18'N/00°28'W], Wimereux}; – Germany: Schleswig Holstein {Helgoland: Düne South}; Isle Of Sylt: Lister Ley, Litoralstation).

**MED:** Europe: Cyprus: {Agia Napa [2-Videos], Coral Bay [Video], Governor's Beach [Video]}, Konnos [2-Videos], Lachi, Yeroskipos}; – Greece: Attica: {Loutsas}, Crete: {Vai}, Macedonia: {Halkidiki Peninsula: Sani}, Rhodes: {Glystra, Ialiosos, Lindos, Tsambika}; Sporades: {Skiathos: Krassa}; – Italy: Campania: {Paestum}, Latium: {Anzio,

Montalto Marina}, Liguria: {San Remo [Video]}, Pelagie Archipelago: {Lampedusa: Spiaggia dei Conigli}, Puglia: {Cozze, Santa Maria di Leuca}, Sicily: {Agrigento, Punta Braccetto}, Tuscan Archipelago: {Capraia: Seno della Perruccia, Punta del Recisello, Elba: Fetovaia}, Tuscany: {Bagno Gorgona, Castiglione della Pescaia, Marina Donoratico, Punta Ala}. – Middle East: Egypt: {Arish East/West, Mamura [2-Videos], Rahman [Video]}; – Israel: {Ahziv [Video], Carmel Tombolo South, Netanya South}.

**ANW:** North America: Delaware {Roosevelt Inlet}, Massachusetts {Good Harbor [2-Videos], Plum Island South [Video]}, New York {Long Island: Shinnecock Inlet Inside/Outside}, Mississippi {Biloxi East}.

**Remarks.** There are 14 video sequences (noted above) available from 10 locations in European and Middle Eastern Mediterranean and north-eastern North America. Four of these are (or will soon be) available from <http://hummon.nas.biosci.ohiou.edu>: # 1861 a mature adult of  $L_t = 956 \mu\text{m}$  (LPh  $\sim 250 \mu\text{m}$ ) from Mt. Carmel S, Israel; # 2087 a mature adult of 953  $\mu\text{m}$  (LPh  $\sim 250 \mu\text{m}$ ) from Good Harbor, Massachusetts; # 1010 a subadult of  $L_t = 467 \mu\text{m}$  (LPh = 146  $\mu\text{m}$ ) from Governor's Beach Cyprus; and # 1018 a subadult of  $L_t = 320 \mu\text{m}$  (LPh = 129  $\mu\text{m}$ ) from Coral Bay, Cyprus. Fig. 23B Subadult *Turbanella bocqueti*:  $L_t = 615 \mu\text{m}$ ; L to PhJIn = 194  $\mu\text{m}$  at U31; LIn = 380  $\mu\text{m}$ ; WTr = 65  $\mu\text{m}$ . TbA 6, TbL 15, TbD 8, TbP 6 per side. Fig. 23C2 Juvenile *Turbanella bocqueti*:  $L_t = 305 \mu\text{m}$ ; L to PhJIn = 97  $\mu\text{m}$  at U33; LIn = 161  $\mu\text{m}$ ; WTr = 43  $\mu\text{m}$ . TbA 1, TbL 4, TbD 2, TbP 2 per side. The head development is variable from juvenile to subadult to adult, but the remainder is mostly metric and meristic change. Fig. 24 is included to illustrate why it was so difficult to recognize that the animal described and illustrated by Boaden (1974) was the same species as that treated by Kaplan (1958). Ecologically, they were reported to differ radically as well, Boaden's species being a thioibiont (habitat confirmed by Tongiorgi 1975), while Kaplan's was an oxybiont. I had been freed from this ecological burden when I found Boaden's species in the type locality under oxybiont conditions, indicating that it was at most a facultative and not an obligate thioibiont (Hummon 1975, confirmed by Potel & Reise 1987).

By comparison are the juveniles of five other species of *Turbanella*: Fig. 23C1 Juvenile *Turba-*

*nella ambronensis* Remane, 1943: Lt=290 µm; L to PhJIn =104 µm at U36; LIn=133 µm; WTr=43 µm. TbA 4, TbL 6-7, TbD 2, TbP 4 per side. Fig. 23C3 Juvenile *Turbanella cornuta* Remane, 1925: Lt=245 µm; L to PhJIn =107 µm at U44; LIn=108 µm; WTr=42 µm. TbA 2, TbL 6, TbD 4, TbP 2 per side. Fig. 23C4 Juvenile *Turbanella hyalina* Schultze, 1853: Lt=240 µm; L to PhJIn =96 µm at U40; LIn=117 µm; WTr=37 µm. TbA 4, TbL 8, TbD 6, TbP 3 per side. Fig. 23C5 Juvenile *Turbanella* of an as yet undescribed species: Lt=216 µm; L to PhJIn =95 µm at U44; LIn=87 µm; WTr=48 µm. TbA 2, TbL 4, TbD 4, TbP 2 per side. Thus, it is possible to identify the juveniles of *Turbanella* from a pool of known species, but only with care.

**Taxonomic affinities.** In the genus *Turbanella*, there are eight species that bear cone-like structures laterally on the head: *T. bengalensis* Rao & Ganapati, 1968; *T. cornuta* Remane, 1925; *T. indica* Rao, 1981; *T. mustela* Wieser, 1957; *T. otti* Schrom in Riedl, 1970; *T. petiti* Remane, 1952; *T. plana* (Giard, 1904); and *T. remanei* Forneris, 1961. Differentiable from them is the one species thus far described that exceeds all of the others in adult length and bears rod-like tentacles laterally on the head: *T. bocqueti* Kaplan, 1958 *sensu* Boaden (1974); it is *sensu* Boaden because Boaden was the first to see and name the adult specimen.

### *Turbanella caledoniensis* new species

[Trb cldn]

Fig. 25

**Diagnosis.** Subadult Lt 516 µm; PhJIn at U33 [adult <700 µm; PhJIn ~U30]. Head narrowed in front, broader behind, lacks lateral lobes, piston pits and tentacles; no neck constriction; body narrows fore to aft; caudum wide spread, only slightly cleft, with a concave surface between the caudal lobes incised to U98, medial cone absent. Glands 17-19 per side. TbA 4 per side, occurring on fleshy hands that insert at U19; TbL 7 per side, symmetrical, 1 in the fore half of the pharynx, 1 at the PhJIn and five evenly spaced along the intestine, none behind the anal opening; TbD 7 per side, 1 mid-pharynx, 1 in the rear near the pharyngeal pores (both pointing diagonally forward) and 5 along the intestine (all pointing diagonally backward), none behind the anal opening; TbV absent; 'cirrata' tubes insert at U35; TbP 5 per side, increasing in length medial to lateral.

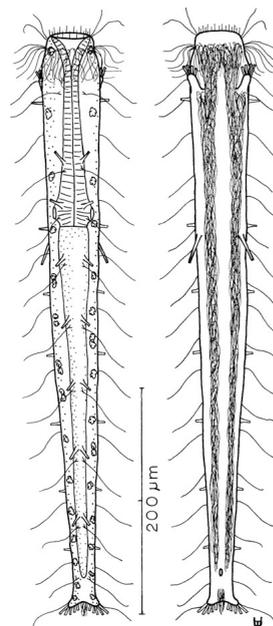


Fig. 25. *Turbanella caledoniensis* n. sp. dorsal and ventral views of early subadult (Lt=515 µm) from Firemore Beach, Scotland, dorsal with adhesive tubes and digestive tract, ventral with adhesive tubes and locomotor ciliary bands.

**Locomotor ciliature:** runs from the circumcephalic ring rearward in 2 longitudinal bands that trace the lateral body margins to the level of the anus, remaining separate except under the head, with a medial post-anal patch. Mouth terminal, broad for this genus; buccal cavity conical; walls lightly cuticularized; pharynx narrow broadening to the conspicuous basal pharyngeal pores; intestine narrows fore to aft; anus ventral at U93. Probably hermaphroditic; testes and ovaries not seen in immature specimens.

**Description.** Subadult Lt 516 µm; L to PhJIn 171 µm at U33. Body long, thin; head narrowed in front, broader behind, lacks lateral lobes, piston pits and tentacles; no neck constriction, the body narrowing gradually from head to the caudal base; caudum is wide spread, only slightly cleft, incised from its tips to U98, with a concave surface between the caudal lobes; medial cone is absent. Widths of apex/head (max.)/body (at PhJIn)/furcal base-tips, and their locations along the body length are: 40/51/31/18-43 at U01/U07/U33/U96-U100. Epidermal glands form a lateral column of 17-19 per side (diam. 4-5 µm).

Adhesive tubes. TbA 4 tubes per side ( $L=7-11\ \mu\text{m}$ ), occurring on fleshy hands that insert at U19; TbL 7 per side, symmetrically arranged, inserted 1 in the fore half of the pharynx, 1 at the PhJIn and the other five evenly spaced along the intestine, none behind the anal opening, locations at U12, U33, U44, U55, U67, U78 and U89; TbD 7 per side, 1 inserted midway along the pharynx and 1 in the rear half near the pharyngeal pores (both pointing diagonally forward), with 5 others along the intestine (all pointing diagonally backward), none behind the anal opening, locations at U22, U30, U39, U44, U60, U71 and U83; TbV are absent; 'cirrata' tubes ( $L=22\ \mu\text{m}$ ) insert at U35; TbP 5 per side, increasing in length ( $L=4<8\ \mu\text{m}$ ) from medial to apical, forming a series around the lobe with the main tube posteriolateral and the others on the medial or inside edge.

Ciliature. Mouth is surrounded with short sensory hairs ( $L=5\ \mu\text{m}$ ), with a pair of longer vibratile hairs at each side ( $L=22$  and  $32\ \mu\text{m}$ ); ciliary hairs ( $L=25-30\ \mu\text{m}$ ) form a circumcephalic ring at U03; sensory hairs occur at regular intervals along the trunk in lateral and dorsal columns, with those of each column being of similar length ( $L=30-36\ \mu\text{m}$  and  $L=40-50\ \mu\text{m}$ ) with 10/9 per side, respectively, but none associated with TbL. Ventral locomotor cilia ( $L=20\ \mu\text{m}$ ) flow from the circumcephalic ring rearward in two longitudinal bands that trace the lateral body margins to the level of the anus, remaining separate throughout except in the head region, but with a medial post-anal patch whose free ends extend beyond the caudum.

Digestive tract. Mouth diameter is  $32\ \mu\text{m}$ ; buccal cavity conical; walls lightly cuticularized; pharynx narrow behind the buccal cavity, broadening toward the rear, with conspicuous basal pharyngeal pores; intestine broadest in front, narrowing toward the rear; anus is ventral at U93.

Reproductive tract. No information, specimens being reproductively immature.

**Ecology.** Sparse in frequency of occurrence (less than 10 % of samples), rare to few in abundance (1-3 % of a sample); littoral in fine, medium-well sorted, clean sand at 0-10 cm depth LWN-LWS.

#### Geographical distribution:

**ANE:** British Isles: Scotland: Highland {Firemore Beach Transects  $^{\wedge}A/D$  {57°49'N/05°41'W} {OS Loc. NG-8188} August 1974-April 1975}.

**Remarks.** The only specimens of *Turbanella caledoniensis* n. sp. found were subadults; adults can be expected to differ in being proportionately larger in all dimensions, reaching a length of perhaps 650-700  $\mu\text{m}$  with the intestinal region growing more than the pharyngeal, so that the PhJIn will tend to shift to lower U-numbers, perhaps U28-U30; the body conformation can be expected to change from being widest in front to being widest in the fore-intestinal region; the body also will have additional sensory hairs and adhesive tubes. In the main, the eidostic pattern of the anterior and posterior ends is not expected to change; a mature adult will be recognizable as belonging to this species.

**Etymology.** The species is named after the ancient Roman designation for Scotland, Caledonia.

**Taxonomic affinities.** There are two species in the genus that have a mouth broader than usual: *T. ambronensis* Remane, 1943 (= *T. italica* Gerlach, 1953; *T. cirrata* Papi, 1957; and *T. digitifera* d'Hondt, 1965 or *T. ambronensis* var. *digitifera* d'Hondt, 1965 [d'Hondt, 1971]) and *T. veneziana* Schrom, 1972. To these two species can be added another, the 23<sup>rd</sup> species in the genus: *T. caledoniensis* n. sp. While both *T. caledoniensis* and *T. ambronensis* have 'cirrata' tubes, they are lacking in *T. veneziana* (Schrom 1972); *T. caledoniensis* n. sp. and *T. veneziana* (Schrom 1972) have many fewer adhesive tubes in all the tube series (TbA, TbL, TbD, TbP) than *T. ambronensis*; and, while *T. ambronensis* and *T. veneziana* both have caudal cones, this feature is missing in *T. caledoniensis*.

#### *Turbanella mikrogada* new species

[Trb mcgd]

Fig. 26

**Diagnosis.** Subadult Lt 300  $\mu\text{m}$ ; PhJIn at U44 [adult <700  $\mu\text{m}$ ; PhJIn ~U35]. Body svelt; head ovoid, lacks lateral lobes, piston pits and tentacles; slight neck constriction along the pharynx; trunk widens in the fore-gut, then thins behind, widening but briefly for the last TbL; caudum moderately cleft, incised from its tips to U93, with a concave surface between the lobes that bears a small medial cone. Glands not seen. TbA 2 per side insert on the narrow apices of the fleshy hands that insert at U17- U20; TbL 5 per side, symmetrical, all bearing support structures, 1 in the fore half of

the pharynx, none in the rear half, and 4 unevenly spaced along the intestine, with none behind the anus; TbD 9 per side, of two types: 3 single tubes, 2 in the pharyngeal region, and 1 in the hind-gut region, and 3 sets of double tubes, all inserting in the intestinal region; TbV and 'cirrata' tubes absent; TbP 3 per side, 1 located distally and 2 medially on each lobe. Locomotor ciliature: runs from the circumcephalic ring rearwards in 2 longitudinal bands that trace the lateral body margins, narrowest medially at the insertion of the hands, then separating from mid-pharynx to U85. Mouth terminal, breadth narrow; buccal cavity goblet-shaped, shallow; walls lightly cuticularized; pharynx narrower in the middle than at both ends, with conspicuous basal pharyngeal pores; intestine narrows fore to aft; anus ventral at U85. Probably hermaphroditic; testes and ovaries not seen in immature specimens.

**Description.** Subadult Lt 300  $\mu\text{m}$ ; L to PhJn 132  $\mu\text{m}$  at U44. Body short, svelt; head ovoid, lacks lateral lobes, piston pits and tentacles; neck constriction slight at two-thirds the way back along the pharynx, trunk widens in the fore-intestinal region, then thins gradually toward the anus, broadens abruptly for the last TbL and then narrows to the caudal base; caudum is moderately cleft, incised from its tips to U93, with a concave surface between the caudal lobes; a small medial cone is present. Widths of apex/head (max.)/neck (min.)/trunk (max.)/(min.)/trunk (at last TbL)/furcal base,tips, and their locations along the body length are: 17/46/36/45,32/45/21,43 at U00/U10/U28/U46,U81/U84/U91,U100. Epidermal glands were not seen.

Adhesive tubes. TbA 2 per side (L-10  $\mu\text{m}$  medially and 12  $\mu\text{m}$  laterally) insert on the narrow forward edge of the hand, occurring on fleshy hands that insert at U17 medially and U20 laterally; TbL 5 per side (1<sup>st</sup> and 5<sup>th</sup> L=12  $\mu\text{m}$ , 2<sup>nd</sup> through 4<sup>th</sup> L=8 $\mu\text{m}$ ), which are symmetrically arranged and all bearing support structures, and are inserted 1 in the fore half of the pharynx at U17 and none in the rear half, with 4 others unevenly spaced along the intestine at U46, U58, U68 and U84, none behind the anal opening; TbD 9 per side, of two types: 3 single tubes (L=7-10  $\mu\text{m}$ ), 2 inserting in the pharyngeal region at U11 and U29, and 1 in the rear intestinal region at U76, and 3 sets of dual tubes (L=9-11  $\mu\text{m}$  for the lateral tube and L=8-12  $\mu\text{m}$  for the medial tube, the latter all inserted in the intestinal region at U49, U59 and

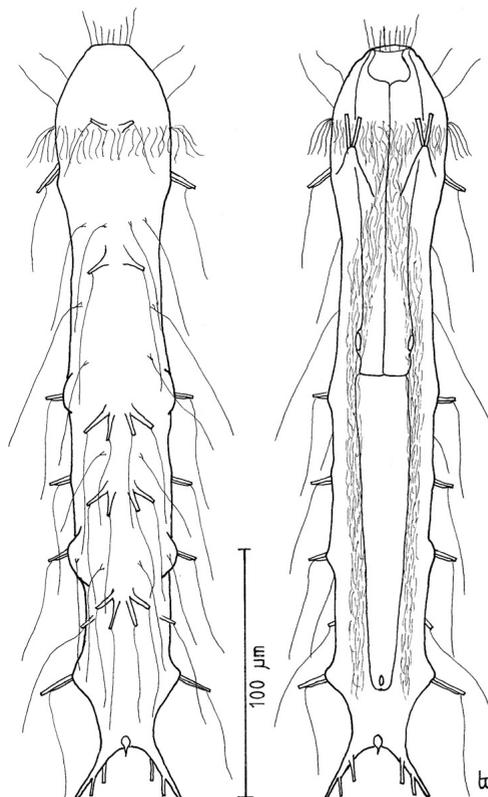


Fig. 26. *Turbanella mikrogada* n. sp. dorsal and ventral views of early subadult (Lt=300  $\mu\text{m}$ ) from Nobska Beach, Massachusetts, dorsal with adhesive tubes, ventral with digestive tract, adhesive tubes and locomotor ciliary bands.

U74; TbV and 'cirrata' tubes are absent; TbP 3 per side, forming a series around the medial edge of the lobe, with 1 distal (L=10  $\mu\text{m}$ ) and 2 medial (L=6-8  $\mu\text{m}$ ), none inserting on the lateral edges of the lobes. TbL show obvious thick duo-gland structure, which is not true of the TbA, TbD or TbP.

**Ciliature:** mouth is surrounded with flexible sensory hairs (L=7-18  $\mu\text{m}$ ), with two longer vibratile hairs on each side of the face (L=18-24  $\mu\text{m}$ ); ciliary hairs (L=8-15  $\mu\text{m}$ ) form a circumcephalic ring at U11; longer flexible sensory hairs (L=45-55  $\mu\text{m}$ ) trail rearward from each of the TbL and TbD, with others (L=60-80  $\mu\text{m}$ ) trailing rearward from the body in lateral and dorsal columns, 4/3 per side, respectively. Ventral locomotor cilia (L=12  $\mu\text{m}$ ) flow from the circumcephalic ring rearward in 2 longitudinal bands that trace the lateral body margins, narrowest medially at the level where

the fleshy hands insert, then remaining separate from the mid-pharyngeal region to the level of the anus.

Digestive tract. Mouth diameter is 11  $\mu\text{m}$ ; buccal cavity goblet-shaped, shallow; walls lightly cuticularized; pharynx broad at both ends, narrower in the middle, with conspicuous basal pharyngeal pores; intestine broadest in front, narrowing toward the rear; anus is ventral at U85.

Reproductive tract. No information, specimens being reproductively immature.

**Ecology.** Occasional in frequency of occurrence (10-30 % of samples), rare in abundance (less than 1 % of a sample); littoral in very fine to very coarse, very poorly-sorted, clean, morainal sand, at MLW-MTL.

#### Geographical distribution:

**ANW:** North America: Massachusetts {<sup>^</sup>Nobska Beach {41°31'N/70°40'W} June 1969}

**Remarks.** The only specimens of *Turbanella mikrogada* n. sp. found were subadults; adults can be expected to differ in being proportionately larger in all dimensions, reaching a length of perhaps 600-700  $\mu\text{m}$  with the intestinal region growing more than the pharyngeal, so that the PhJIn will tend to shift to lower U-numbers, perhaps U30-U35; the body also will have additional sensory hairs and adhesive tubes. In the main, the eidostic pattern seen here is not expected to change; a mature adult will be recognizable as belonging to this species.

**Etymology.** The species is named: *mikros* Gr. a. *gados* Gr. m. meaning 'little cod', after the codfish for which Cape Cod was famously named.

**Taxonomic affinities.** Most species of *Turbanella* that do not bear corns or tentacles, or have broader than normal mouths have sculpted profiles, including: *T. brusci* Hochberg, 2002; *T. corderoi* Dioni, 1960; *T. hyalina* Schultze, 1853; *T. lutheri* Remane, 1952; *T. multidigitata* Kisielewski, 1987; *T. pacifica* Schmidt, 1974; *T. pontica* Valkanov, 1956; and *T. subterranea* Remane, 1934. Only *Turbanella ocellata* Hummon, 1974b; *T. palaciosi* Remane, 1952 and *T. aminensis* Rao, 1991, *T. mikrogada* n. sp. and the species to be described next can be said to have bulbar or bullet-shaped heads; these five species will be differentiated following the next new species description.

#### *Turbanella scilloniensis* new species

[Trb scln]

Fig. 27

*Turbanella* sp. E of Hummon & Warwick, 1990: p. 523.

**Diagnosis.** Subadult Lt 460  $\mu\text{m}$ ; PhJIn at U53 [adult <800  $\mu\text{m}$ ; PhJIn ~U40]. Body svelt; head bulbar, lacks lateral lobes, piston pits and tentacles; slight neck constriction near mid-pharynx, trunk widens behind, then thins gradually to the caudal base; caudum is slightly cleft, incised from its tips to U97, with a flattened surface between the caudal lobes, medial cone absent. Glands 75 per side, tiny. TbA 11 thin tubes per side from the medial to the forward edge of the hand, increasing in length medial to lateral, occurring on fleshy hands that insert at U19; TbL 6 per side, symmetrical, 1 in the mid-pharynx, 2 in the rear pharynx, with 3 others evenly spaced along the intestine, none behind the anal opening; TbD 4 per side, 1 mid-pharynx, 1 near the pharyngeal pores, with 2 others in the fore and rear of the intestine, none behind the anal opening; TbV and 'cirrata' tubes absent; TbP 7 per side, of similar size, forming a series surrounding the lobe with 2 located posteriolaterally, 2 others on the lateral or outside edge and 3 more on the medial or inside edge. TbL/TbD show obvious thick duo-gland structure, which is not true of the thin TbA or normal TbP. Locomotor ciliature: runs from the circumcephalic ring rearward in 2 longitudinal bands that trace the lateral body margins, separate throughout except in the head region. Mouth terminal, breadth narrow; buccal cavity cup-shaped, shallow; walls lightly cuticularized; pharynx broad, with conspicuous basal pharyngeal pores; intestine narrows fore to aft; anus ventral at U94. Probably hermaphroditic; testes and ovaries not seen in immature specimens.

**Description.** Subadult Lt 460  $\mu\text{m}$ ; L to PhJIn <243  $\mu\text{m}$  at U53. Body short, thick but svelt; head bulbar, lacks lateral lobes, piston pits and tentacles; neck constriction slight at one-third the way back along the pharynx, trunk widens in the mid-pharynx region, then thins gradually to the caudal base; caudum is slightly cleft, incised from its tips to U97, with a flattened surface between the caudal lobes; medial cone is absent. Widths of apex/head (max.)/neck (min.)/trunk (max.)/furcal base-tips, and their locations along the body

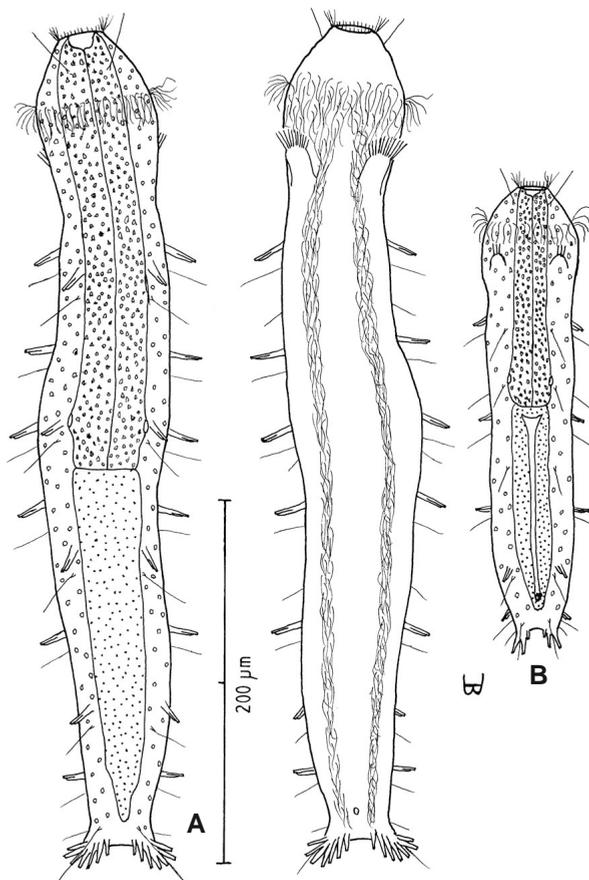


Fig. 27. *Turbanella scillonensis* n. sp. A. dorsal and ventral views of early subadult (Lt=460 µm) from Old Quay Flats, St. Martin's, Isles of Scilly, England, dorsal with adhesive tubes and digestive tract, ventral with adhesive tubes and locomotor ciliary bands. B. composite dorsal/ventral view of juvenile (Lt=270 µm), from Little Porth Cessa, St. Mary's, Isles of Scilly, England.

length are: 26/65/51/72/32-61 at U00/U09/U21/U46/U94-U99. Epidermal glands many, but are small and inconspicuous, numbering ca. 75 per side along the lateral body margins, giving the body a yellowish cast.

**Adhesive tubes.** TbA 11 thin tubes per side (L=5 µm medially, increasing to 10 µm laterally) from the medial to the forward edge of the hand, occurring on fleshy hands that insert at U19; TbL 6 per side, symmetrically arranged, inserted 1 at the mid-point of the pharynx and 2 in the rear half, with 3 others evenly spaced along the intestine, none behind the anal opening, locations at U26, U38, U47, U56, U71 and U89; TbD 4 per side, inserted 1 midway along the pharynx and 1 in the rear half near the pharyngeal pores, with 2 others in the fore and rear of the intestine, none behind

the anal opening, locations at U28, U46, U62 and U81; TbV and 'cirrata' tubes are absent; TbP 7 per side, all of about the same length (L=8-10 µm), forming a series around the lobe with the main 2 located posteriolaterally, 2 others on the lateral or outside edge and 3 more on the medial or inside edge. TbL and TbD show obvious thick duo-gland structure, which is not true of the thin TbA or normal TbP.

**Ciliature.** Mouth is surrounded with short sensory hairs (L=2 µm), with a tuft of longer vibratile hairs at each side (L=8 µm); a long solitary hair (L=30 µm) inserts on each side of the head at U05; ciliary hairs (L=15 µm) form a circumcephalic ring at U08; sensory hairs of similar length (L=18-25 µm) occur on the trunk in lateral and dorsal columns, with 7/5 per side,

respectively, the last in the dorsal series being longer ( $L = 48 \mu\text{m}$ ) than the rest, but none associated with TbL. Ventral locomotor cilia ( $L = 12 \mu\text{m}$ ) flow from the circumcephalic ring rearward in 2 longitudinal bands that trace the lateral body margins, remaining separate throughout except in the head region.

Digestive tract. Mouth diameter is  $14 \mu\text{m}$ ; buccal cavity cup-shaped, shallow; walls lightly cuticularized; pharynx broad throughout, with conspicuous basal pharyngeal pores; intestine broadest in front, narrow toward the rear; anus is ventral at U94.

Reproductive tract. No information, specimens being reproductively immature.

**Ecology.** Occasional in frequency of occurrence (10-30 % of samples), rare to scarce in abundance (1-5 % of a sample); littoral in a sand flat of fine, medium to well sorted, clean sand at 0-10 cm depth LWN-LWS.

#### Geographical Distribution:

**ANE:** British Isles: England: Isles Of Scilly {St. Martin's: ^Old Quay Flats {49°57'N/06°17'W} [OS Loc. SV-9215] May 1988, St. Mary's: Little Porth Cressa}.

**Remarks.** *Turbanella scilloniensis* n. sp. is fast, acrobatic, and very delicate. TbP series reminds one somewhat of those in *Desmodasys*. The only specimens found were subadults; adults can be expected to differ in being proportionately larger in all dimensions, reaching a length of perhaps 700-800  $\mu\text{m}$  with the intestinal region growing more than the pharyngeal, so that the PhJIn will tend to shift to lower U-numbers, perhaps U40-U45; the body also will have additional sensory hairs and adhesive tubes. In the main, the eidostic pattern seen here is not expected to change; a mature adult will be recognizable as belonging to this species. Juvenile: Lt = 270  $\mu\text{m}$ ; L to PhJIn = 121  $\mu\text{m}$  at U45; TbA 3 per side, TbL 4 per side, TbD 1 per side, TbP 4 per side.

**Etymology.** The species is named after the mystical Isles of Scilly in which it was found.

**Taxonomic affinities.** *Turbanella mikrogada* n. sp. and *T. scilloniensis* n. sp., the 23<sup>rd</sup> and 24<sup>th</sup> species of the genus, both have bulbar or bullet-shaped heads, though they have little else in common. Unfortunately, both species descriptions have been

based on subadults, so differentiation between species must be made on the basis of unchanging patterns of morphology and on projections of changing features from subadult into the adult state. Of the five species that might be confused with one another, differentiation can be made based on the pattern of adhesive tubes per side in the pharyngeal region: *T. aminensis* (Rao 1991), has TbL and TbD in the rear half, but none in the fore half; *T. mikrogada* n. sp. has TbL in the fore half, but not in the rear half, and has unusual TbD with one in the fore half and one in the rear half, with six pairs in the intestinal region, a unique condition that does not occur in any other member of the genus; *T. ocellata* (Hummon 1974b), has TbL along both the fore and rear halves and TbD only near the base of the pharynx; *T. palaciosi* (Remane 1952), has TbL only in the rear half and no TbD in the pharyngeal region; *T. scilloniensis* has TbL and TbD only along the rear half, and alone of these species has TbP that are arranged around the caudal lobes onto the lateral surfaces.

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## Biodiversity, morphology and ecology of small benthic organisms

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Volume 16

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