

GASTROTRICHA FROM BEAUFORT, NORTH CAROLINA, U.S.A.

by

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Résumé

Thaumastoderma heideri et *Aspidiophorus mediterraneus* sont signalés ; *Turbanella ocellata* n.sp., *Aspidiophorus paramediterraneus* n.sp. et *Aspidiophorus multitubulatus* n.sp. sont décrits du sable argileux de la zone intercotidale la plus basse de Pivers Island, Beaufort, North Carolina. De plus, *Chaetonotus oligohalinus* n.sp. est décrit des détritiques benthiques contenus sous les eaux de basse salinité d'un réservoir expérimental à Pivers Island.

Introduction

Thus far the Gastrotricha known from North Carolina are restricted to the report of Hawkes (unpubl. MS thesis), from the freshwater habitat, and those of Schoepfer-Sterrer (1969) and Ruppert (1970) from the marine habitat. None of the species treated herein has been previously reported from this region.

Methods and Materials

Collections were made throughout the summer of 1966, while I was attending the Duke University Marine Laboratory, Beaufort, North Carolina, and once during the summer of 1970. Sand containing all but one of these animals was obtained from the thin beach at the base of a sea wall below the Duke Oceanographic Laboratory on Pivers Island. This beach faces the main boat channel leading to the town of Beaufort and is subject to periodic wave wash owing to the passage of fishing boats. The beach is also subject to occasional stress conditions such as: a) siltation resulting from dredging operations, designed to maintain channels leading from the sea to both Morehead City and Beaufort, and b) reduced salinity associated with the northward movement of tropical storms.

Normal conditions in the Beaufort Channel during June of 1966 included the following: air temperature, 17.5 to 26°C; water temperature, 20.5 to 23.5°; and water salinity, 35 p. 1,000. Tidal amplitude

ranged from 75 to 125 μm . Sand was analysed granulometrically, using wet sieves for -1, 0, 1, 2, 3 and 4 ϕ sizes and standard pipette methods for 5 and 6 ϕ sizes. Results, calculated after Inman (1952), were $M 0 = 2.2$ (218 μm and $\sigma 0 = 0.5$). Energy of waters off the beach would have to be considered low to moderate and somewhat variable over time as evidenced by relatively fine grain sizes and moderate sorting of the sand. Roundness, measured after Powers (1953), indicates that grains are angular to subangular ($x = 0.242 \pm \text{SE}x = 0.001$; $n = 100$). Only about 5 % of the grains were carbonate, the remainder being silicious.

Lengths and widths of morphological characters are given in micrometers (μm); all body measurements are taken so as not include scales. Locations of morphological characters along the length of body are given in percentage units (U), measured from anterior to posterior. All specimens were studied in the living condition; type and other specimens of two species described herein have been sent to the U.S. National Museum (USNM), Washington, DC U.S.A.

ORDER MACRODASYIDA Remane, 1925

Family *Thaumastodermatidae* Remane, 1926, *sensu* Hummon, 1974

Genus *Thaumastoderma* Remane, 1926

Thaumastoderma heideri Remane, 1926

Specimens rarely encountered; mostly adults, though no specimens with well-developed ova were noted. The one discussed below was typical of the few specimens observed. Total length 218 μm ; max. head width 42 μm ; min. neck width 35 μm ; and max. trunk width 64 μm . Specimens were longer and stouter than those found at Kiel, Germany (Remane, 1926), but were shorter and stouter than those from Naples, Italy (Remane, 1927 a) and Waltair, India (Ganapati and Rao, 1967). Head rugose, not smoothly rounded, with one pair of dorsal and two pairs of lateral cephalic tentacles; lengths of lateral cephalic tentacles, 19 (anterior) and 9 (posterior) μm ; posteriolateral cephalic tentacle was of the "heideri" type, elongate-spatulate in shape and narrowing gradually toward the base.

Adhesive tubes present in anterior, posterior and ventrolateral series, along with several dorsolateral pairs of elongate cirriform tentacles. Anterior tubes 5 per side, inserting directly on the ventral surface and located in a semi-continuous arc behind the mouth; posterior tubes with paired feet projecting from the posterior trunk border and 6 additional tubes inserting directly on the trunk between the feet; each posterior foot made up of 2 large tubes, fused at their bases and diverging at their tips, and a smaller, mediodorsal tube inserting in the fusion zone between the 2 larger tubes; ventrolateral tubes with about 20 per side, mostly located posterior to openings of the pharyngeal pores; dorsal tentacles of 5 pairs, distributed more or less evenly along the length of body, but less distinct than usually figured.

Cuticular armature of tetrancreas, with lengths of individual prongs not exceeding 6 μm . Granular eye spots present, but not distinctly colored, agreeing with specimens reported from Manai Straits, Wales (Boaden, 1963). Pharyngointestinal junction present at U29, anus at U81; pharyngeal pores not easily seen.

These specimens were identified as *T. heideri*, despite the lack of brightly colored eye spots. Such variability in eye spot coloration is not uncommon. Tentacle and adhesive tube characters, as well as other features of the Beaufort specimens, agree well with the range of descriptive information published on animals previously identified as *T. heideri* (in addition to the above cited references, see Gerlach, 1961).

This constitutes the first report of this species from North America.

Family Turbanellidae Remane, 1925, *sensu* Hummon, 1974

Genus *Turbanella* Schultze, 1853

Turbanella ocellata n. sp.

(Fig. 1-3; Table I)

Holotype:

Adult, 660 μm long; Pivers Island, Beaufort, North Carolina, U.S.A. (lat. 34°43'N, long. 76°40'W), lower intertidal in detrital marine sand; August, 1970, W.D. Hummon, col.; relaxed in MgCl_2 (6 p. 100), fixed in formalin (10 p. 100), mounted in glycerine jelly and sealed with nail polish, USNM 51575.

Description:

Holotype adult (Figs 1, 2), a *Turbanella* with head bluntly rounded anteriorly, forming two shallow lobules on each side, U1-8 and U8-14, beneath the second of which are inserted the ventroanterior feet at U12; body narrows slightly in the mid-pharyngeal region forming a neck at U14, then gently expands in a series of shallow wave-like undulations (terminated at their crests by lateral adhesive tubes) to a maximal width in the anterior intestinal region, U42-52, and then narrows gradually to the base of the caudal lobes at U96; caudal lobes are short, rounded and spreading; mediocaudal cone rudimentary or absent. Max. head width 56 μm ; min. neck width 47 μm ; max. trunk width 65 μm ; min. width at base of caudal lobes 37 μm ; max. width of caudal lobes 42 μm ; and max. width between tips of outermost caudal adhesive tubes 66 μm .

Adhesive tubes present in anterior, posterior, lateral and dorsolateral series, along with a single pair of posteriorly directed ventral "cirrata" tubes. Anterior tubes 7 per side, 5 to 8 μm long, borne on a well-developed pair of ventral feet; posterior tubes 12 per side, 9 to 11 μm in length, appearing to decrease in length from lateral to medial, but in actuality with only the lateral most tube of each lobe inserting on the posterior lobe margin and the others inserting more and more ventrally and subterminally as the series progresses medially; lateral tubes 18 per side, 9 to 12 μ in length, implanted somewhat ventrolaterally and distributed more or less regularly from U11-96 with good bilateral symmetry; dorsal tubes 15 per side, 8 to 12 μ in length, decreasing gradually in length and separation from anterior to posterior and distributed from the posterior pharyngeal region nearly to the base of the caudal lobes, from U25-98, with fair bilateral symmetry; finally, one pair of 9 μ long, posteriorly directed adhesive tubes, of the sort first noted by Papi (1957) in *T. cirrata* (junior synonym of *T. ambronensis* Remane, 1943) are inserted at U30.

Cilia 10 to 12 μm long form a circumcephalic ring at U5 and extend medioventrally in a tract of 16 to 18 μm width to U26; independent ventrolateral tracts of similar sized cilia extend posteriorly from the base of the anterior tube-bearing feet at U12 to the base of the caudal lobes at U96,

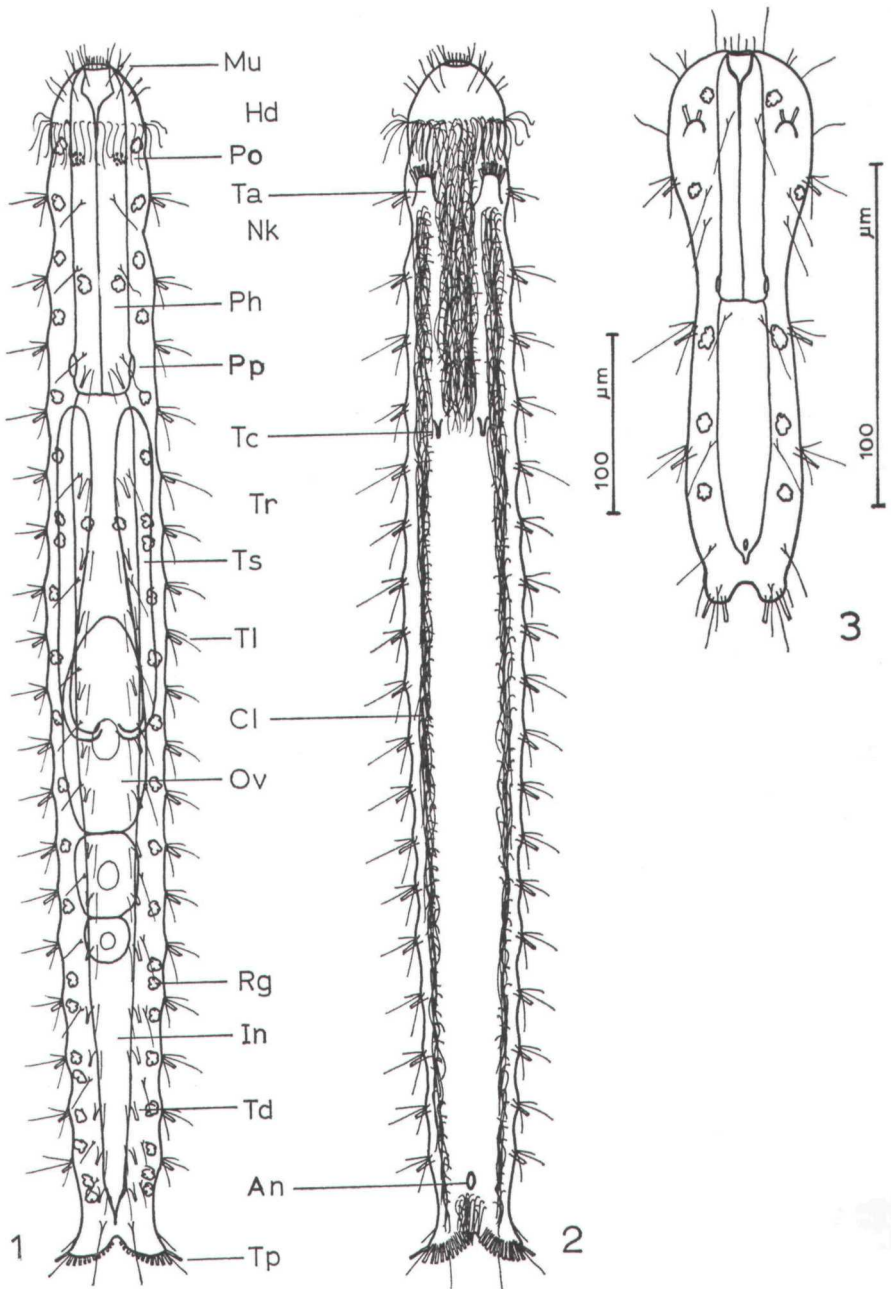


FIG. I

Turbanella ocellata n.sp.

1: dorsal view of adult, including digestive and reproductive systems; 2: ventral view of adult; 3: composite dorsal and ventral views of juvenile without ventral ciliation.

Head (Hd), neck (Nk), and trunk (Tr); anterior (Ta), lateral (Tl), dorsal (Td), posterior (Tp) and "cirrata" (Tc) adhesive tubes; ventral cilia (Cl), glandular refractile bodies (Rg) and ocellar pigment granules (Po); mouth (Mu), pharynx (Ph), pharyngeal pores (Pp), intestine (In) and anus (An); and testis (Ts) and ovum (Ov).

each tract narrowing in width from ca 14 to ca 6 μm as it proceeds posteriorly; and a single patch 10 by 12 μm in size occurs just posterior to the anal aperture at U94-96, being made up of cilia of similar length. The mouth is surrounded by short seta-like bristles, 4 to 5 μm long, with longer flexible bristles, 6 to 15 μm in length, scattered over the dorsal, lateral and ventral borders of the head. Five rows of stiff bristles, 10 to 12 μm long, are located along the lateral and dorsal trunk surfaces on either side of the midline; one row of bristles inserts medially, adjacent to each of the dorsal adhesive tubes; a second row is distributed along the length of the body, midway between rows of dorsal and lateral tubes; and the other three rows are associated with the lateral adhesive tubes, each tube having a 15 μm long, laterally directed bristle inserted just medial to its base, an 8 μm long, posteriorly directed bristle arising from the anterior portion of the tube base, and a 4 μm long, laterally directed bristle inserted immediately anterior to the medium length bristles; no bristles are inserted on the tips of adhesive tubes. Finally, three posteriorly directed bristles are located on each caudal lobe; a 15 μm long bristle extends dorsally from the base of each lobe, an 8 μm long bristle arises from the space between the two lateral-most adhesive tubes, and a 4 μm long bristle inserts on the outer margin of the lobe and lies parallel to that margin.

Cuticle is thin, smooth and nearly transparent, without scales or spines. Yellowish glandular refractile bodies are located in two rows along the length of the body, the lateral row extending from U7-93 and the medial row extending from U19-85. Paired sets of red pigment granules, presumably light sensitive, are located at U8.

Mouth is terminal, 17 μm wide, leading to a buccal cavity which opens to 22 μm width at U2; pharynx 180 μm long, with pharyngointestinal junction at U27; pharynx 27 to 29 μm wide, expanding to 31 μm at the pharyngeal pores which are located at U24-26; length of intestine 455 μm , narrowing progressively from 30 μm anteriorly to 9 μm just in front of the anus, then swelling to 12 μm about the anus which is located at U92-94, and then narrowing posteriorly to an apex some 18 μm behind the anus.

Testes extend from U28-51 and vasa deferentia continue posteriorly to U55 before turning medioanteriorly; male genital pore was not seen. Three ova lie mediodorsally from U46-75; they measure 120 x 46 μm (germinal vesicle 21 X 15 μm), 46 X 37 μm (gy. 15 X 11 μm), and 23 μm diam. (gv. 12 μm diam.) respectively from anterior to posterior. Protonephridia were not seen, nor was their presence sought by means of squash mounts.

Etymology:

Ocellata (L), having little eyes.

Discussion:

Discussion : Specimens were common, but not abundant. The shortest juvenile found measured 126 μm in total length, the largest adult measured 824 μm . Means and a letter index of variability of measurements from 56 animals have been grouped by length class and are presented in Table I. As is typical in gastrotrichs, the head and pharynx are relatively better developed at hatching than are the trunk and intestine. Consequently, metric, meristic and eidostic characters (Hummon, 1971) associated with the trunk and intestine are most likely to show the effects of body growth in terms of increased means and relatively large variabilities. In macrodasyids, numbers of adhesive tubes, anterior and posterior as well as lateral and dorso-lateral, show this relationship, as was admirably demonstrated by Teuchert (1969). Of particular interest is the relatively constant increase in mouth width with increase in total body length. Such an arrangement would tend to decrease intraspecific competition between

TABLE I.

Body measurements in μm by length-class for *Turbanella ocellata* n.sp.

Lt: total length from anterior tip of head to posterior tips of caudal adhesive tubes; LPh: length of pharynx, from anterior tip of head to pharyngointestinal junction; LIn: length of intestine, from pharyngointestinal junction to posterior tip of anus; LCLb: length of caudal lobe, obliquely from medial junction of lobes to tip of furthest projecting adhesive tube; WHd: max. width of head; WNk: min. width of body in region of ventroanterior foot insertion; WTr: max. width of trunk; SLbBs: min. width of body at base of caudal lobes; TbAFt: mean no. adhesive tubes per side on ventroanterior foot; TbL: mean no. adhesive tubes per side in lateral series; TbDL: mean no. adhesive tubes per side in dorsolateral series; TbLb: mean no. adhesive tubes per side on caudal lobes; WMu: width of mouth opening.

All measurements were made on relaxed specimens.

No.	100 μm Length class	Midpoint of class	Lt	LPh	LIn	LCLb	WHd	WNk	WTr	WLbBs	Tb				WMu
											AFt	L	DL	Lb	
10	175 (125-224)	166d*	70c	73e	15f	35.5d	25.5d	29c	17.5f	3g	4e	3e	3a	6-8	
10	275 (225-324)	293b	108c	149b	21e	42e	33.5d	38d	21d	4.5e	9.5d	5e	5d	8-10	
10	375 (325-424)	385b	123b	229b	26.5e	49c	41c	48d	27.5d	6.5d	14.5d	10f	6d	10-12	
8	475 (425-524)	478b	131b	303c	28d	53c	47c	56d	28d	7d	22b	15d	7d	12-14	
10	575 (525-624)	569b	146b	375b	27c	53b	45b	57b	29.5c	7.5c	21.5f	15d	8c	14-16	
6	675 (625-724)	651b	153b	434c	28.5d	54c	46c	59b	29.5b	8e	19.5a	14.5b	10d	16-18	
2	775 (725-824)	776c	186b	528d	25c	60d	54c	67d	29.5c	9.5b	20i	17c	12i	18-20	

* Coefficient of variation $\frac{SD}{X}$ 100 letter values: a=0 to 4, b=4 to 8, c=8 to 12, d=12 to 16, e=16 to 20, f=20 to 24, g=24 to 28, h=28 to 32, i=32 to 36, j=36 to 40, k=40 to 44, l=not used, m=44 to 48, ... z=96 to 100. In percentage.

juveniles, subadults and adults, if feeding were generalized and mean food size was related to mouth width.

The 126 μm long juvenile, mentioned above, was a posthatch juvenile as was demonstrated by the presence of an embryonic body fold at U43. The smallest animal having pigmented ocelli was 182 μm in length. A specimen 286 μm long possessed a diatom frustrule (*Navicula* sp.) measuring 29 x 7 μm in its intestine. The smallest specimen seen which possessed an ovum (17 x 15 μm , gv. 5 μm diam.) measured 565 μm in length.

The type specimen differed from the mean of its size class group in having slightly larger measurements in all but three of the categories listed in Table I. Its mouth width was typical of its size class group, but numbers of both anterior and lateral adhesive tubes are slightly less than those of its size class group. Fig. 3 represents a juvenile of 164 μm in total length (Paratype specimen, USNM 51574). Measurements of other characters listed in Table I for this specimen are: LPh 72 μm , LIn 74 μm , LCLb 10 μm ; WHd 42 μm ; WNk 28 μm , WTr 33 μm , WLbBs 22 μm ; TbBAFt 2, TbBL 3, TbBDL 2, TbBLb 2; and WMu 6 μm . Such juvenile specimens are extremely difficult to identify, unless they can be definitively associated with mature specimens of identifiable species.

Of the 17 species in the genus *Turbanella*, *T. ocellata* is grouped with the five which bear neither lateral cephalic lobes nor enlarged mediocaudal cones: *T. subterranea* Bemane, 1934, *T. lutheri* Remane, 1952, *T. palaciosi* Remane, 1953, *T. pontica* Valkanov, 1957, and *T. corderoi* Dioni, 1960. Subadults and adults of *T. ocellata* can be distinguished from these other species by means of the following set

of characters: head bluntly rounded anteriorly, lateral adhesive tube series initiated in front of anteroventral foot insertion, absence of adhesive tubes from the leading edge of caudal lobes, and presence of granular ocelli.

ORDER CHAETONOTIDA Remane, 1925

Family Chaetonotidae Zelinka, 1889, *sensu* Hummon, 1969

Genus *Aspidiophorus* Voigt, 1904

Aspidiophorus mediterraneus Remane, 1927b

(Fig. 4, 5)

Several specimens were identified as *A. mediterraneus* despite the difficulties of such an identification. Few species of marine gastrotrichs stand as greater enigmas than this one. It was originally described in 20 words, primarily by way of contrast with *A. marinus* Remane, 1926, and no figure was provided. The species has since been treated in seven publications (Wilke, 1954; Swedmark, 1956; Valkanov, 1957; Kaplan, 1958; Schrom, 1966, 1972 and Rudescu, 1967), with but a single figure presented (Rudescu, 1967).

Total lengths range from 88 μm (juvenile) to 168 μm (largest adult), with a mean of 153 μm for five adult specimens. One, 150 μm in total length and non-ovigerous, had a furca 19 μm long, head width 23 μm , neck width 18 μm , trunk width 26 μm and width at furcal base of 16 μm . The specimen illustrated and discussed below was 161 μm long, ovigerous, and morphologically typical of the group. Its furca length was 21 μm , head width 26 μm , neck width 20.5 μm , trunk width 34 μm and width at furcal base 16 μm . In no case are the constrictions of neck and furcal base as great as those noted by Rudescu. Cephalion (head shield) is prominent, held nearly vertical and, in the specimen illustrated, measures 11.5 μm in width. Hypostomion is not as strongly developed as in specimens studied by Wilke and Schrom. The cephalic refractile bodies, which characterize *A. marinus*, are absent.

Adhesive tubes of furcal branches are small and delicate, with 0.6 X their length free of overlapping pedunculated scales. Adhesive glands, bulbar and 3 μm in diameter, lie lateral to the anal opening.

Cephalic tactile cilia are arranged in two sets per side, one dorso-lateral tuft at U4-5, consisting of 4-6 cilia ranging in length from 8 to 30 μm and the other a ventrolateral row of 10-15 cilia at U2-5, paralleling the lateral expansion of the head and increasing in length anterior to posterior from 6 to 24 μm . Ventral locomotor cilia are 10 to 14 μm in length and are arranged in two ventral tracts; each tract originates anteriorly at U3, then expands in width to 9 μm in the mid-pharyngeal region, narrows to 4 μm in the post-pharyngeal region and further narrows to 2 μm as it progresses to its posterior terminus at U87; the tracts are separated by a 4 to 6 μm wide mid-ventral field in the pharyngeal region, close to about 1.5 μm separation at U52, and then closely parallel one another as they proceed to the rear; at no point along their length, however, do they merge; ciliature is thickest in the pharyngeal region and considerably thinner in the intestinal region. Two pairs of tactile bristles are inserted on small papillae located at U20 and U87; bristles are 10 to 12 μm long in the anterior pair and 8 to 10 μm long in the posterior pair; the anterior pair is often lacking.

Cuticular armature is of pedunculated scales, with 12-15 transverse rows of 38-42 scales each on the dorsal and dorsolateral surfaces and 2-5 transverse rows of scales on the ventrolateral surfaces; scales are most weakly developed at the anterior, posterior and ventrolateral extremities; endplates are keeled, oval elongate, 4 to 6 μm long where well developed, and are there borne on 2 μm long peduncles.

Mouth opening is subterminal, located at U1-4, and is depressed some 2 μm beneath the ventral head surface; its 5 μm width leads to a mouth tube some 4 to 6 μm long. Pharynx expands to 11 μm in width and pos-

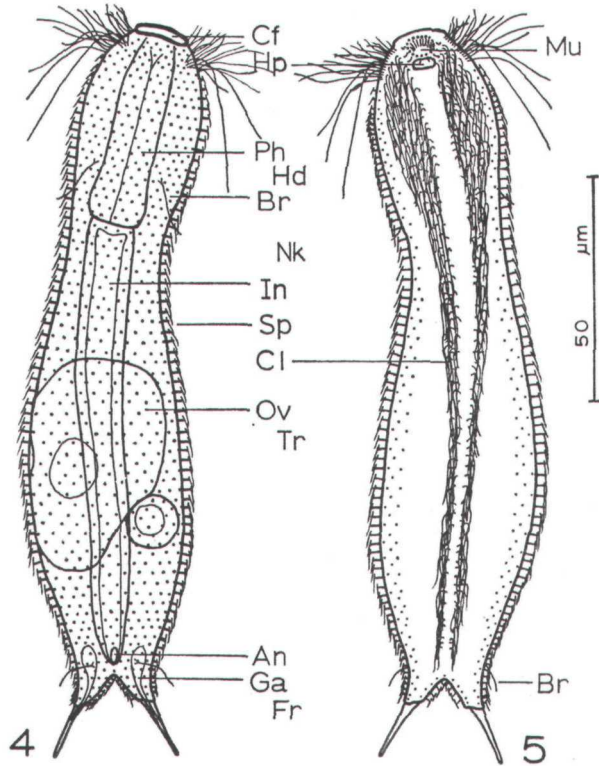


FIG. II

Aspidiophorus mediterraneus.

4: dorsal view of adult, including pattern of pedunculated scales and digestive and reproductive systems; 5: ventral view of adult, including pattern of pedunculated scales and ventral ciliation.

Head (Hd), cephalion (Cf), hypostomion (Hp), neck (Nk), trunk (Tr) and furca (Fr); ventral cilia (Cl), dorsal tactile bristles (Br) and adhesive glands (Ga); spines (Sp); mouth (Mu), pharynx (Ph), intestine (In) and anus (An); and ovum (Ov).

sesses a slight posterior swelling of 13 μm width; pharyngointestinal junction is at U27; pharynx lacks retractile bodies noted by Wilke and Schrom. Intestine narrows gradually from 11 to 5 μm in width over its length; anal opening is dorsal, at U85-87.

The specimen illustrated has two dorsal ova, one 29 X 47 μm (germinal vesicle 13 μm diam.) and the other 11.5 μm diam. (gv. 7 μm diam.). Another specimen had a single ovum, 52 X 30 μm (gv. 14 μm diam.).

This constitutes the first report of this species from North America.

Aspidiophorus paramediterraneus n. sp.
(Fig. 6-8)

Holotype:

Adult, 248 μm long; Pivers Island, Beaufort, North Carolina, U.S.A. (lat. 34°43' N, long. 76°40' W), lower intertidal in detrital marine sand; August, 1970, W.D. Hummon, col.; relaxed in MgCl_2 (6 p. 100), fixed in formalin (10 p. 100), mounted in glycerine jelly and sealed with nail polish, USNM 51573.

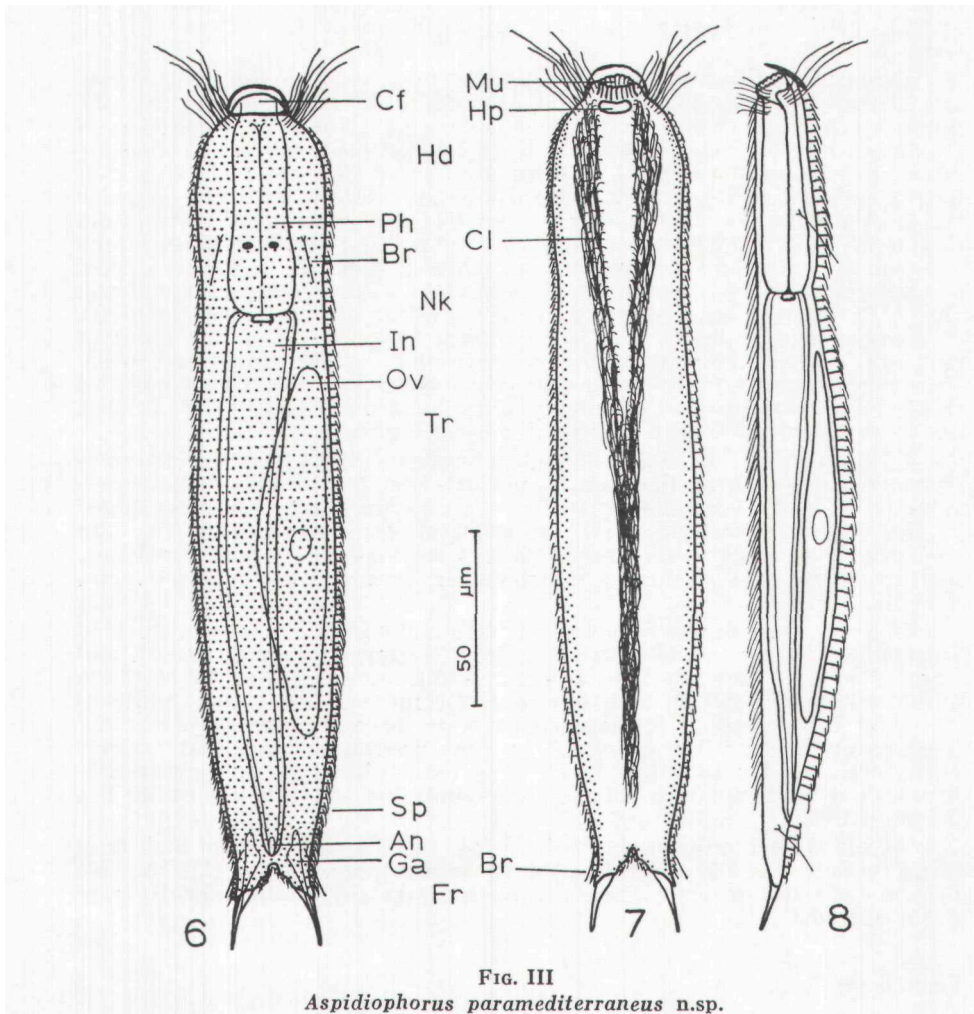


FIG. III
Aspidiophorus paramediterraneus n.sp.
6: dorsal view of adult, including pattern of pedunculated scales and digestive and reproductive systems; 7: ventral view of adult, including pattern of pedunculated scales and ventral ciliation; 8: lateral view of adult, including dorsal pattern of pedunculated scales, ventral ciliation and digestive and reproductive systems.

Head (Hd), cephalion (Cf), hypostomion (Hp), neck (Nk), trunk (Tr) and furca (Fr); ventral cilia (Cl), dorsal tactile bristles (Br) and adhesive glands (Ga); spines (Sp); mouth (Mu), pharynx (Ph), intestine (In) and anus (An); and ovum (Ov).

Description:

Holotype adult (Figs 6-8), an *Aspidiophorus* with elongate body, shallow neck constriction and relatively short furca; head single-lobed, bearing a conspicuous arched cephalion (head shield) of 18 μm width and 15 μm height at U0-3 and a flat hypostomion of 9 μm width and 3 μm length at U3-4; max. head width 38 μm at U14, min. neck width 36 μm at U24; max. trunk width 40 μm at U49, and min. width of furcal base 20 μm at U90; furcal branches each 9 μm wide at their base, narrowing stepwise to 6 μm , as furcal base gives rise to the proximal end of the adhesive tube at U93, and then to 1 μm at the distal tips of the tubes; adhesive glands are more or less bilobed and lie adjacent to the anal opening; maximal spread of furcal tubes in relaxed specimens is 25 μm at their distal ends, U100. Head height increases from 12 μm at U1 to 18 μm at U21; min. neck height 16 μm at U25; max. trunk height 24 μm at U50; and height at base of caudal furca 7 μm .

Cephalic tactile cilia are arranged in two sets per side, one dorso-lateral row at U3-4, consisting of 4 cilia 22 to 34 μm in length, and the other a ventrolateral row at U1-5, consisting of 15-17 cilia increasing in length anterior to posterior from 12 to 18 μm ; both sets tend to parallel the lateral expansion of the head. Ventral locomotor cilia are 14 to 16 μm in length and are arranged in a Y-shaped ciliary pattern with two anterior tracts originating at U3, which merge at U44 into a single posterior tract that terminates at U83; tracts each vary in width from 6 to 9 μm in the pharyngeal region and narrow to 5 μm width just before they merge; they are separated by a mid-ventral field varying in width from 8 to 9 μm anteriorly, becoming progressively narrower until it disappears at the point of merger; merged tracts then narrow from 10 μm width at the point of merger to 4 μm at their posterior terminus; cilia are most thickly set in the pharyngeal region, thinning considerably toward the rear. Two pairs of tactile bristles are inserted on small papillae located at U16 and U88; bristles are 15 to 17 μm in length and all are generally present.

Cuticular armature is of pedunculated scales, with 14-22 transverse rows of 80-90 scales each on the dorsal and dorsolateral surfaces and 3-6 transverse rows on the ventrolateral surfaces; scales are most weakly developed at the anterior, posterior and ventrolateral extremities; endplates are keeled, oval elongate to rhomboidal, 3 to 4 μm long where well developed, and are borne on 1 μm long peduncles laterally and 2 μm long peduncles dorsally.

Digestive tract begins with a nearly terminal 9 μm diam. mouth, shielded from above by the cephalion; mouth tube is ridged, 5 μm in length and leads to a 62 μm long pharynx; pharynx width increases abruptly to 16 μm at U4, retains that width to U16, and gently increases to a max. width of 21 μm at U21, where it forms a slight posterior bulb; pharyngointestinal junction at U26 is followed by a 3 μm long pharyngeal plug that projects posteriorly into the intestine; intestine is 158 μm long, decreases gradually in width from 20 μm to 3 μm as it surrounds the anus; anal opening lies dorsal at U89.

An oblong ovum measuring 106 μm long X 20 μm wide X 9 μm high (germinal vesicle 9 X 7 X 4 μm) lies dorsal in the region from U32-75. No evidence of testes or seminal bursa was seen. Likewise, protonephridia were not observed.

Etymology:

Para (Gk), near; referring to the taxonomic proximity of this species to *A. mediterraneus*.

Discussion:

Specimens of *Aspidiophorus paramediterraneus* were found commonly, though not abundantly. Three additional specimens are

available as paratypes (USNM 51570 to 51572); in these as well as in the Holotype specimen, considerable shrinkage has taken place in the fixation and mounting process. All specimens seen exceeded 180 μm in length and, though some were not ovigerous, none were juveniles.

The difficulty of distinguishing between *A. marinus*, *A. mediterraneus* and *A. tentaculatus* is compounded by the addition of *A. paramediterraneus* to this group. *A. paramediterraneus* is considerably larger than *A. marinus*, has a slightly longer furca and lacks the refractile bodies located laterally in the head region; it is of the same size range as *A. tentaculatus* and is similar in most morphological features, but lacks cephalic tentacles; finally, it must be considered a sibling species of *A. mediterraneus*, probably overlapping in size and many morphological features, but differing in specifics as follows. Two features, both subject to possible misinterpretation, best serve to distinguish *A. paramediterraneus* from *A. mediterraneus*: 1) the mouth of *A. paramediterraneus*, as in that of *A. tentaculatus*, is nearly terminal, whereas it is clearly subterminal in *A. mediterraneus*, and 2) the posterior portion of the ventral ciliary tract is unitary in *A. paramediterraneus*, whereas these tracts are separate, though closely adjacent, in *A. mediterraneus*. Perhaps the greatest difficulty will be the distinguishing of juvenile *A. paramediterraneus* from adult but non-ovigerous *A. mediterraneus*. Caution and use of high quality optical equipment are urged in dealing with members of this sibling complex.

Swedmark (1956) reported seeing specimens off Marseille, which appeared to combine characters of *A. mediterraneus* and *A. tentaculatus*. His specimens were the size and appearance of *A. tentaculatus*, but lacked cephalic tentacles as does *A. mediterraneus*. It is possible that these animals were in fact *A. paramediterraneus*.

Aspidiophorus multitubulatus n. sp.

(Fig. 9-13)

Several specimens of this peculiar species of *Aspidiophorus* were seen during the summer of 1966. Information was obtained from three, but unfortunately none was preserved. Thus, the species is described without benefit of a Holotype specimen.

Body measurements that follow are given for three individuals from shortest to longest: total length 126, 155, 163 μm ; pharynx length 48, 48, 48 μm ; intestine length 58, 83, 88 μm ; length of furcal branch 31, 32, 32 μm ; max. head width 25.5, 26.5, 28 μ ; min. neck width 24, 24.5, 24.5 μm ; max. trunk width 29, 31, 32 μm ; and min. width at furcal base 16.5, 16.5, 17 μm .

The specimen illustrated and discussed below was the largest of the three, non-ovigerous, but morphologically typical of the group. Head single-lobed, without cephalion or obvious hypostomion. General contours of the body change gently from tip of head to furcal base, increasing from oral opening to max. head width at U16, diminishing slightly to min. neck width at U29, increasing again to max. trunk width at U53, and narrowing to min. width of furcal base at U78; furcal branches then quickly diverge; maximal spread of normal furcal tubes in relaxed specimens is 58 μm at their tips.

Posterior end with one pair of normal adhesive tubes borne at tips of furcal branches and, in addition, bearing two pairs of accessory adhesive tubes; naked portion of normal tubes are clearly demarcated as they emerge obliquely from furcal bases at U84, have a posterior bend 6 μm from

the point of emergence and are 15 μ m long; one pair of 17 μ m accessory tubes emerges laterally from the furcal bases ventral and slightly anterior to the position from which the normal tubes emerge, being overlapped slightly by the normal tubes as viewed from above (Figs. 9-12); and a second pair of 17 μ m long accessory tubes emerge dorsolaterally from the trunk at U78, barely in front of the furcal bases (Figs. 9, 11, 12). A series of posteriorly directed spines also emerge from furcal bases and rump; 4 occur laterally (7 to 8 μ m long) and 15 medially, the medial group arranged from dorsal to ventral in rows of 1 (8 μ m long), 2 (5 μ m long), 6 (2 to 4 μ m long), 3 (7 μ m long), 2 (7 μ m long) and 1 (ventral, 7 μ m long).

Cephalic tactile cilia occur in two series; one series of 4-5 cilia, 24 to 32 μ m in length, is located dorsolaterally along the lateral edge of the head at U6-8; the anterior most cilium of this group typically pointed obliquely forward, whereas the others are mostly directed toward the side; a second series of 12-14 cilia, 7 to 16 μ m in length, is located in a ventrolateral row along the lateral edge of the head at U2-8. Ventral locomotor cilia lie in two parallel rows beneath the lateral edges of the digestive tract from U2-80; each row is 2 to 4 μ m wide and consists of individual cilia 10 to 12 μ m long. Two pairs of dorsolateral tactile bristles are inserted on small papillae located at U19 and U83, though the anterior pair may be absent; bristles are 15 to 16 μ m long.

Cuticular armature is of tiny pedunculated scales, which cover the dorsal and ventrolateral surfaces of the body (Fig. 13); peduncles are 1.5 μ m in length and occur at 0.6 μ m intervals transversely and at 1.0 μ m intervals longitudinally; endplates are elongate rhomboidal and have some slight longitudinal overlap.

Mouth opening is nearly terminal, located at U0-2 and protrudes 2.5 μ m beneath the ventral head surface; its 8 μ m width tapers to 6 μ m at U4, before entering the pharynx; pharynx is 6 to 9 μ m wide and has no visible swelling; pharyngo-intestinal junction is at U29; intestine broadens quickly to 14 μ m and then narrows gradually to 6 μ m width in the vicinity of the dorsal anus at U84.

No details of the reproductive or protonephridial systems are known.

Etymology:

Multi (L), many; *tubulus* (L), little pipe.

Discussion:

Aspidiophorus multitubulatus, in bearing elongate spines on the posterior end, is most closely associated with *A. heterodermus* Saito, 1937, but is differentiated from this species by the large number of spines present in *A. multitubulatus*. Further, *A. multitubulatus* is clearly differentiated from all other species of *Aspidiophorus* (and, in fact, from other species in the family Chaetonotidae) by the presence of accessory adhesive tubes associated with the posterior end.

Genus *Chaetonotus* Ehrenberg, 1830

Chaetonotus oligohalinus n. sp.

(Fig. 14-16)

Unlike other species found on Pivers Island, this one occurred in Tank One of the U.S. National Marine Fisheries Service Radiobiological Laboratory. Numerous specimens were collected from benthic detritus in oligohaline waters of 0.7 p. 1,000 salinity.

Measurements for a series of 20 animals ranging from 86 to

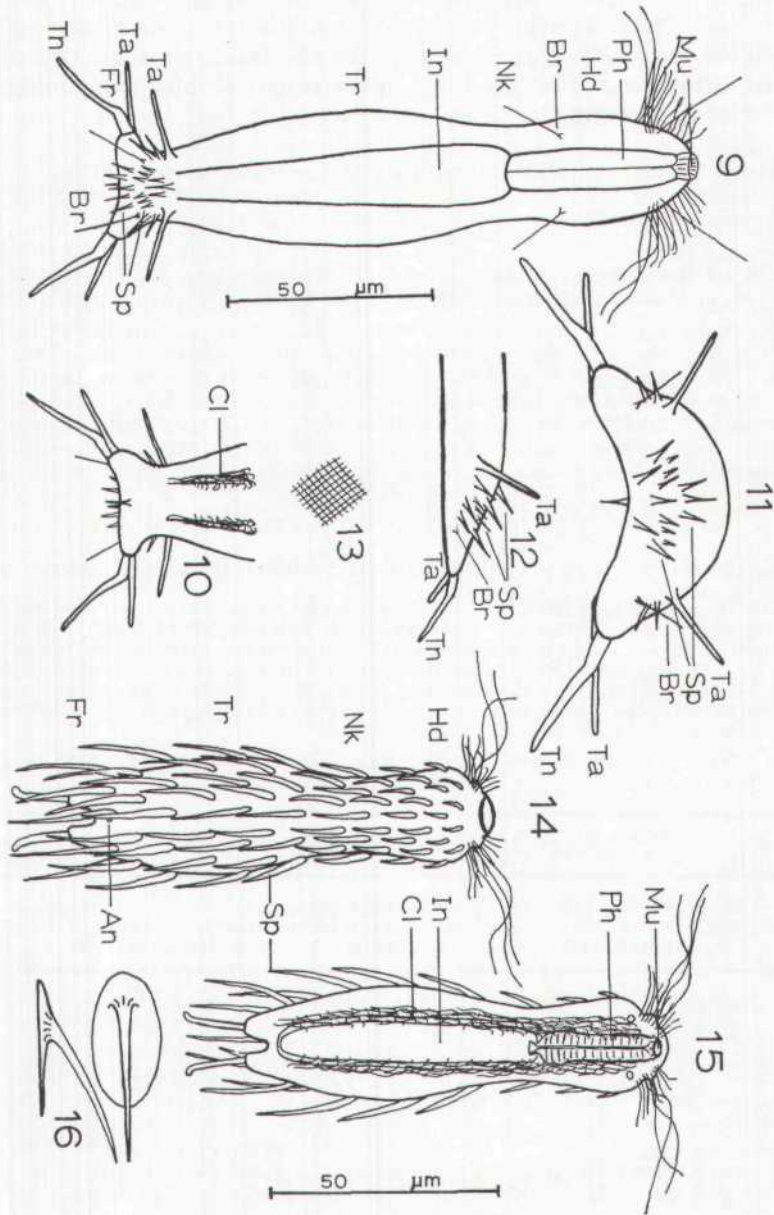


FIG. IV

9-13: *Aspidiophorus multitubulatus* n.sp.

9: dorsal view of subadult, including digestive system but not including pedunculated scales; 10, 11, 12: ventral, caudal and lateral views of furcal region, respectively; 13: superficial appearance of dorsal scale pattern (11, enlarged over the others).

14-16: *Chaetonotus oligohalinus* n.sp.

14: dorsal view of subadult, including spines but not scales; 15: ventral view of subadult, including digestive system; 16: dorsal and lateral views of spined scales from neck-region (16, enlarged over the others).

Head (Hd), neck (Nk), trunk (Tr), furca (Fr); normal adhesive tubes (Tn) and accessory adhesive tubes (Ta); ventral cilia (Cl) and dorsal tactile bristles (Br); spines (Sp); mouth (Mu), pharynx (Ph), intestine (In) and anus (An).

114j/m in total length are given by length-class in Table II. Unfortunately, none having been preserved, this species is described without benefit of a Holotype specimen. The specimen illustrated and discussed below was 106 (μm long, non-ovigerous, but morphologically typical of the group.

Head 5-lobed, with small cup-shaped head shield, but without obvious hypostomion. Max. head width at U10; min. neck width at U30; max. trunk width at U57; and min. width of furcal base at U82.

Furcal length is made up 0.3 X by furcal base and 0.7 X by the naked portion of the adhesive tube. Tips of adhesive tubes turn fairly sharply outward, giving a maximal spread of 15 μm between tips of furcal tubes.

Cephalic tactile cilia occur in two series; one series of 3-4 cilia, 25 to 30 μm in length, is located dorsolaterally along the lateral edge of the head at U4-5; a second series of 8-10 cilia, 6 to 10 μm in length, is located in a ventrolateral row along the lateral edge of the head at U2-6. Ventral locomotor cilia occur in two parallel rows beneath the lateral edges of the digestive tract from U4-82; each row is 2 to 4 μm wide and consists of individual cilia 8 to 10 μm long. No dorsolateral tactile bristles are found.

TABLE II.

Body measurements in *jim* by length-class for *Chaetonotus oligohalinus* n.sp.

Lt: total length, from anterior tip of cephalion to posterior tips of furcal adhesive tubes; LPh: length of pharynx, from anterior tip of head to pharyngo-intestinal junction; Lin: length of intestine, from pharyngo-intestinal junction to posterior tip of anus; LFr: length of furca, obliquely from medial junction of furcal branches to tip of adhesive tube; WHd: max. width of head, inside scales; WNk: min. width of neck, inside scales; WTr: max. width of trunk, inside scales; Wfb: min. width of furcal base, inside scales.

(—) refers to non-gravid specimens; (+) refers to gravid specimens. All measurements were made on relaxed specimens.

No.	W _{th} ⁰¹ c _{..sS}	"	LPh	Un	Lf	WHd	-	^	^	^^	WB
3 (3—, 0+)	90 (85—94)	88.5a*	30.5a	43.5b	15 a	19a	13.5b	—	16.5a	—	lia
5 (2—, 3+)	100 (95—104)	102.5a	31 a	58 b	16 a	21b	15.5b	16.5c	20 b	29d	15b
12 (4—, 8+)	110(105—114)	108.5a	32.5a	61 b	16.5b	23b	17 a	19.5c	21 c	19b	15b

* Coefficient of variation letter values: see Table I.

Cuticular armature consists of simple spines arising from quincuncially imbricated oval scales; 9 longitudinal rows of spines can be seen from dorsal view, each consisting of 7 spines. Scales increase gradually in size from anterior (6 μm long X 3.5 μm wide) to posterior (12 μm long X 7 μm wide); spines increase gradually in length from anterior (4 μm) to posterior (24 μm) and occur from U7-78; no scales or spines are found on the furcal bases.

One pair of colorless glandular bodies is located laterally in the head at U8.

Mouth opening is subterminal, located at U1-3, and protrudes 2 μm beneath the ventral head surface; its 3 μm width leads quickly to the pharynx; pharynx has a mean width of 5 to 6 μm with a posterior bulb, which expands to 7 μm ; pharyngeal plug extends some 2 μm into intestine; pharyngo-intestinal junction occurs at U26; intestine broadens to an average at 10 μm width and maintains that width nearly to anus; anal opening dorsal at U78-80.

Ova, when present, measure 38 to 39 X 25 to 27 μm (germinal vesicle 13 to 15 μm diam.). No evidence of testes or seminal bursa was seen. Similarly, protonephridia were not observed.

Etymology:

Oligos (Gk), few, scanty; *helos* (Gk), sea, salt; referring to the conditions under which this species was found.

Discussion:

Aspidiophorus oligohalinus was subjected to a series of lethal tolerance tests, after acclimation for more than 24 h at 21-23°C and 0.7 p. 1,000 salinity. Somatic lethal limits over 24 h at 22°C extended over the oligohaline range of 0.5 to 3 p. 1,000 and up to 7 p. 1,000, but not to 8 p. 1,000 salinity. Criteria of "death" were absence of voluntary locomotion and whole-body response to tactile stimuli. Since reproductive lethal limits are by definition narrower than somatic lethal limits, it is appropriate to consider this species to be an oligohaline species in terms of its upper salinity tolerances.

In accordance with the groups of species set up within the genus *Chaetonotus* by Remane (1927a), *C. oligohalinus* belongs in the broadly defined Maximus-group, which contains a large number of species. Along with *C. chicous* Hummon 1974, and certain other members of the Maximus-group, *C. oligohalinus* possesses a 5-lobed head and complete dorsal scalation, consisting of overlapping oval scales bearing simple spines that increase in length from anterior to posterior. *C. oligohalinus* can be differentiated from other members of this subgroup in lacking cuticular armature on the furcal bases, in having relatively few spine-scale sets (<70) dorsally and in having the scale size increase twofold and the spine length increase sixfold from fore to aft.

Abstract

Thaumastoderma heideri and *Aspidiophorus mediterraneus* are reported and *Turbanella ocellata* n.sp., *Aspidiophorus paramediterraneus* n.sp. and *Aspidiophorus multitubulatus* n.sp. are described from muddy sand of the lower intertidal zone on Pivers Island, Beaufort, North Carolina, U.S.A. In addition, *Chaetonotus oligohalinus* n.sp. is described from benthic detritus beneath low salinity waters of an experimental tank on Pivers Island.

REFERENCES

- BOADEN, P.J.S., 1963. — Marine Gastrotricha from the interstitial fauna of some North Wales beaches. *Proc. Zool. Soc. London*, 140, pp. 485-502.
- DIONI, w., 1960. — Notas Hydrobiologicas. I. *Turbanella corderoi* n.sp. (Gastrotricha Macrodasyoidea) gastrotricha aberrante de aguas salobras de Rio de la Plata. *Anais Primeiro Cong. Sul-Amer. Zool. (La Plata)*, pp. 12-24.
- GANAPATI, P.N. and HAO, G.c., 1967. — On some marine interstitial gastrotrichs from the beach sands of Waltair Coast. *Proc. Indian Acad. Sci. (Sect. B)*, 66, pp. 214-225.
- GERLACH, s., 1961. — über Gastrotrichen aus dem Meeressand der Malediven (Indischer Ozean). *Zool. Anz.* 167, pp. 471-475.
- HAWKES, J.A.W., 1965. — A taxonomic study of gastrotrichs from the southern Appalachian mountain region. MA Thesis, Wake Forest College, 63 pp.

- HUMMON, w.D., 1969. — *Musellifer sublitoralis*, a new genus and species of Gastrotricha from the San Juan Archipelago, Washington. *Trans. Amer. Microsc. Soc.*, 88, pp. 282-286.
- HUMMON, w.D., 1971. — The marine and brackish-water Gastrotricha in perspective. Proc. 1st Intern. Meiofaunal Conf. *Smithsonian Contrib. Zool.*, 76, pp. 21-23.
- HUMMON, w.D., 1974 a. — Some taxonomic revisions and nomenclatural notes concerning marine and brackish-water Gastrotricha. *Trans. Amer. Microsc. Soc.* 93, pp. 194-205.
- HUMMON, w.D., 1974 b. — Intertidal marine Gastrotricha from Colombia. *Bull. Mar. Sci.*, 24, in press.
- INMAN, D.L., 1952. — Measures for describing the size distribution of sediments. *J. Sedim. Petrol.*, 22, pp. 125-145.
- PAPI, F., 1957. — Tre nuovi Gastrotrichi mediterranei. *Pubbl. Staz. Zool. Napoli*, 30, pp. 177-182.
- POWERS, M.c., 1953. — A new roundness scale for sedimentary particles. *J. Sedim. Petrol.*, 23, pp. 117-119.
- REMANE, A., 1925. — Organisation und systematische Stellung der aberranten Gastrotrichen. *Verhandl. Deutsch Zool. Ges. (Jena)*, 30, pp. 121-128.
- REMANE, A., 1926 a. — • Morphologie und Verwandtschaftbeziehungen der aberranten Gastrotrichen. I. *Zeitschr. Morphol. Ökol. Tiere*, 5, pp. 625-754.
- REMANE, A., 1926 b. — Marine Gastrotrichen aus der Ordnung der Chaetonotoidea. *Zool. Anz.*, 66, pp. 243-252.
- REMANE, A., 1927 a. — Beiträge zur Systematik der Süßwassergastrotrichen. *Zool. Jahrb. (abt. Syst.)*, 53, pp. 269-320.
- REMANE, A., 1927 b. — Gastrotricha. In: G. Grimpe (ed.), *Die Tierwelt der Nord- und Ostsee*, 10 (7d), pp. 1-56.
- REMANE, A., 1934. — Die Gastrotrichen des Küstengrundwassers von Schilksee. *Schr. Naturwiss. Ver. Schleswig-Holstein*, 20, pp. 473-478.
- REMANE, A., 1943. — *Turbanella ambronensis* nov. spec, ein neues Gastrotrich aus der Otoplanenzone der Nordsee. *Zool. Anz.*, 141, pp. 237-240.
- REMANE, A., 1952. — Zwei neue *Turbanella* - Arten aus dem marinen Kiistengrundwasser. *Kieler Meeresf.*, 9, pp. 62-65, Taf. 9.
- REMANE, A., 1953. — Ein neues Gastrotrich aus dem Pazifik, *Turbanella palaciosi* nov. sp. *Zool. Anz.*, 151, pp. 272-276.
- RUDESCU, L., 1967. — Gastrotricha. Fauna Republ. Socialiste Romania, 2 (3), pp. 1-289.
- RUPPERT, E. E., 1970. — On *Pseudostomella* Swedmark, 1956 with descriptions of *P. plumosa* nov. spec, *P. cataphracta* nov. spec, and a form of *P. roscovita* Swedmark, 1956 from the West Atlantic Coast. *Cah. Biol. Mar.*, 11, pp. 121-143.
- SAITO, I., 1937. — Neue und bekannte Gastrotrichen der Umgebung von Hiroshima (Japan). *J. Sci. Hiroshima Univ. (Ser. B, Div. 1)*, 5, pp. 245-265.
- SCHOEPFER-STERREER, c., 1969. — *Chordodasyis riedli*, gen. nov., spec. nov., a Macro-dasyoid Gastrotrich with a chordoid organ. *Cah. Biol. Mar.*, 10, pp. 391-404.
- SCHROM, H., 1966. — Gastrotrichen aus Feinsanden der Umgebung von Venedig. *Boll. Museo Civico Venezia*, 17, pp. 31-45.
- SCHROM, H., 1972. — Nordadriatische Gastrotrichen. *Helgoländer Wiss. Meeres.*, 23, pp. 286-351.
- SCHULTZE, M., 1853. — Über *Chaetonotus* und *Ichthydium* (Ehrb.) und eine neue verwandt Gattung *Turbanella*. *Milliers Arch. Anat. Physiol.*, 6, pp. 241-254, Taf. VI.
- SWEDMARK, B., 1956. — Etude de la microfaune des sables marins de la région de Marseille. *Arch. Zool. exp. gén.*, 93, pp. 70-95.
- TEUCHERT, G., 1968. — Zur Fortpflanzung und Entwicklung der Macro-dasyoidea (Gastrotricha). *Zeitschr. Morph. Tiere*, 63, pp. 343-418.
- VALKANOV, A., 1957. — Erster versuch zur erforschung der Gastrotrichen des Schwarzen Meeres. *Ann. Univ. Sofia (Biol.)*, 50, pp. 383-399.
- VOIGT, M., 1904. — Die Rotatorien und Gastrotrichen der Umgebung von Plön. *Forschungsber. Biol. Stat. Plön*, 11, pp. 1-178, Taf. I-VII.
- WILKE, u., 1954. — Mediterrane Gastrotrichen. *Zool. Jahrb. (abt. Syst.)*, 82, pp. 497-550.
- ZELINKA, c., 1889. — Die Gastrotrichen. Eine Monographische Darstellung ihrer Anatomie, Biologie, und Systematik. *Zeitschr. Wiss. Zool.*, 49, pp. 209-384, Taf. XI-XV.