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Description of Two New Thaumastodermatids (Gastrotricha, Macrodasyida) from Korea

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Two new marine gastrotrichs of the family Thaumastodermatidae are described from South Korea. *Tetranchyroderma gracilium* n. sp. bears pestle organs, tetrancres, and two pairs of large dorsolateral tubes. It seems most closely related to *T. massiliense* Swedmark, *T. heterotubulatum* Hummon, Todaro and Tongiorgi, and *T. boreale* Clausen. *Thaumastoderma copiophorum* n. sp. has five pairs of dorsal cirrata, the overall picture of which differs clearly from that of all known species. In the presence of accessory cirrata, it relates to *T. appendiculatum* Chang, Lee and Clausen.

Although Thaumastodermatidae constitutes the most diversified natural taxon of marine gastrotrichs (Ruppert, 1988), they are still poorly known, and only 83 species of eight genera have been described until now. They have evident and consistent taxonomic characteristics such as sculptured dorsal scales, often with spines, cephalic tentacles, dorsolateral cirrata, and posterior adhesive tubes. Especially in the Western Pacific, the taxonomic study of this family was nearly lacking, except that one species, *Tetranchyroderma dendricum* Saito, was reported once from Hiroshima, Japan (Saito, 1937). Recently two new Korean species of *Thaumastoderma* were described (Chang *et al.*, 1998), *T. coronarium* from the Yellow Sea, and *T. appendiculatum* from the East Sea; yet, the faunal study in this area remains a pressing one.

As a result of the examination of the thaumastodermatid gastrotrichs from Cheju Island, South Korea, we obtained two species each belonging to the genera *Tetranchyroderma* and *Thaumastoderma,* both of which resulted to be new to science. We provide the descriptions of the two new species with illustrations and photomicrographs.

Materials and Methods

Samples were collected from the intertidal and shallow sublittoral zones of Hyopchae beach (36° 47′ 53″ N, 126° 08′ 59″ E), and Udo Isle (37° 13′ 00″ N, 126° 06′ 56″ E) in Cheju Island, South Korea. Samples were dredged into polyethylene vinyl bags by scuba divers, then were extracted at the laboratory by the anesthetization (using $MgCl_2$)-decantation technique.

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Specimens were drawn and measured in lactophenol on Cobb's aluminium hole slide, and also observed and photographed under a differential interference microscope. Figures were made with the aid of a drawing tube. The SEM material was prefixed overnight at 4℃ in 2.5% glutaraldehyde, then followed by postfixation with 1% cold osmium tetroxide. After dehydration through a graded series of ethanol (50-100% at 10% intervals) for 30 min each, the material at the critical point was dried, coated with gold-palladium in a high evaporator, and then examined in a Hitachi S-520 scanning electron microscope operated at 20 KV.

Terminology used in the description of the reproductive system follows Ruppert (1991), and abbreviations are shown in Table 1.

Descriptions

Family Thaumastodermatidae Remane, 1926
Subfamily Thaumastodermatinae Ruppert, 1978
Genus *Tetranchyroderma* Remane, 1926

Tetranchyroderma gracilium, new species
(Figs. I, 3A-F)

Material examined: 18 individuals, Hyopchae, Aug. 10, 1997, coll. H. S. Rho and J. W. Choi. Holotype (Cat.

Table 1. Abbreviations used

Lt	total length, from anterior tip of head to posterior tip of caudum, or pedicles including adhesive tubes
U	percentage units of Lt from anterior to posterior
PhJIn	junction between pharynx and intestine
Cirratum	cuticular tube with a granular content
Cirrata 1-5	first to fifth pair of dorsolateral cirrata
TbA	anterior adhesive tubes
TbD	dorsal adhesive tubes
TbP	posterior adhesive tubes
TbVL	ventrolateral adhesive tubes

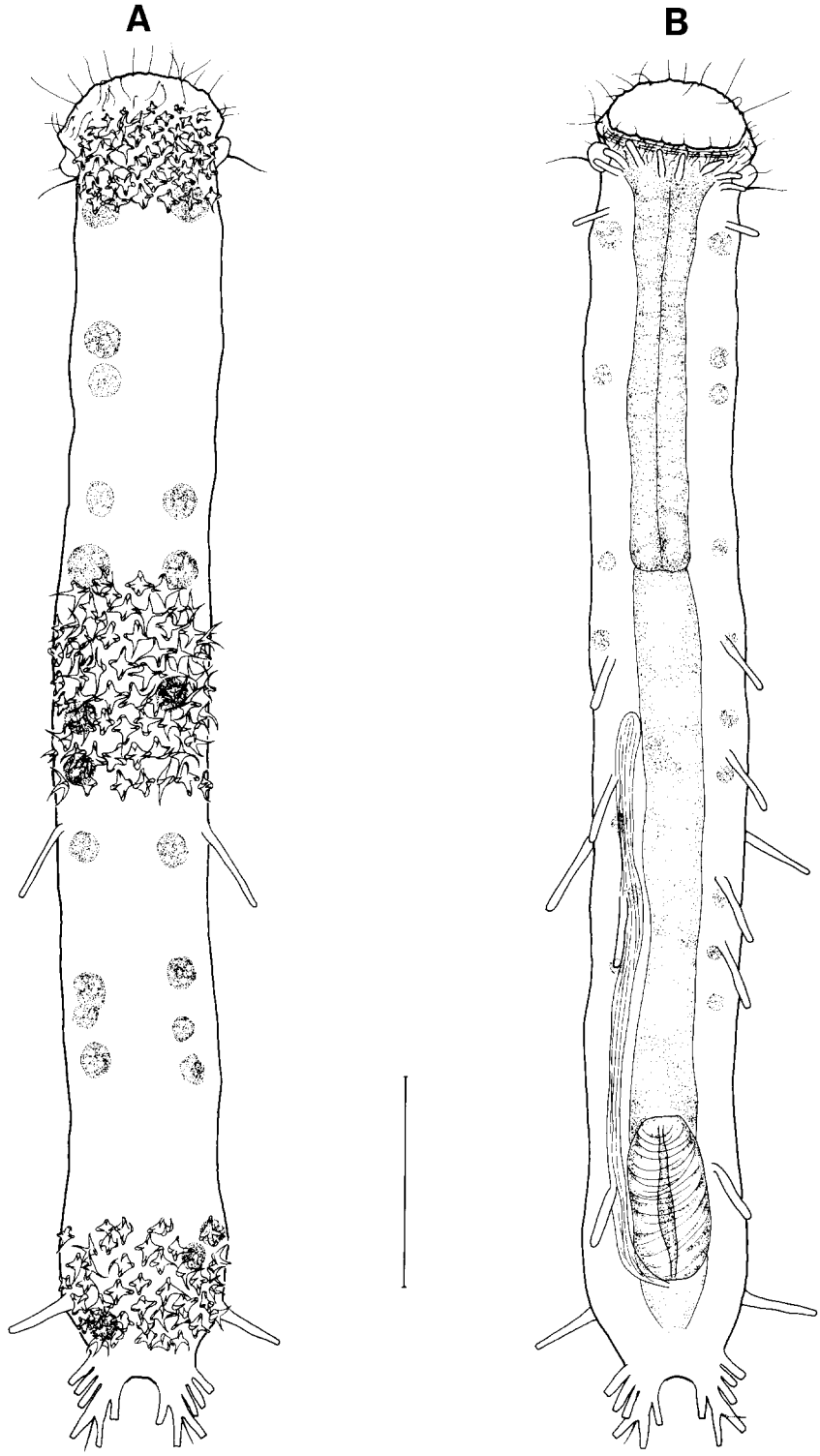

Fig. 1. *Tetranchyroderma gracilium*, n. sp. A, Habitus, dorsal. B, Habitus, ventral. Scale bar=50 μm.

No. 66780) and 2 paratypes (Cat. Nos. 66781-2) mounted in lactophenol and deposited in Zoological Museum, University of Bergen, Norway. Other paratypes (three specimens mounted in lactophenol on Cobb's hole slide, and twelve on aluminum stub for SEM observation) are kept in the Department of Biology,

Taegu University under reg. nos. GasTh0201- 960810-1~12.

Additional material examined: 1 individual, Hyòpchae, Oct. 14, 1997, coll. H. S. Rho and J. W. Choi.

Diagnosis: *Tetranchyroderma* with slender body with parallel sides, and a short caudum; without cephalic tentacles; with pestle organs; cuticular armature of tetrancres. Adhesive tubes: TbA, 4 per side, 1 medial and 3 lateral; TbVL, 5-6 per side, a small one close to TbA, 3-4 concentrated in the mid-trunk region, and 1 at U80; TbD, 2 per side, robust, 1 just behind mid-trunk and 1 at the latero-posterior edge of body; TbP, 6 per side, 2 forming one foot at bilobed caudum and the other 4 flanking each foot, 3 laterally and 1 medially. Copulatory organ oblong.

Description of the holotype: Body slender, total length about 336 μm; sides parallel before narrowing abruptly behind second pair of dorsal tubes; posterior border narrow and concave. Widths of head/neck/PhJIn/trunk/caudal base 40/40/39/37/25 μm at U03/U21/U35/U55/U93 respectively. Eyespot lacking.

Head protruding anteriorly, with slightly undulating border. Anterodorsal and ventrodistal margins each with 8-10 sensory hairs. No particular cephalic tentacles or cirri present. Numerous minute hairs forming a band subdistally on oral hood, at U05. Paired oval pestle organs (U07) projecting anterolaterally, each with an apical sensory bristle. Epidermal glands number 10-12 per side all along the body behind the pestle organ to the base of the caudum (U08-U92), mixed in size (from 5 to 6 μm in diameter) with a generally circular shape. Cuticular armature consisting of tetrancres only, arranged in columns (9-11 in mid-trunk region), each with up to 58-63 tetrancres; size of tetrancres variable, 6 μm between opposite tines at the head portion (U04), 14 μm at the mid-trunk region (U56), and 7 μm near the caudum (U90) respectively.

Adhesive tubes: 4 pairs of TbA, ca. 7 μm long, wavily inserted behind the mouth rim at U06 to U07, one tube occurring medially. 5-6 pairs of TbVL, a smaller one (9 μm) at U10, 3-4 (ca. 18 μm) in the mid-trunk region, more or less evenly spaced from U41 to U63, and a single one (18 μm) at U80. 2 dorsal tubes (TbD) per side, robust, located just behind the mid-trunk (U55), and near the hind end (U90), 22 μm and 17 μm long, respectively. 6 TbP per side, around each caudal lobe, 2 distal tubes (15 μm) forming foot or pedicle, 4 additional tubes flanking each foot, 3 laterally, anterior-most one (9 μm) slightly longer than the others, and 1 medially (6 μm). A 7 μm long bristle implants dorsally on the pedicle.

Oral opening broad (33 μm in width), with oral hood extending to U05. Pharynx attenuated at its proximal third (U15).

Testis reaching to U46, far behind PhJIn; vas deferens straight; copulatory organ oblong (18 μm×40 μm, 5U×12U), located in U76-U87; any seminal receptacle in front of copulatory organ not observed.

Measurements and Variability: Body lengths of six type specimens mounted on hole slide ranged from 216 μm to 336 μm (standard deviation 41.98), maximum widths 32-41 μm (11U-16U). First TbD ranged from 14 μm to 23 μm (5U-9U), and second one 12-17 μm (5U-7U). One of the five paratypes has five pairs of TbA, and another paratype has one additional TbP lateral to its right pedicle. In addition, several dorsolateral hairs were observed from just behind the pestle organ to about two-thirds of the body (U07-U68) in paratypes.

Etymology: The specific name, *gracilium*, is derived from the Latin *gracilis*, meaning 'slender', and refers the general body appearance of this new species.

Remarks: Of the 42 recorded species of *Tetranchyroderma*, the new species resembles *T. massiliense* Swedmark, 1956, *T. heterotubulatum* Hummon, Todaro and Tongiorgi, 1993, and *T. boreale* Clausen (clausen, 1998) in the following character combinations: (1) absence of particular cephalic cirri or tentacles, except the pestle organ; (2) cuticular armature with tetrancres; (3) pedicles with 2 TbP; (4) 2 robust TbD; (5) similar distribution of TbVL (Swedmark, 1956; Hummon et al., 1993; Clausen, 1998). *T. gracilium* differs from *T. massiliense* in that the latter has very long and thin pedicles, the TbA arranged in ventrolateral columns, and fewer and oblong epidermal glands. However, only these two species of the group have the pestle organ. *T. heterotubulatum* differs from all the other three in the presence of secondary head lobes; from *T. gracilium* it differs in that the TbP flanking the pedicles show the reverse situation of that of this species, as there are more tubes medially than laterally, while the arrangement of TbA are much the same as in *T. gracilium* and *T. boreale*. The two latter species also have a similar arrangement of TbP, but *T. gracilium* has more protruding pedicles. However, the remarkably elongate and evenly broad copulatory organ sets *T. gracilium* aside from *T. boreale* and all other known species to *Tetranchyroderma*.

Genus *Thaumastoderma* Remane, 1926

Thaumastoderma copiophorum, new species
(Figs. 2, 3G-I)

Material examined: 5 individuals., Udo I., Oct. 14, 1996, coll. H. S. Rho. Holotype (Cat. No. 66783) and 2 paratypes (Cat. Nos. 66784-5) deposited in Zoological Museum, University of Bergen, Norway. Other paratypes are kept in Department of Biology, Taegu University under reg. nos. GasTh0103-961014-1~2. All the specimens above mounted in lactophenol.

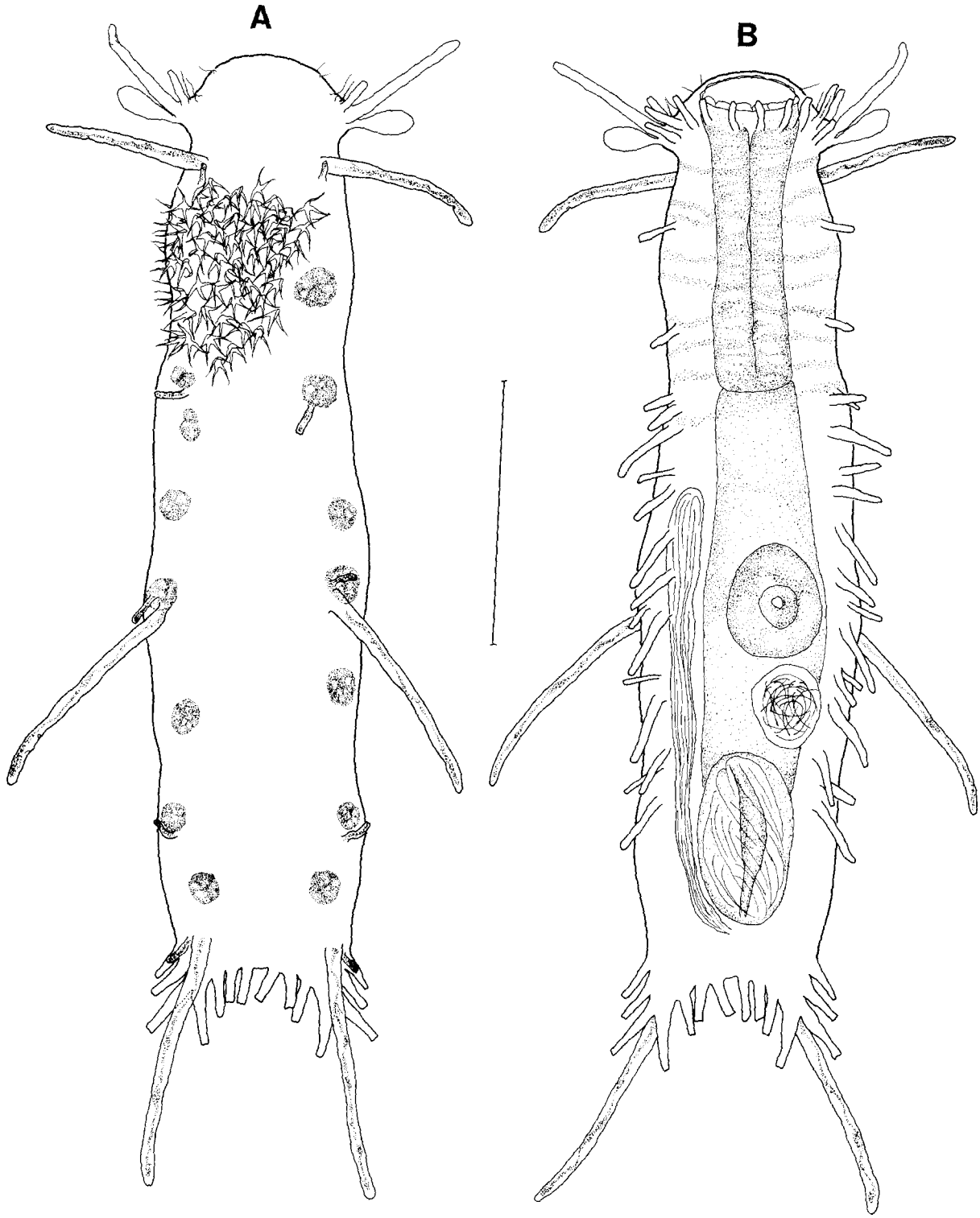

Fig. 2. *Thaumastoderma copiophorum*, n. sp. A, Habitus, dorsal. B, Habitus, ventral. Scale bar=50 μm.

Additional material examined: At the same locality as above, 11 inds. (including 1 juv.), July 13, 1996, H. S. Rho; 1 ind. Mar. 1, 1998, J. M. Lee, H. S. Rho and J. W. Choi.

Diagnosis: *Thaumastoderma* with 1 pair of simple

Table 2. Measurements (μm) of type specimens of *Thaumastoderma copiophorum* n. sp.

Specimen No	Characters								
	Lt	Body width	Cirrata 1	Cirrata 3	Cirrata 5	Anterior tentacle	Pharynx length	Copulatory organ	
								Width	Length
1	149.5	34.0	28.2	31.7	46.9	8.0	53.7	-	-
2	177.5	43.6	33.1	49.5	53.3	8.1	59.6	16.5	31.4
3	207.4	46.8	31.3	48.8	54.5	10.1	67.6	22.9	38.3
4	191.5	43.8	32.6	51.4	51.0	7.8	69.1	20.7	31.1
5	187.5	40.0	35.2	55.8	54.9	7.8	66.2	17.3	32.6
6	150.6	42.8	29.3	46.5	48.0	7.6	50.3	12.8	23.4
7	157.8	46.7	32.6	46.9	50.7	9.0	46.8	-	-
8	192.2	34.7	29.8	41.5	42.3	6.6	56.8	15.7	34.6
9	155.5	36.1	30.5	46.6	44.4	9.6	55.3	21.0	33.0
10 (holotype)	192.6	42.5	31.7	45.7	49.1	7.6	61.7	17.6	33.1
Mean ±SD	176.2 ±20.2	41.1 ±4.5	31.4 ±2.1	46.5 ±6.4	49.5 ±4.1	8.2 ±1.6	58.8 ±7.1	18.1 ±3.0	32.2 ±4.2

spatulate tentacles and 5 pairs of dorsal cirrata, of which the third pair is elongate; the second and fourth pairs are reduced to vestigial.

Description of the holotype: Body length 192.6 μm, width 42.5 μm. Anterior margin of head convex. Body slender, a little swollen in the pharyngeal portion (U25), broadest near mid-trunk (U55). Posterior border slightly incurved. Widths of head/neck/PhJln/trunk/caudal base 33/28/34/43/33 μm at U05/U08/U36/U55/U89 respectively. Eyespot lacking.

Anterior tentacles slim, 7 μm long (U05); rod-shaped lateral tentacles 24 μm long (U06); spatulate tentacles simple-form, 13 μm long (U07); shaft and blade smoothly merging. 2 pairs of sensory hairs with distinct conical base just ahead of anterior tentacle.

Cuticular armature of tetrancres, in about 13-17 columns and 45-47 rows; ancres ca. 4 μm wide on head, ca. 12 μm on mid-trunk, and ca. 7 μm near base of caudum respectively. 7-8 epidermal glands per side, fairly evenly spaced from U21 to U85, round to oval in shape, mixed in size (from 3 μm to 8 μm in diameter).

Five pairs of dorsolateral cirrata; 1st, 3rd, and 5th pairs stout and elongate, 32 μm (17U), 46 μm (24U), and 49 μm (26U) long and located at U11/U55/U88 respectively, whereas second and fourth pairs extremely reduced and even vestigial; cirrata 3 markedly elongate and just a little shorter than the longest one (last pair); cirrata 1, 3, and 5 with an accessory cirratum near their bases.

Five TbA per side, forming a row of 8 tubes behind the mouth at U05, last 2 tubes inserting behind outer most tubes of the row at U06. TbVL, 16-17 per side, 2 small in the pharyngeal region at U15 and U25, and 14-15 in the trunk region from U32 to U75, mixed in size from 5 μm to 14 μm. TbP 7 per side; pedicles with 2 distal tubes (11 μm), 3 medial tubes (7-8 μm), and 2 tubes lateral to pedicles (7-9 μm).

Mouth little extendable, with undulating distal part. Pharynx narrowest at its middle. Intestine expanding toward its middle portion at U54. A single testis on the right side, not reaching PhJln; seminal receptacle rounded, 13 μm or 7U in diameter; copulatory organ ellipsoidal, 33 μm long (17U) and 18 μm wide (9U). Egg (22 by 18 μm) situated dorsally in the mid-trunk region.

Collected from rather coarse (ϕ1-3 mm) coralline sands in shallow sublittoral zone (2-4 m deep).

Measurements and variability: Measurements from ten specimens are shown in Table 2. All of them had an accessory cirratum constantly ahead of or behind cirrata 1, 3, and 5. In three of ten specimens cirrata 3 were the longest (slightly longer than cirrata 5). Two specimens had 4-5 medial TbP. Other characteristics showed no significant variations.

Juvenile: A juvenile examined showed a few morphological differences from adults: (1) body rather stubby (Lt 80 μm, width 21 μm, width to length ratio 26/100, vs 22/100 in adult holotype); (2) TbA of only 2 pairs; (3) only 2 ventrolateral tubes on each side of the trunk; (4) 4 TbP on each side, *i.e.* the 2 pedicle tubes and 2 lateral flanking tubes, but no medial tube; (5) accessory cirratum absent; (6) cirrata 5 (21 μm, 26U) more than 3 times as long as cirrata 3 (6 μm, 8U); (7) cirrata 4 not observed.

Etymology: The specific name, *copiophorum* means 'bearing or carrying an oar', alluding to the elongate pairs of cirrata 1, 3 and 5, the most characteristic feature of this species lend the look of a rowing boat, or that the animal might move by means of them.

Remarks: A total of eleven species belong in the genus *Thaumastoderma*. The new species exhibits an unique arrangement of dorsal cirrata. As far as the elongate middle pairs are concerned, this species is reminiscent of *T. cantacuzeni* Lévi and *T. truncatum* Clausen. However, *T. cantacuzeni* has a complex spatulate tentacle, while in *T. truncatum* cirrata 3 is more than twice the length of the next longest pair, and that the species also has a coiled vas deferens (Lévi, 1958; Clausen, 1991).

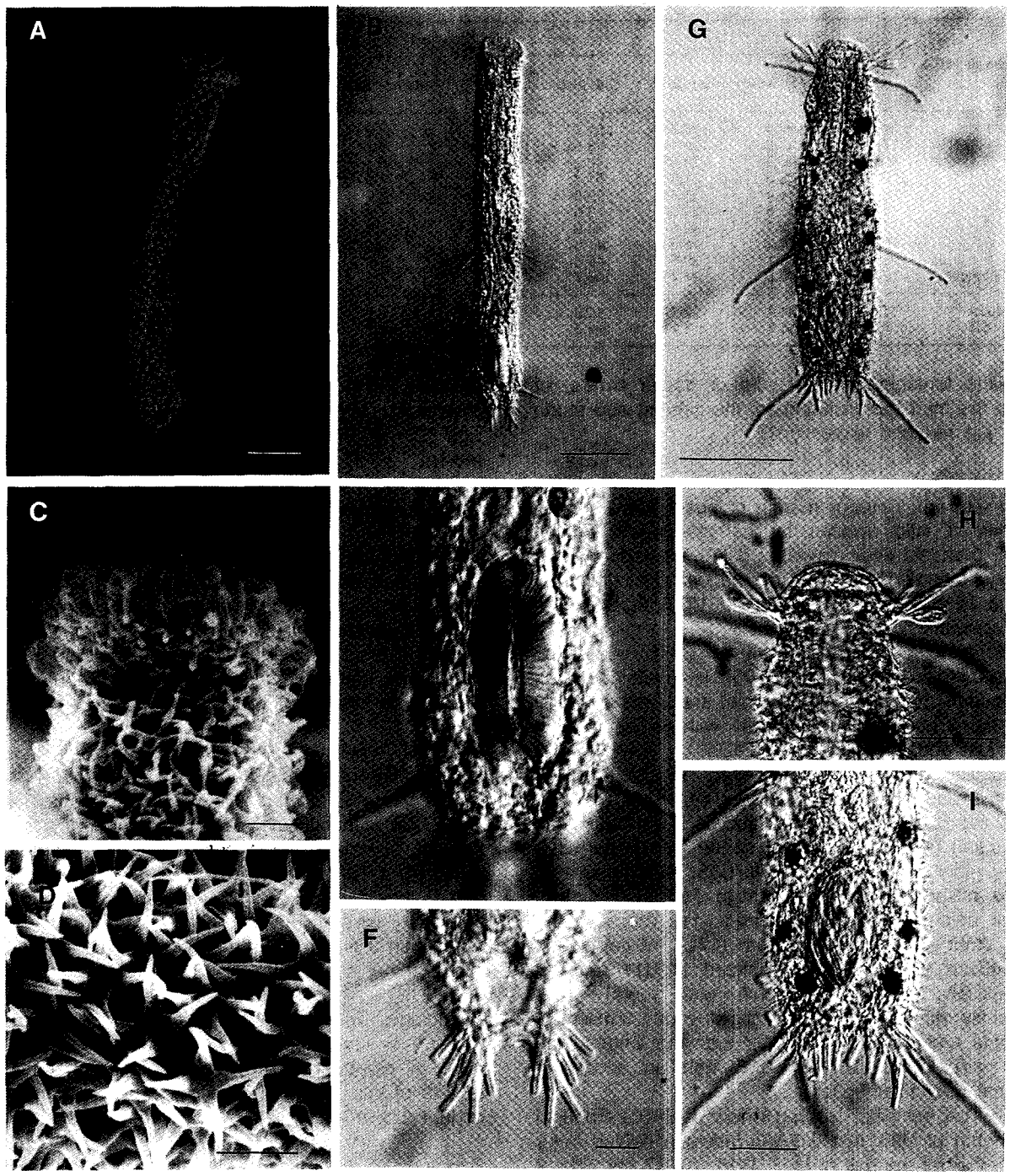

Fig. 3. *Tetranchyroderma gracilium,* n. sp. (A-F) and *Thaumastoderma copiophorum,* n. sp. (G-I). A, Habitus, dorsal. B, Habitus, ventral. C, Head portion, dorsal. D, Tetrancres. E, Copulatory organ. F, Posterior adhesive tubes. G, Habitus, dorsal. H, Head portion, dorsal. I, Copulatory organ and posterior adhesive tubes. Scale bars=5 μm (C-F), 20 μm (A, H, I), and 50 μm (B, G).

T. appendiculatum Chang, Lee and Clausen, 1998 appears very close to the new species in sharing with it two characteristics: the presence of accessory cirrata annexed to the dorsal cirrata, and a simple swollen spatulate tentacle. However, *T. appendiculatum* shows the clear discrepancies in the arrangement of dorsal cirrata, as well as in the pattern of TbP.

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