TAB II

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Amphidiscophoran Hexasterophora

Konstantin R. Tabachnick & Claude Levi

Part I (K.R. Tabachnik & C. Levi), Part 2 (K. R. Tabachnick)

Abstract of part 1 & 2: New representatives of the subfamily Corbitellinae (Hexactinellida; Euplectellidae) are described (*Amphidiscella caledonica, A. monai*, and *Vityaziella renki*) The most peculiar feature of this hexasterophoran sponges is the presence of amphidiscs. The nearly complete morphological row of microscleres from hexasters to amphidiscs including the hexadiscs and staurodiscs is observed. This character of the new Hexasterophora together with the presence of staurodiscs and hexadiscs in addition to amphidiscs in some Amphidiscophora (for example, *Monorhaphis*) contradicts the classical definition of two subclasses of Hexactinellid sponges, first of all that Amphidiscophora are characterized by amphidiscs. The new data support the less known concept of Reid (1958) that Amphidiscophora should be defined by the presence of hexactines and their derivatives with the ray number reduction, including amphidiscs and never hexasters.

Key words: Porifera, Hexactinellida, Corbitellinae.

Adresses of the authors: Konstantin R. Tabachnick: Institute of Oceanology Ac. of Science of Russia, Moscow, RUSSIA. Claude Levi: Museum National d'Histoire Naturelle, Paris, FRANCE.

Amphidiscella, gen. nov. Tabachnick & Levi

Diagnosis: Cup-like pedonculate sponge. The choanosomal skeleton is chiefly of diactines. Dermalia and atrialia are hexactines. Microscleres: amphidiscs, staurodiscs, hexadiscs, hemidisco-hexasters and discohexasters, all with anchorate discs, floricomes and sometimes sigmatocomes.

Type species: *Amphidiscella caledonica*, sp. nov. Tabachnick & Levi

Amphidiscella caledonica, sp. nov. Tabachnick & Levi

(Text-Fig. 1; Pl.1, Figs.1-6; Pl.2, Figs.1-2; Tab. 1)

Holotype: with number MNHN HCL 150 is stored in alcohol in the Museum National d'Histoire Naturelle (Paris).

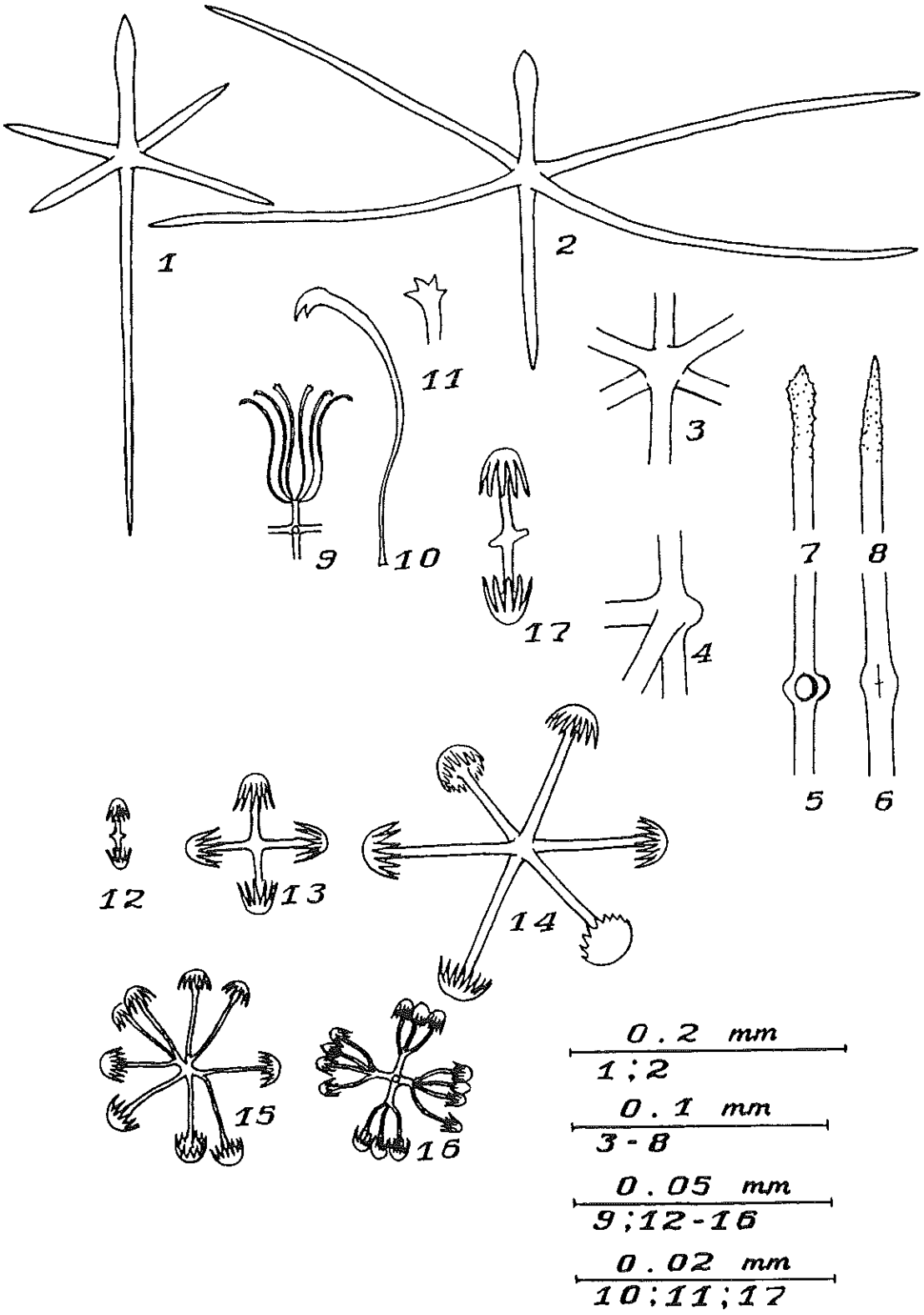
Location: Campaign "CALSUB n 8", submarine "Cyana n 1023/29", 26.2.1989, New Caledonia, W of Lifou, N of the Bay Santal, 20 48'3 S 167 05' E, depth 880-516 m, coll. B. Laurin.

Description:

Body. The single specimen is cup-like with wide osculum and atrial cavity, relatively thin walls, attached with a long and thin tubular peduncle. Total length of the body 70 mm, maximal diameter 80 mm; the walls are 15-20 mm thick. The tubular peduncle is over 50 mm in length and about 4 mm in diameter.

Spicules. Choanosomal skeleton consists chiefly of diactines 1.2-2.8/0.005-0.010 mm with small widening or rarely with four rudimental tubercles in the middle. Additional spicules are rare. They are hexactines and paratetractines with rays similar in length, terminations and diameter to the rays of diactines. All the choanosomal spicules are smooth, terminated by small spiny end. The spicules of peduncle are parallel diactines, 0.005-0.007 mm in diameter, fused to each other by numerous synapticular. Dermal and atrial spicules are very similar. They are both smooth hexactines. Few pentactines were found among atrialia. The length of the rays directed out of walls is 0.05-0.27 mm, tangential - 0.08-0.44 mm, the rays directed inside the wall are usually the longest 0.07-0.66 mm; their diameter is 0.004-0.160 mm.

Microscleres. The most abundant spicules are amphidiscs with two rudimental rays in the middle, total length 0.0063-0.0238 mm, the umbel length 0.0030-0.0088 mm, the umbel diameter 0.0025-0.0075 mm. Stauractines and hexactines were found more rarely, 0.0150-0.0500 mm in diameter, the umbel length 0.0030-0.0075 mm, the umbel diameter 0.0050-0.0100 mm. Discohexasters and hemidiscohexasters were found occasionally, the latter have very short principal rays with 1-3 terminations, 0.0350-0.0600 mm in diameter, 0.0100-0.0150 mm the diameter of the rosettes of primary rays. Another usual type of microscleres are floricomes, 0.0500-0.0715 mm in diameter, with the diameter of the rosettes of primary rays 0.0100-0.0175 mm. The secondary rays of floricomes seem to be smooth under the light microscope and turned to be covered with short spines at SEM.



Text-Fig. 1: *Amphidiscella caledonica* - spicules (drawings):

1: dermal hexactine. **2:** atrial hexactine. **3:** choanosomal hexactine. **4:** choanosomal pentactine. **5:** choanosomal diactine with four tubercles in the middle. **6:** choanosomal diactine with widening in the middle. **7-8:** terminations of the choanosomal spicules. **9:** floricome. **10-11:** floricome terminations. **12:** amphidisc. **13:** staurodisc. **14:** discohexactine. **15:** hemidiscohexaster. **16:** discohexaster. **17:** amphidisc.

Tab. 1: Measurements of the spicules of *Amphidiscella caledonica* sp. nov. Tabachnick & Levi (in mm)

	n	avg	min	max	std
L dermal hexactin distal ray	25	.0842	.0500	.2700	.0417
L dermal hexactin tangential ray	23	.2485	.0800	.3400	.0792
L dermal hexactin proximal ray	25	.2698	.0750	.6400	.1766
L atrial hexactin proximal ray	22	.0982	.0800	.1300	.0132
L atrial hexactin tangential ray	24	.2846	.0800	.4400	.0737
L atrial hexactin distal ray	20	.4325	.1200	.6600	.1421
D floricome	25	.0604	.0500	.0715	.0055
d floricome primary rays	25	.0132	.0100	.0175	.0022
L amphidisc	25	.0141	.0063	.0238	.0032
L amphidisc umbel	25	.0043	.0030	.0088	.0014
d amphidisc umbel	25	.0042	.0025	.0075	.0012
D hexa-, staurodisc	18	.0286	.0150	.0500	.0100
L disc umbel of hexa-, staurodisc	18	.0052	.0030	.0075	.0012
d disc umbel of hexa-, staurodisc	18	.0062	.0050	.0100	.0013
D discohexaster	3	.0450	.0350	.0600	.0132
d discohexaster primary rays	3	.0125	.0100	.0150	.0025

L = length; D, d = diameter

Amphidiscella monai, sp. nov. Tabachnick & Levi

(Text-Fig. 2; Pl.2, Figs. 3-4; Tab.2)

Holotype: number 5/2/3076 is stored in alcohol in the Institute of oceanology Ac. of Sc. of Russia (Moscow).

Location: R/V "Akademik Mstislav Keldysh", campaign 36, sta. 3572, submarine "Mir 2" n 10/184, 1995, North Atlantic, Mona mountain range, 73 12'80-22'10 N 7 16'30-16.90 E, depth 2920-2942 m, coll. S. V. Galkin.

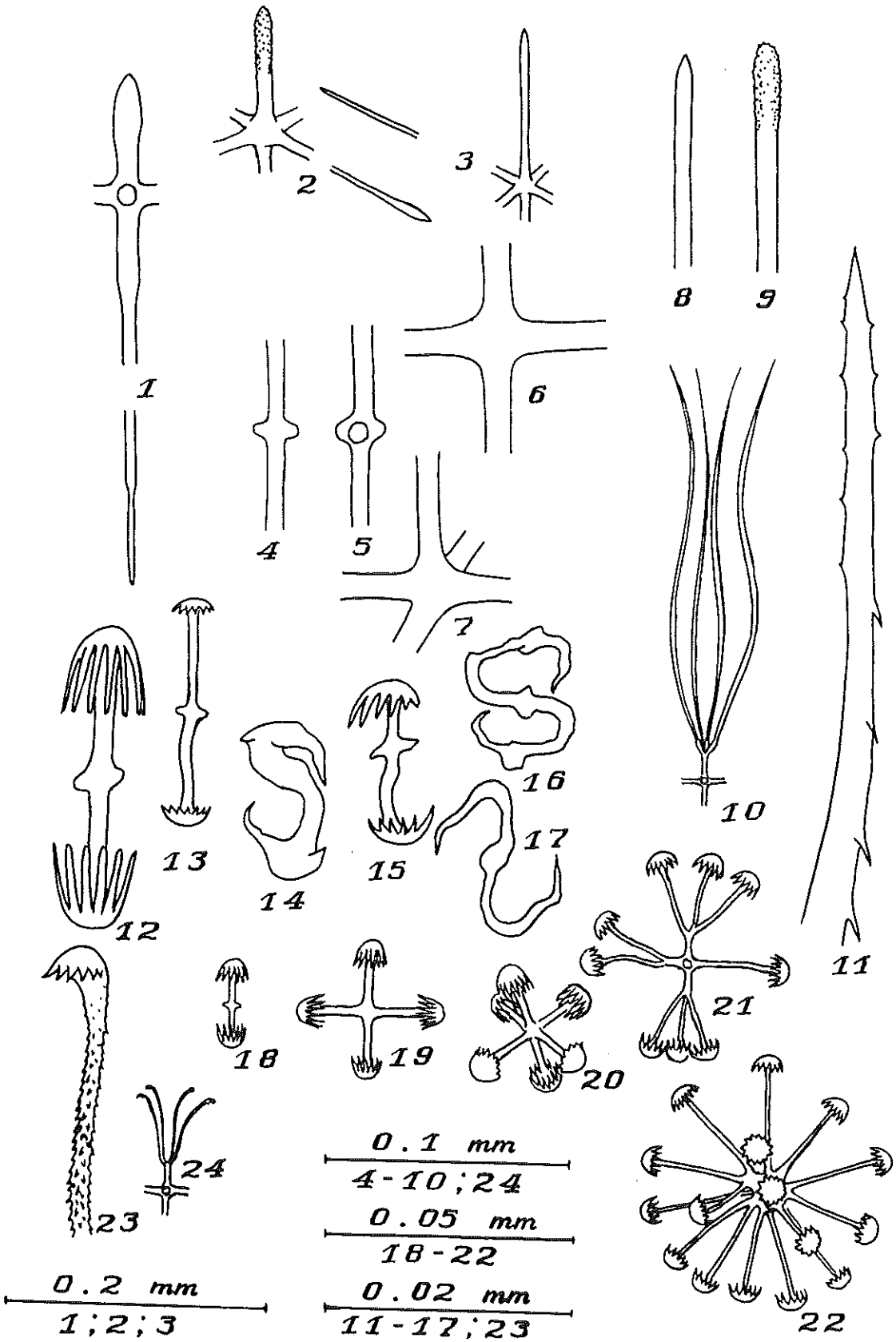
Description:

Body. The single specimen is expected to be cup-like. The sector of a body of specimen seems to be destroyed from the peduncle up to the osculum. If so the sponge has a single small osculum. Total length of the body is 40 mm, maximal diameter is about 32 mm, the osculum is oval 8 x 3 mm; the walls are 3-4 mm thick. The tubular peduncle is 110 mm in length and about 2 mm in diameter with thickening basal part, and square for fixation on substratum is about 20 mm in diameter.

Spicules. Choanosomal skeleton consists chiefly of diactines 0.86-2.4/0.006-0.009 mm with two or four rudimental tubercles in the middle. Additional spicules are hexactines, pentactines, stauractines and paratetractines with rays similar to the rays of diactines in length, terminations and diameter. All the choanosomal spicules are smooth, terminated by both smooth or small spiny ends. The spicules of peduncle are parallel diactines about 0.015 mm in diameter, fused to each other by numerous synapticulae. Dermal and atrial spicules are both hexactines, usually smooth. Sometimes the ray directed outside the wall is thicker in diameter then the other rays, it may be covered with short spines. Dermalia contains some pentactines and about a half of atrialia are pentactines. However in both cases some of these pentactines could be choanosomal spicules. The length of the rays directed out of wall is 0.03-0.15 mm, tangential - 0.14-0.44 mm, the rays directed inside the wall are usually the longest 0.12-0.80 mm; their diameter is 0.007-0.022 mm.

Microscleres. The most abundant spicules are amphidiscs with two rudimental rays in the middle, total length 0.0126-0.0198 mm, the umbel length 0.0036-0.0063 mm, the umbel diameter 0.0036-0.0063 mm. Rarely the amphidiscs have small-teethed discs, they are, probably, young forms of common anchorate discs. Small amount of amphidiscs are paradiscs or even diactines with rudimental widening in the middle and sometimes with rudiments of anchorate discs. Stauractines and hexactines were found more rarely, 0.0270-0.0306 mm in diameter, the umbel length 0.0054-0.0063 mm, the umbel diameter 0.0054-0.0072 mm. Discohexasters (0.0684-0.0936 mm in diameter, 0.0108-0.0180 mm the diameter of the rosettes of primary rays) and hemidiscohexasters (0.0432-0.0720 mm in diameter, 0.0108-0.0144 mm the diameter of the rosettes of primary rays) were found occasionally. The floricomes are 0.0792-0.1044 mm in diameter, with the diameter of the rosettes of primary rays 0.0144-0.0252 mm, with short spiny secondary rays. This species has an additional kind of spicules comparing with *A. caledonica* - sigmatocomes, 0.2916-0.3780 mm in diameter, with the diameter of the rosettes of primary rays 0.0144-.0324 mm, with spiny secondary rays. Both floricomes and sigmatocomes are common in this species.

Some spicules of allochthonic origin were observed here. They belong to *Caulophacus arcticus* and *Asconema* sp. Both species were captured in the same station.



Text-Fig. 2: *Amphidiscella monai* - spicules (drawings):

1-2: dermal hexactine. **3:** atrial hexactine. **4:** choanosomal diactine with widening in the middle. **5:** choanosomal diactine with four tubercles in the middle. **6:** choanosomal stauractine. **7:** choanosomal pentactine. **8-9:** terminations of the choanosomal spicules. **10:** sigmatocome. **11:** sigmatocome termination. **12-13:** amphidiscs. **14:** deformed paradisc. **15:** paradisc. **16-17:** paradiscs deformed up to microdiactines. **18:** amphidisc. **19:** staurodisc. **20:** discohexactine. **21:** hemidiscohexaster. **22:** discohexaster. **23:** floricome's termination. **24:** floricome

Tab. 2: Measurements of the spicules of *Amphidiscella monai* sp. nov. Tabachnick & Levi (in mm)

	n	avg	min	max	std
L dermal hexactin distal ray	25	.0872	.0532	.1520	.0226
L dermal hexactin tangential ray	23	.3298	.1368	.4180	.0849
L dermal hexactin proximal ray	20	.6069	.3800	.7980	.1459
L atrial hexactin proximal ray	14	.0765	.0304	.1064	.0201
L atrial hexactin tangential ray	14	.3083	.1368	.4408	.0639
L atrial hexactin distal ray	10	.3944	.1292	.6080	.1422
D floricome	22	.0903	.0792	.1044	.0076
d floricome primary rays	22	.0200	.0144	.0252	.0037
L amphidisc	25	.0167	.0126	.0198	.0019
L amphidisc umbel	25	.0048	.0036	.0063	.0008
d amphidisc umbel	25	.0049	.0036	.0063	.0007
D hexa-, staurodisc	7	.0280	.0270	.0306	.0018
L disc umbel of hexa-, staurodisc	7	.0059	.0054	.0063	.0005
d disc umbel of hexa-, staurodisc	7	.0063	.0054	.0072	.0007
D hemidiscohexaster	3	.0624	.0432	.0720	.0166
d hemidiscohexaster	3	.0132	.0108	.0144	.0021
D discohexaster	9	.0808	.0684	.0936	.0097
d discohexaster	9	.0144	.0108	0180	.0025
D sigmatotocome	25	.3432	.2916	.3780	.0220
d sigmatotocome	8	.0221	.0144	.0324	.0060

L = length; D, d = diameter

Part 2 (K. R. Tabachnick)

Vityaziella, gen. nov. Tabachnick

Diagnosis: Pedonculate, probably cup-like sponge. The choanosomal skeleton is chiefly of diactines. Dermalia and atrialia are hexactines. Microscleres: amphidiscs, graphiocomes.

Type species: *Vityaziella renki*, sp. nov. Tabachnick

Vityaziella renki, sp. nov. Tabachnick

(Text-Fig. 3; Pl. 2, Fig. 5; Tab. 3)

Holotype: number 5/2/1232 is stored in alcohol in the Institute of oceanology Ac. of Sc. of Russia (Moscow).

Location: R/V "Vityaz", campaign 54, sta. 6754, trawl, Indian ocean, West Australian basin, 15 46'6 S 99 54'5 E, depth 5120-4820 m.

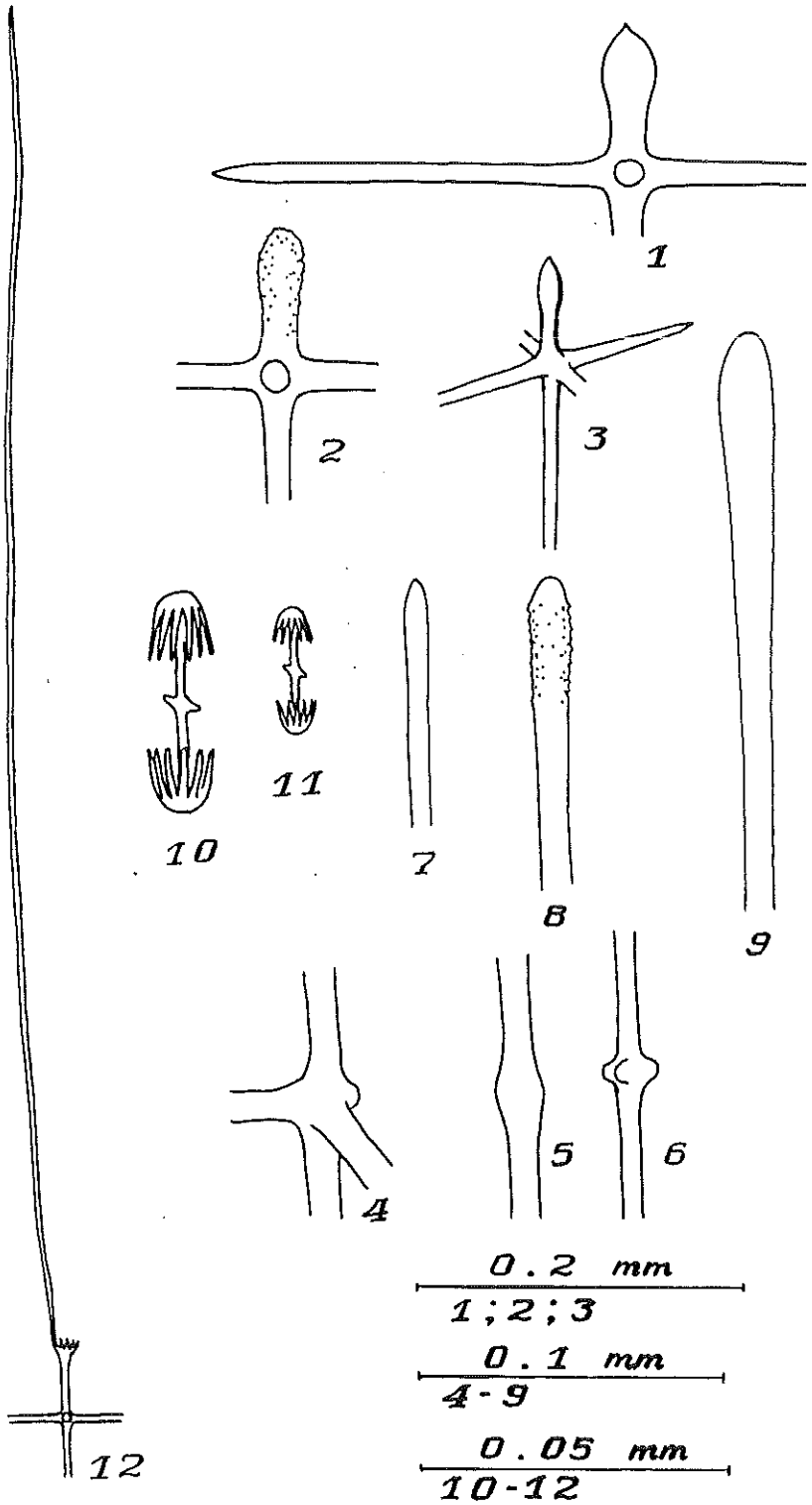
Description:

Body. The single specimen is swab-like. It may be supposed that it was a cap-like pedunculate sponge. The both dermal and atrial surfaces and atrial cavity are strongly damaged when captured and owing to several years of storage in formol. Total length of the body is at least 55 mm, diameter about 45 mm. The tubular peduncle is over 100 mm and 1.5-3.5 mm in diameter.

Spicules. Choanosomal skeleton consists chiefly of diactines 0.56-3.50/0.005-0.016 mm with widening or with four rudimental tubercles in the middle. Additional spicules are hexactines, pentactines and paratetractines. All the choanosomal spicules have the rays terminated with smooth or rough sometimes widening ends. The spicules of peduncle are parallel diactines, 0.023-0.038 mm in diameter, fused to each other by numerous synapticular.

Dermal and atrial spicules are hexactines. The presence of additional pentactines as in *Amphidiscella* is not obvious. All this spicules are in poor - broken condition. The ray directed outside the wall is more or less widening, smooth or covered with spines, its' length is 0.056-0.111 mm. The length of the tangential rays is 0.086-0.296 mm. The diameter of such rays is 0.0074-0.0296 mm. No spicules with an entire ray directed inside the wall were found, nevertheless it seems to be the longest.

Microscleres. Amphidiscs with two rudimental rays in the middle, total length 0.0175-0.0342 mm, the umbel length 0.0036-0.0108 mm, the umbel diameter 0.0036-0.0090 mm. Graphiocomes 0.2970-0.4590 mm in diameter, 0.0189-0.0216 mm the diameter of the rosettes of primary rays.



Text-Fig. 3: *Vityaziella renki* - spicules (drawings):

1-3: dermal or atrial hexactines. **4:** choanosomal tauactine. **5:** choanosomal diactine with widening in the middle. **6:** choanosomal diactine with four tubercles in the middle. **7-9:** terminations of the choanosomal spicules. **10-11:** amphidiscs. **12:** graphiocome

Tab. 3: Measurements of the spicules of *Vityaziella renki* n. sp. Tanachnik (in mm)

		n	avg	min	max	std
L dermal hexactin distal ray		6	.0783	.0555	.0925	.0125
L dermal hexactin tangential ray		2	.1684	.0851	.2516	.1177
L dermal hexactin proximal ray		1	.2960	.2960	.2960	
L atrial hexactin proximal ray		3	.0999	.0814	.1110	.0161
L atrial hexactin tangential ray		1	.2960	.2960	.2960	
L atrial hexactin distal ray		0				
D graphiocome	25	.3709	.2970	.4590	.0464	
d graphiocome primary rays		6	.0200	.0189	.0216	.0009
L amphidisc		25	.0175	.0117	.0342	.0055
L amphidisc umbel		25	.0047	.0036	.0108	.0021
d amphidisc umbel		25	.0046	.0036	.0090	.0018

L = length; D, d = diameter

Discussion

These new sponges are close to some other genera of the subfamily Corbitellinae which have the peduncle: *Hyalostylus* (Schulze, 1886), *Bolosoma* (Ijima, 1926) and *Saccocalyx* (Schulze, 1895). *Hyalostylus* and *Saccocalyx* are both cup-like, *Bolosoma* is more inverted - fungus-like. All the three genera are attached to substrata by a peduncle usually thin and long, dermalia and atrialia are presumably hexactines, the choanosomal skeleton is chiefly of diactines, lateral oscula are poorly reported (trustworthy known as the orifices at the peduncle of *Bolosoma*).

All the principal difference among these genera is represented by the combinations of microscleres. Bolosoma has different kinds of discohexasters, discasters, hemidiscohexasters and discohexactines with anchorate and small-teethed discs. *Saccocalyx* contains small-teethed and anchorate discohexasters with tendency to twist spirally the terminal rays, plumicomes and drepanocomes. Microscleres of *Hyalostylus* are small-teethed and anchorate discohexasters, floricomes, hexasters with typha-like ending terminal rays and curved rough diactines. Thus the new genera *Amphidiscella* and *Vityaziella* may be distinguished both on the new spicule combination and presence of amphidiscs. Besides, two other genera supposingly belong to the pedunculate Corbitellinae. The first of them is *Trachycaulus*. It's body-form is known owing to a photo of this sponge made just before collecting. It has a ball-like body on a long thick peduncle (Tabachnick, 1988). *Trachycaulus* is a rare case of pedonculate Corbitellinae with microscleres in the peduncle: graphiocomes and drepanocomes. The second is Rhabdopectella which could be considered to be pedunculate is poorly-investigated (Schmidt, 1880; Schulze, 1886). The young specimen is tubular as well as the other known young Corbitellinae (e.g., *Regadrella okinoseana* Ijima, 1901). A recently found by one of the authors specimen of *Rhabdopectella* (temporal number KT146) in collections of the Smithsonian Institution (Albatross expeditions) occurred to be a pedunculate sponge. The described earlier "adult" specimen (Schmidt, 1880; Schulze, 1886) turned to have a thick pedunckle build of a framework of beams with numerous lateral oscula similar to *Bolosoma*. *Rhabdopectella* is an intermediate form between pedunculate and other - "Venus'-flowers basket" Corbitellinae. The microscleres of *Rhabdopectella* are also specific: spirodiscohexasters and discohexasters with small-teethed and anchorate discs, floricomes, hexasters and asters. Spicules which were described as "spiralige Bogennadel mit Querriefen" (Schmidt, 1880) or "bow-shaped spicule" (Schulze, 1886) after careful investigation turned to be broken terminals of specific hexasters similar to sigmatocomes. Analogous curved rough diactines in *Hyalostylus* could be also terminals of hexasters. It requires a special investigation.

The most remarkable feature of new Hexasterophoran genera is the presence of amphidiscs. The independent origin of the hexasterophoran and amphidiscophoran amphidiscs is doubtless. Formal resemblance of them is obvious but amphidiscs of Hexasterophora differ from amphidiscophoran's ones by having two tubercles of rudimental rays on the shafts. The shafts of the amphidiscs in Amphidiscophora usually have four tubercles or a whorl of tubercles on the shaft which is smooth, or the shaft is entirely rough or smooth. The amphidiscs in Amphidiscella are a part of nearly complete morphological row of ray number reduction from hexasters including hexadiscs and staurodiscs. The ray number reduction of hexasters was observed in some other Hexasterophora as well, e.g., "oxystaurasters" of *Regadrella okinoseana* (Ijima, 1901), "hemioxy-hexasters" and "oxydiasters" of *Euplectella nobilis* (Schulze, 1904). Amphidiscs of *Amphidiscella* have the analogous origin, but the ray number reduction takes place in discohexactines instead of hexasters. This morphological row is prolonged by *A. monai* with the paradiscs analogous to that of *Hyalonema* (*Paradisconema*) (Ijima, 1926) and curved diactines similar to diactines of *Euplectella jovis*, supposingly derivated from hexasters

(Schulze, 1886). Thus basing upon the morphology and the long independent history of Hexasterophora and Amphidiscophora from the early Paleozoic (Mostler & Mehl 1990), the similarity of their amphidiscs should be considered to be a convergence and the observed rows to be the result of a parallel evolution.

The difference between *Amphidiscella* and *Vityaziella* is mainly in the presence of graphiocomes in the latter genus. Of coarse, it is possible to imagine the origin of graphiocomes from sigmatocomes. But nevertheless graphiocomes are traditionally discussed as a special kind of microscleres with great taxonomical significance and sponges containing the graphiocomes - families Euplectellidae and Lychniscosa were recently united into a higher taxon - Graphiocomida (Mehl, 1992). The presence of graphiocomes and some other differences - the absence of discohexactines and discohexasters in *Vityaziella* - gives reasons to separate two different genera of amphidiscophoran Hexasterophora.

Together with *Monorhaphis dives* (Schulze, 1905) which has amphidiscs, staurodiscs and hexadiscs (found also in some other Amphidiscophora) the new genera destroy the classical definition of two subclassis of Hexactinellida: Amphidiscophora (earlier characterized by amphidiscs) and Hexasterophora (characterized by hexasters).

Another less known concept was suggested by Reid (1958): "Amphidiscophora ... Hexactinellida in which the parenchymal microtriaxones are always holactines, never astral, and in which some form of birotulate is present"; "Hexasterophora...Hexactinellida in which the parenchymal microtriaxones are mainly or all astral, and are typically hexasters; without birotulates of any kind". Nevertheless according to the new material we can assume that Hexasterophora can have the amphidiscs and hence the last part of the Reid's diagnosis dealing with the absence of amphidiscs-birotulates of Hexasterophora should be removed.

Acknowledgements

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Plate 1

Amphidiscella caledonica - spicules. Bar = 0.05 mm.

Fig. 1: discohexaster

Fig. 2: discohexactine

Fig. 3: amphidisc

Fig. 4: amphidisc

Fig. 5: floricome

Fig. 6: floricome

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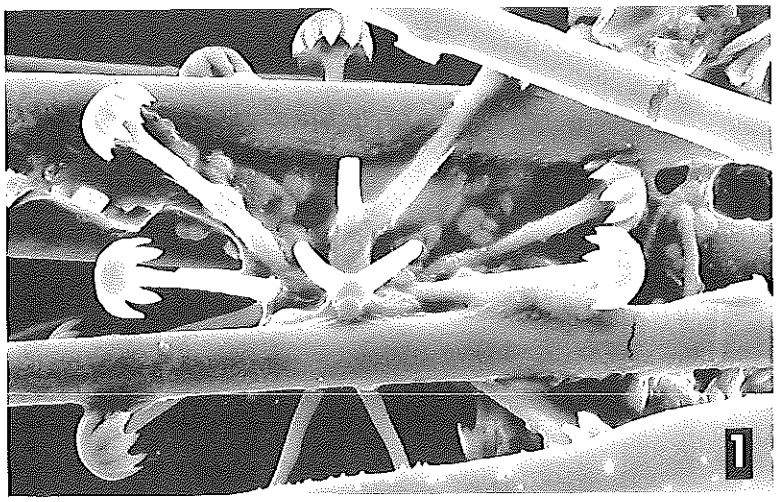
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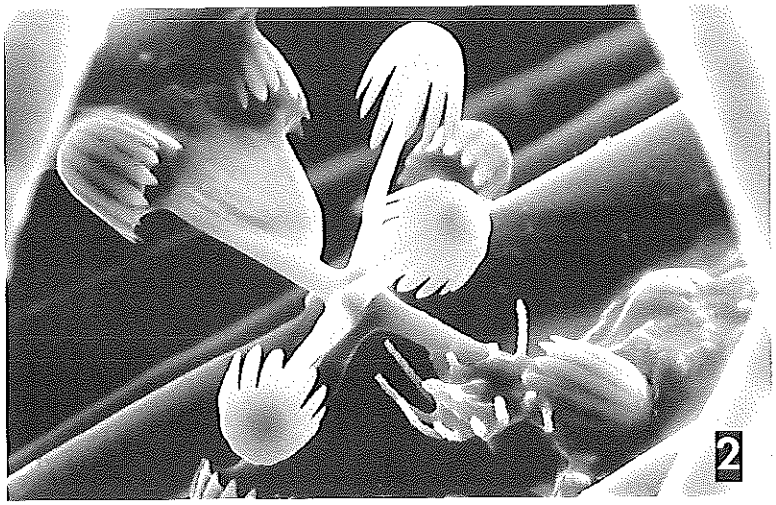
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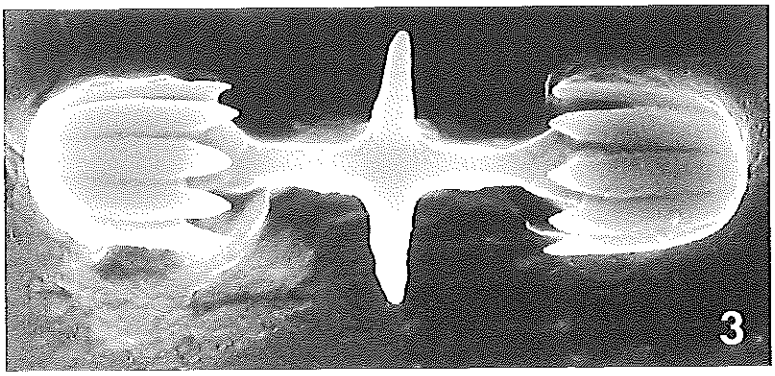
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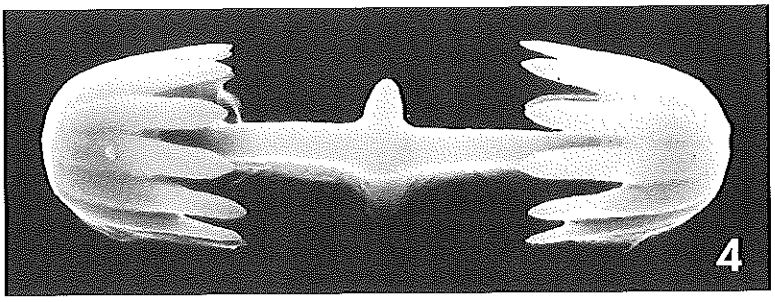
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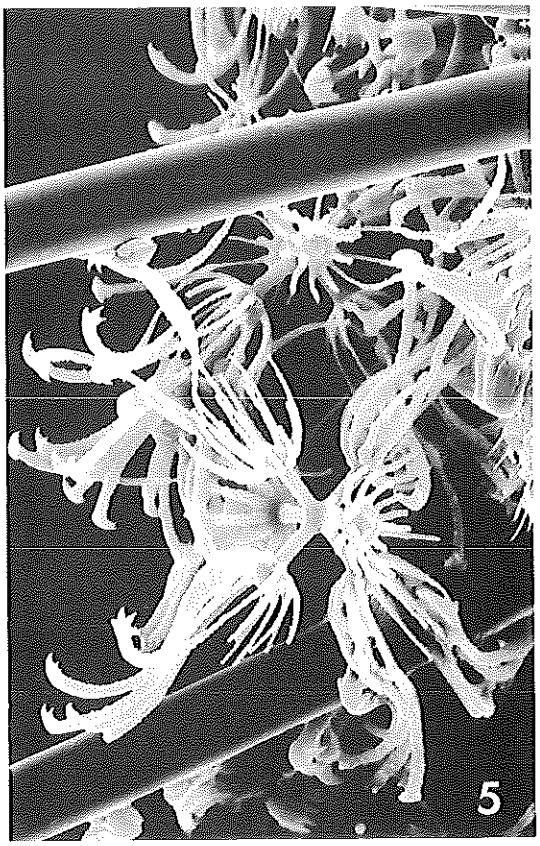
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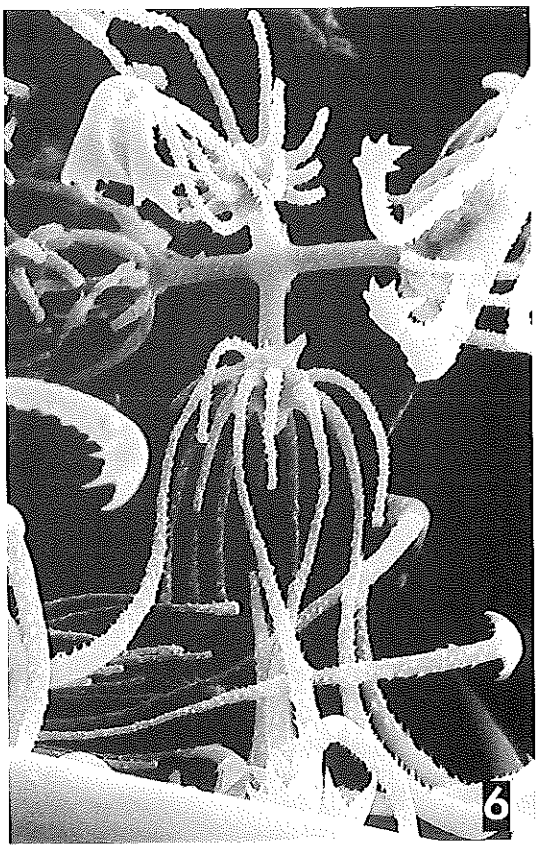
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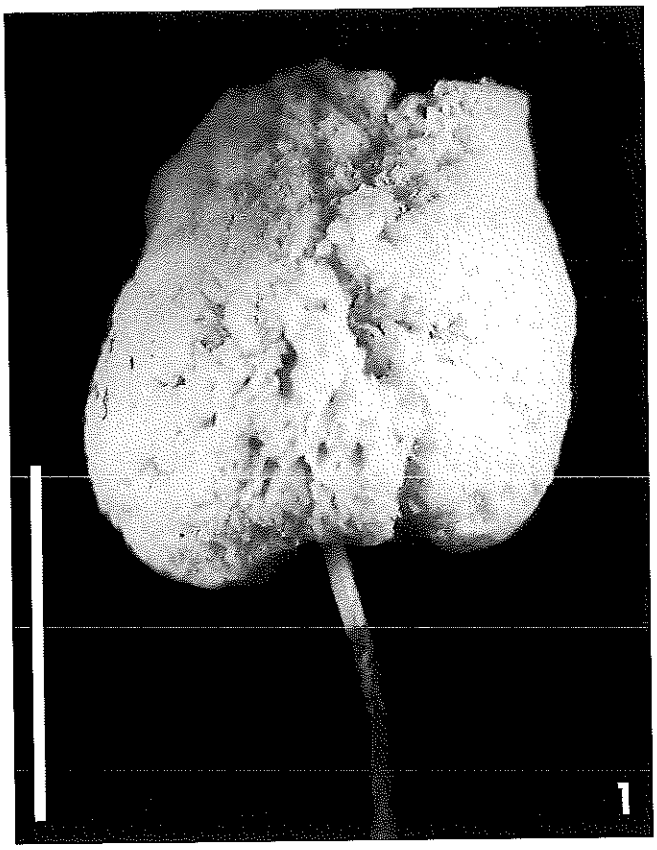
Plate 2:

Fig. 1: *Amphidiscella caledonica* - external shape - view from the side. Bar = 70 mm.
Fig. 2: *Amphidiscella caledonica* - external shape - view from above. Bar = 70 mm.

Fig. 3: *Amphidiscella monai* - external shape - view from the side
Fig. 4: *Amphidiscella monai* - external shape - view from the side

Fig. 5: *Vityaziella renki* - external shape - view from the side
In Fig. 3-5 Bar = 60 mm.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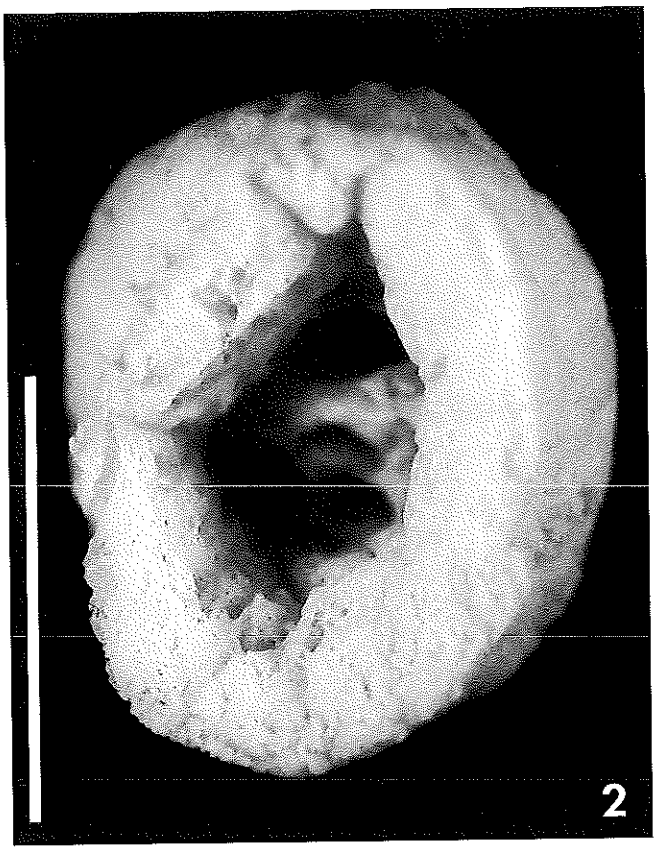
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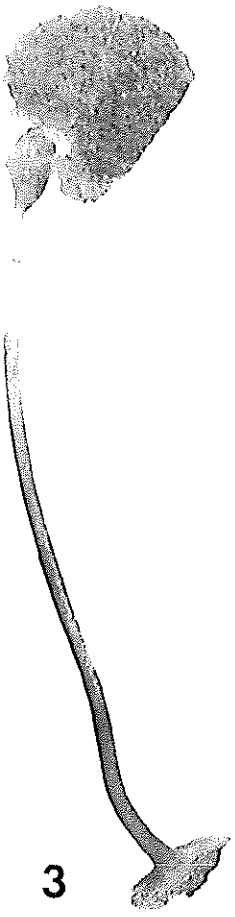
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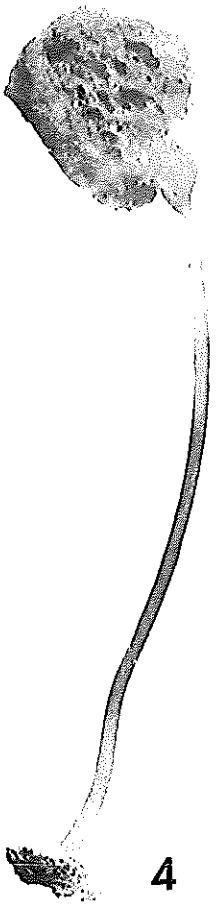
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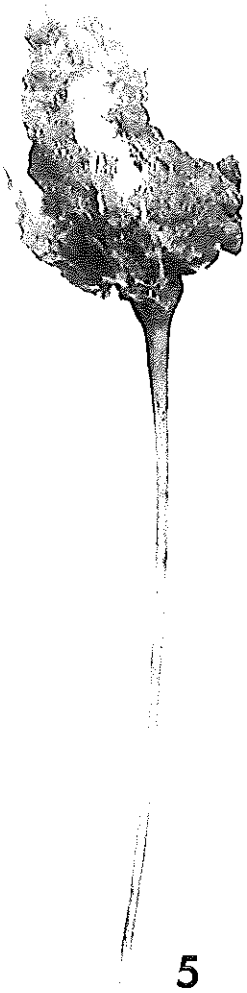
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