REVISION OF *PLEUROCHORIUM ANNANDALEI* (PORIFERA, HEXACTINELLIDA)

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ABSTRACT

Pleurochorium annandalei Schrammen, 1912, known previously from the N Indian ocean, is found to be widely distributed in the W Indian ocean as well. Two new subspecies of *P. annandalei* are described. A finding of a more complete, branching specimen and examination of its spicule content showed that *Pleurochorium* has much more complex body form then was previously considered. The type of tubular branching observed in this genus may not be attributed to dichotomous or to any of its variations but it should be considered as a regular emission of tubular branches from the side of the wall. Hence the genus should be conserved within Chonelasmatinae. The new data allow supplementation of the diagnosis of this genus and clarify the differences between the subfamilies of Euretidae.

KEY WORDS

Porifera, Hexactinellida, *Pleurochorium*.

ABBREVIATIONS

BMNH - Natural History Museum (London).
IORAS - Institute of Oceanology of Russian Academy of Sciences (Moscow).
MNHN - Museum national d'Histoire naturelle (Paris).

Pleurochorium Schrammen, 1912
Pleurochorium annandalei annandalei (Kirkpatrick, 1908)

Materials examined

Lectotype: BMNH 1907.08.09.003 - R.V. 'Investigator', Bay of Bengal, stn. 321, 5°48.5' N - 80°22' E, 1350 m.

Paralectotypes: 1907.08.09.001; 1907.08.09.002 - same location.

Few new data can be added to the descriptions by KIRKPATRICK (1908) and REISWIG & WHEELER (2002). The fragments which we have examined contains no loose spicules other than spiny hexactines, the rays of which are much smaller (0.06 - 0.14 / 0.004 - 0.005 mm) than corresponding dimensions given in the two previous descriptions.

Pleurochorium annandalei pseudoclavula ssp.n.
(Figs 1-5, Tab. I)

Synonymy. Nil.

Materials examined

Holotype: IORAS 5/3/343.1 - R.V. 'Academic Kurchatov' - 36, stn. 3779, 1°06.5' - 06.1' N – 56°28.7' - 29.6' E, 1280 - 1380 m.

Paratypes: IORAS 5/2/3138; 3143; 3144 - same location.

Description

Body. The holotype is presented by a fragment of the lower part of the body broken close to the basal disc of attachment. The central tube is 270 mm in length with constant diameter 14 - 16 mm. The walls are 1 - 2.5 mm in thickness. The lateral appendages in the lower part of the body are perpendicular to the central tube; they are peak-like, lamellar, 10 - 16 mm long, 15 - 28 mm wide and about 1 mm in thickness. The lateral appendages in the middle may have saddle shape and some rare and small finger-like additional appendages up to 6 mm long situated on them. The lateral appendages of the upper part of the body are tubular and also perpendicular to the central tube (these tubes are 6 - 7 mm in diameter 10 - 65 mm in length with walls 0.5 - 1 mm in thickness). Most of these appendages have two large horizontal lamellar lateral appendages and some relatively rare additional irregular lamellate appendages on the surface which may fuse to neighbour branches. Some of these appendages are tubular which develop the numerous lateral lamellar branches perpendicular to them or even bearing tubular branches with their own lamellar appendages. These lateral appendages are opposite-crossed with an angle usually differing from 90°. They are arranged in four longitudinal series (rows). The lateral oscula 3.5 - 5 mm in diameter are situated on the central tube at base of the most of the peak-like, lamellar lateral appendages in the basal part of the body and on both sides (upper and lower) of these appendages in some distance from the base. In the upper part of the body the lateral oscula are absent on the central tube but present either on the upper or on the lower surface of the lateral tubular branches being situated in an alternate position (incomplete monopodial branching here). The atrial cavity of this sponge is common but in the central tube it has lamellate beams perpendicular to each pair of lateral appendages inside the central tube. The external (dermal) surface of this sponge (except the lower part of the central tube and some lower peak-like, lamellar lateral appendages) is covered by dense prostalia lateralia 1 - 5 mm long. The paratype 5/2/3138 contains small broken fragments. The paratypes 5/2/3143 and 3144 are relatively large fragments of the upper part of the body with most lateral tubular appendages bearing numerous perpendicular lamellar lateral appendages. It is possible that the holotype and the paratypes are fragments of a single specimen.

Skeleton. The dictional framework entirely corresponds to that of *P. annandalei* described by KIRKPATRICK (1908) and REISWIG & WHEELER (2002).

Spicules. Prostalia marginalia consist of dense tufts of numerous sceptrules: abundant oxyscopules are situated in the middle of these tufts, some rhopaloscopules with 1 tine are on their sides. Nearly all rhopaloscopules and tyloscopules [they all are called tyloscopules by REISWIG & WHEELER (2002) or knobbed scopules by KIRKPATRICK (1908)] are located in the vicinity of atrial

surface. The oxyscopules (lanceolate scopules according to KIRKPATRICK (1908)) are 0.836 - 1.368 / 0.006 - 0.007 mm; they have 3 - 4 (sometimes 2 - 6) tines 0.030 - 0.084 mm in length. The rhopaloscopules with 1 tine have a widening on the shaft which clearly marks the origin of the tine, the shafts are spiny, the spines are directed opposite to the tine. These rhopaloscopules with 1 tine are 0.258 - 0.684 / 0.002 - 0.003 mm, their tines are 0.030 - 0.084 mm long. Rhopaloscopules and tyloscopules both have smooth shafts in the middle and rough free ends, differing in having rhopaloidal (clavate with spines) or tyloidal rough tines. These spicules are 0.266 - 0.616 / 0.003 - 0.005 mm, they have 3 (sometimes 2 - 5) tines 0.030 - 0.076 mm long.

Fig. 1. *Pleurochorium annandalei pseudoclavula*, external shape of the holotype (scale 50 mm).

Dermalia are pentactines, rarely hexactines with rough rays which outer ends are clavate or rounded. Their tangential rays are 0.076 - 0.243 mm, proximal ray is 0.061 - 0.236 mm. Atrialia are pentactines, rarely hexactines and stauractines which are less abundant then dermal spicules and have rays similar in shape. Atrialia of the central tube are smaller then that of the lateral tubular branches. Their tangential rays are 0.046 - 0.182 mm, distal ray is 0.038 - 0.213 mm. These spicules of the lateral tubular branches have tangential rays 0.106 - 0.258 mm (avg. 0.201; std 0.043; n = 25), distal ray is 0.068 - 0.342 mm (avg. 0.194; std 0.075; n = 25). The rays of dermal and atrial spicules are 0.005 - 0.013 mm in diameter.

Fig. 2. *Pleurochorium annandalei pseudoclavula*, external shape of the paratype (IORAS 5/2/3141)(scale 30 mm). **A,** view from a side with a removed wall; perforated long septa is visible. **B,** same specimen, view from a side with the whole wall.

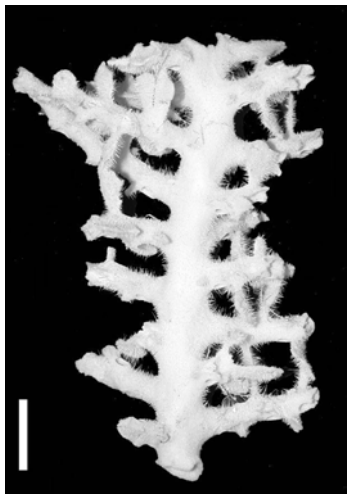

Fig. 3. *Pleurochorium annandalei pseudoclavula*, external shape from side of the paratype (IORAS 5/2/3143) (scale 20 mm); long tubular lateral outgrowths are visible.

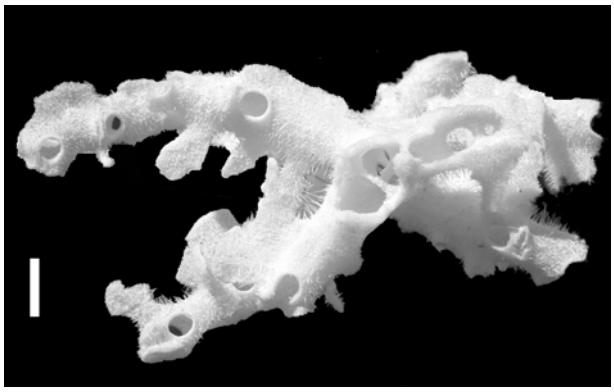

Fig. 4. *Pleurochorium annandalei pseudoclavula*, view from above of the paratype (IORAS 5/2/3143) (scale 10 mm); long tubular lateral outgrowths and two atrial beams are visible.

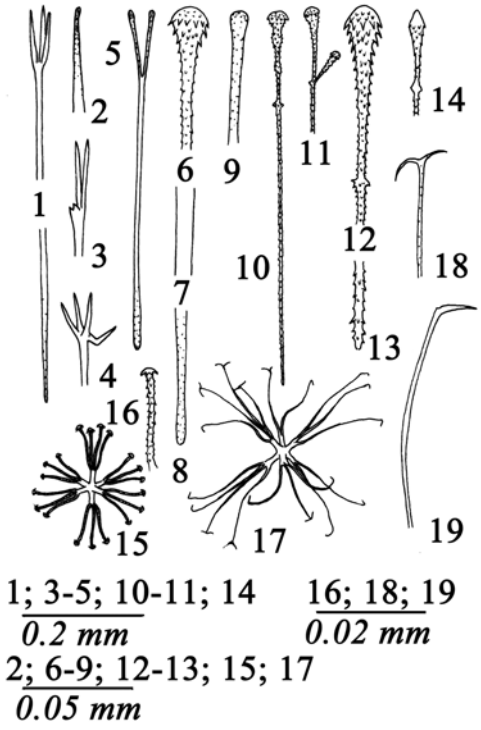

Fig. 5. Spicules of *Pleurochorium annandalei pseudoclavula*. **1-9,** scopules. **1,** oxyscopule. **2-4,** tines of oxyscopules. **5,** rhopaloscopule. **6-8,** tine, shaft and outer end of rhopaloscopule. **9,** tine of tyloscopule. **10,** rhopaloscopule with one tine. **11,** abnormal rhopaloscopule. **12-14,** outer ends of rhopaloscopules. **15,** discohexaster. **16,** secondary ray of discohexaster. **17,** onychohexaster. **18,** secondary ray of onychohexaster. **19,** secondary ray of sigmatocome.

Microscleres. Microscleres are stellate discohexasters, onychohexasters and sigmatocomes or forms with mixed secondary rays of two latter forms. The discohexasters are 0.027 - 0.043 mm in diameter, their primary rosette is 0.007 - 0.014 mm in diameter. They usually have 4, sometimes 2 - 3 secondary rays. The onychohexasters and sigmatocomes are 0.047 - 0.076 mm in diameter, their primary rosette is 0.007 - 0.016 mm in diameter. Spiny hexactines are rare; they have rays 0.038 - 0.099 / 0.003 mm. Uncinates are present as rare fragments. They may have allochthonic origin. Doubtless allochthonic spicules of different types belong to *Sarostegia* and *Saccocalyx*.

Pleurochorium annandalei maldiviensis ssp.n.
(Figs 6-7, Tab. I)

Synonymy. *P. annandalei*: Burton, 1955: 178; Reiswig & Wheeler, 2002.

Materials examined. Holotype: BMNH 1936.03.04.006 (b283) - R.V. 'Mahabis', off Maldives, stn. 152, 4° 49.00' - 48.00' N 72° 46.30' - 40.00' E, 878 m.

Paratypes: BMNH 1936.03.04.006 (b284; b285; b286; b287; b288) - same location.

Description

Body. The holotype is presented by a fragment of the lower part of the body: central tube (150 mm long, about 12 mm in diameter) with basal disc of attachment and peak-like, lamellar lateral appendages perpendicular to the central tube. The lateral appendages are opposite-cross and arranged in four longitudinal series in opposite pairs. The angle between neighbour pairs usually differ from 90°. The lateral oscula, 4 - 5 mm in diameter, are situated on the central tube at the base of most of the peak-like, lamellar lateral appendages or both at the base and the upper part of them. The atrial cavity of the central tube with lamellate beams is perpendicular to each pair of lateral appendages inside the central tube. Two paratypes 1936.03.04.006 (b284; b285) are similar to the holotype; the other paratypes have no basal disc but some of them have tubular lateral; outgrowths. It is likely that some paratypes are fragments of holotype and others paratypes.

Skeleton. The dictyonal framework entirely corresponds to that of *P. annandalei* described by KIRKPATRICK (1908) and REISWIG & WHEELER (2002). The interior beams in the lower part of the body and the beams in the upper part of the body contain primary euretoid skeleton with framework of rectangular meshes. The beams in the upper part of the body are covered exteriorly by secondary skeleton with triangular meshes. The same is observed for the inner tube walls of the atrial cavity but the beams begin to develop the secondary skeleton much earlier then the former.

Spicules. Prostalia marginalia are composed of dense tufts similar to those of *P. annandalei pseudoclavula*. The same types of sceptrules are observed in this subspecies. The oxyscopules are 0.798 - 1.634 / 0.006 - 0.007 mm; they have 3 - 4 (sometimes 2 - 6) tines 0.038 - 0.076 mm in length. The rhopaloscopules with 1 tine similar in shape to that of *P. annandalei pseudoclavula* are 0.334 - 0.608 / 0.003 - 0.004 mm, their tines are 0.042 - 0.084 mm long. The tines in *P. annandalei maldiviensis* are more regular (stout) then in the first subspecies. Rhopaloscopules and tyloscopules, mostly found at the atrial surface, are 0.274 - 0.684 / 0.006 - 0.007 mm long; they have 3 - 4

(sometimes 2) tines 0.038 - 0.068 mm long. Uncinates are present as rare fragments; they may have an allochthonic origin.

Dermalia are pentactines of typical for the genus shape. Their tangential rays are 0.084 - 0.167 mm, proximal ray is 0.061 - 0.182 mm, these rays are 0.038 - 0.053 mm in diameter. Atrialia seem to be nearly absent in these specimens.

Microscleres. Microscleres are only stellate discohexasters 0.029 - 0.047 mm in diameter; their primary rosette is 0.009 - 0.018 mm in diameter. They usually have 4, sometimes 2 - 3 secondary rays.

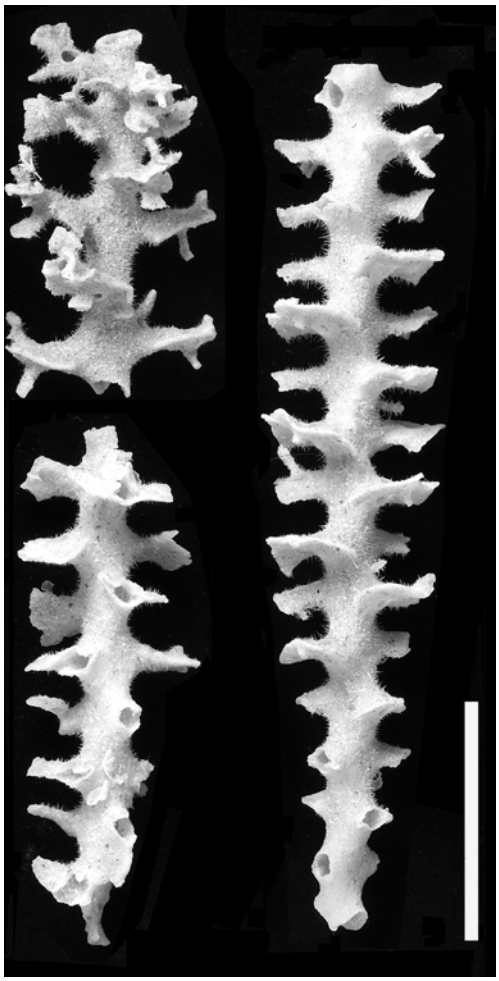

Fig. 6. *Pleurochorium annandalei maldiviensis*, external shape from side of the paratypes (scale 40 mm).

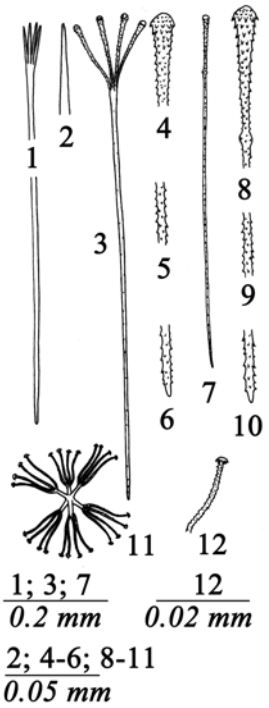

Fig. 7. Spicules of *Pleurochorium annandalei maldiviensis*. **1,** oxyscopule. **2,** outer end of oxyscopule. **3,** rhopaloscopule. **4-6,** tine, shaft and outer end of rhopaloscopule. **7,** rhopaloscopule with one tine. **8-10,** tine, shaft and outer end of rhopaloscopule. **11,** discohexaster. **12,** secondary ray of discohexaster.

Pleurochorium annandalei ssp.

These are specimens which have no loose spicules and their exact identification is impossible. Nevertheless it is very likely that these specimens stored in 'IORAS' are *P. annandalei pseudoclavula* and that some of them were collected together with type specimens: IORAS 3140 - R.V. 'Rift' - 2, stn. 6, 1°04.1' - 05.9' N – 56°32.7' - 34.7' E, 795 - 800 m. IORAS 5/2/309 - R.V. 'Academic Kurchatov' - 36, stn. 3705, 1°08.9' N – 56°31.8' E, 1260 - 1310 m. IORAS 5/2/343; 343.3; 228; 341; 342; 343; 344; 345: 355 - R.V. 'Academic Kurchatov' - 36, stn. 3724, 6°13.2' - 13.2' S – 54°24.0' - 26.0' E, 1420 - 1510 m. IORAS 5/2/3141; 358 - R.V. 'Academic Kurchatov' - 36, stn. 3730, 6°12.2' - 12.0' S – 54°20.3' - 19.7' E, 960 - 1260 m. IORAS 5/2/3139; 219 - R.V. 'Academic Kurchatov' - 36, stn. 3731, 6°11.5' - 12.0' S – 54°21.3' - 20.8' E, 560 - 640 m. IORAS 5/2/343.2 - R.V. 'Academic Kurchatov' - 36, stn. 3776, 1°08.0' - 07.7' N - 56°34.8' - 35.8' E, 950 - 1120 m.

Description

Body. These sponges are mostly small fragments of the lower parts of the body and descriptions of some of them are given to add to some features of generic

morphology. Investigation of the lower parts of the body showed that the lateral appendages appear here as tubercles with no regular distribution. The typical regularity appears at some distance above the base when the tubercles become peak-like, lamellar lateral appendages. The lateral oscula are rare at the base of the central tube. They are situated only close to the bases of only some of the lateral appendages, along one-two of their close (not opposite) linear series. The angle between the linear series may be different (up to about 90 degrees) close to base. The atrial cavity at the lower part of the body has a single, long, vertically directed septum. It begins from the first lateral osculum (very close to base) and continues to the appearance of regularity of lateral oscula (when they are situated at the base of each of the lateral appendage). Above this point the single septum (may be perforated) ends and lamellate beams perpendicular to each pair of lateral appendages inside the central tube appear (Figs 4, 8). In one specimen this initial septum is more than 100 mm long (the upper part of this sponge is broken) and the oscular openings are situated irregularly.

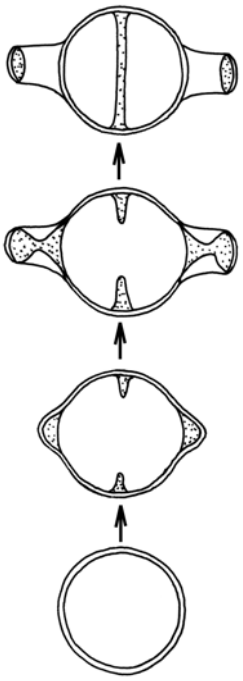

Fig. 8. Scheme of growth of *Pleurochorium* (emission of lateral oscula and tubular branches from the sides of truncate tube and beams).

Tab. I. Dimensions of some spicules of *Pleurochorium annandalei* (in mm) (L - length, l - length of sceptrules' tines, D - diameter, d - diameter of primary rosette).

	P. annandalei			*P. annandalei*					*P. annandalei*				
	annandalei			*pseudoclavula*					*pseudoclavula*				
	(from KIRKPATRICK, 1908; REISWIG & WIEDER, 2002)			IORAS 5/2/342.1					BMNH 1936.03.04.006				
	avg	min	max	n	avg	min	max	std	n	avg	min	max	std
L dermal pentactine tangential ray		.135	.231	25	.157	.076	.243	.046	25	.133	.084	.167	.024
L dermal pentactine proximal ray				24	.146	.061	.236	.044	19	.125	.061	.182	.028
L atrial pentactine tangential ray				25	.107	.046	.182	.034	1	.182	.182	.182	
L atrial pentactine distal ray				25	.111	.038	.213	.051	1	.281	.281	.281	
L oxyscopule	.694			25	1.047	.836	1.368	.121	16	1.111	.798	1.634	.236
l oxyscopule	.082			25	.063	.030	.084	.011	16	.055	.038	.076	.010
L tyloscopule=rhopaloscopule	.436			35	.426	.266	.616	.083	25	.335	.274	.684	.077
l tyloscopule=rhopaloscopule	.062			35	.053	.030	.076	.011	25	.048	.038	.068	.008
L rhopaloscopule with 1 tine				34	.472	.258	.684	.088	25	.442	.334	.608	.064
l rhopaloscopule with 1 tine				34	.060	.030	.084	.012	25	.061	.042	.084	.010
D discohexaster	.046			25	.034	.027	.043	.004	25	.037	.029	.047	.005
d discohexaster	.013			25	.010	.007	.014	.002	25	.012	.009	.018	.002
D onychohexaster				26	.058	.047	.076	.007					
d onychohexaster				26	.012	.007	.016	.002					

Pleurochorium sp.

The specimens of the 'MNHN' are doubtless representatives of *Pleurochorium*. They have no loose spicules and since their location is far from the other species and subspecies their complete identification is impossible: MNHN (fr136) - 'Benthedi', stn. DS 58, 12°47.50' S - 44°56.60' E, 700 m. MNHN (fr113; fr120; fr128; fr133; fr140; p1027) - 'Benthedi', stn. 59 F, 12°45.10 S - 44°57.60' E, 800 - 700 m. MNHN (p1476) - R.V. 'Marion Dufresne' - 32, stn. CP 11, 21°14.70' S - 55°51.90' E, 900 - 955 m. MNHN (p1487; p4092; p4093) - R.V. 'Marion Dufresne' - 32, stn. FA 137, 20°45.80' S - 55°35.60' E, 940 - 980 m.

REMARKS

The two new subspecies described in this paper are very similar in many features to *P. annandalei annandalei*. First of all their external shape especially observed in *P. annandalei pseudoclavula* is likely to be common for all the species and probably for all the living representatives of the genus, previously known by very incomplete specimens. *P. annandalei maldiviensis* has the only significant difference from *P. annandalei annandalei* - presence of scopules with 1 tine. These spicules were not described for *P. annandalei annandalei* and they were not found during the reinvestigations of poor fragments, so these subspecies, *annandalei* and *pseudoclavula*, may be synonyms. *P. annandalei pseudoclavula* has specific microscleres - onychohexasters and sigmatocomes - which allow it to be differentiated from the other subspecies. The common spicules are very similar in shape and size in all these subspecies.

In his original description of *P. cornutum* Ijima (1927) provided description and figures of its lateral tubular branches. The lower part of the body (central tube) is figured by LÉVI & LÉVI (1982). Similar to *P. annandalei*, *P. cornutum* has atrial beams in the central tube situated perpendicular to each pair of lateral oscula-appendeges complex (TABACHNICK & LÉVI, unpubl. data).

The new data allow supplementation of the features defining the genus *Pleurochorium* given by REISWIG & WHEELER (2002). Since they are unknown or undescribed for fossil representative (SCHRAMMEN, 1912) we do not propose to include them directly into the diagnosis. In external body form the osculum positions and lamellar extensions are very complicated. The lateral tubes may be rather long. The atrial cavity of the central tube has septa in the lower part of the body and beams in the upper part. Prostalia marginalia are present in *P. annandalei*. New types of loose spicules in some representatives are scopules with 1 tine, onychohexasters and sigmatocomes. Uncinates are probably allochthonic.

At first appearance branching in *Pleurochorium* does not reflect its position in the subfamily Chonelasmatinae. But unlike Euretina the branching in *Pleurochorium* is not dichotomous or even originated from the dichotomous type [a row of branching types from dichotomy-isotomy to sympodial is known for plants and from dichotomy-isotomy to monopodial body forms in Hexactinosida (TABACHNICK, 1991; TABACHNICK & MENSHENINA, pers. comm.)]. In the upper part of the central tube each unit of the pair of the lateral oscula-appendeges complex (an osculum, a lamellar appendage a tube) is situated directly opposite the corresponding unit (in the

upper part of the central tube). *Pleurochorium* shows a rare case of regular emission of tubular branches from the side of the wall - an alternative to dichotomous type of branching. Such branching is known in other Chonelasmatinae: *Periphragella* and very short outgrowths in *Verrucocoeloidea* and *Myliusia* (REID, 1964; REISWIG & WHEELER, 2002), but their branches are not so regularly organised in opposite pairs as in *Pleurochorium*. It is interesting that REID (1958) in his support of definition of Euretidae into Euretinae and Chonelasmatinae did not pay much attention to these principal branching differences which he described later; *Periphragella*, *Verrucocoeloidea*; *Myliusia* and *Pleurochorium* are not dichotomousely branching forms and were considered to be representatives of Euretinae. Unlike the other representatives of Chonelasmatinae which branch or emit lateral oscula, *Pleurochorium* has only two opposite units at each level of branching.

Discovery of scopules with 1 tine somewhat similar to clavules in *Pleurochorium* (clavules are specific spicules for Farreidae) is not an outstanding feature for Euretidae since pileate clavules are described as 'possibly foreign' in another represantative of Euretidae - *Bathyxiphus subtilis*. Moreover that deep difference between Farreidae and Euretidae which previously gave reason to attribute them to the higher taxa, Clavularia and Scopularia (up to including IJIMA, 1927), is now considered to be less important (WHEELER, 1999), and this subdivision is entirely omitted by REISWIG (2002).

ACKNOWLEDGEMENTS

We greatly appreciate help from Drs. M. Pansini and M. Sará in being able to present this material at the Conference in Rapallo, to Mrs. C. Valentine (BMNH) for her kind help with the collections and photo preparations and to unknown reviewer for his very important critical advises.

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