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Crambe tuberosa n. sp. (Demospongiae, Poecilosclerida): a new Mediterranean poecilosclerid with lithistid affinities.

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Abstract : A new species of the genus *Crambe* Vosmaer is described from the Alboran sea. The features of this new sponge support the artificial grouping of the Lithistida. A new systematic position is proposed for *Crambe* Vosmaer into the new family Crambidae and some relationships with fossil genera traditionally regarded as lithistids are indicated. The anaxial nature of the sphaeroclonar desmas is discussed, claiming for a polyaxial origin of the sphaeroclones of the genus *Crambe*.

Résumé : Une nouvelle espèce du genre *Crambe* Vosmaer est décrite de la mer d'Alboran. Les caractéristiques de cette nouvelle éponge confirment le groupement artificiel des Lithistida. Une nouvelle position systématique pour *Crambe* Vosmaer est proposée dans la nouvelle famille Crambidae, et des parentés avec des genres fossiles considérés d'habitude comme des lithistides ont été mis en exergue. On discute la nature anaxiale des sphaeroclones, en montrant une origine polyaxiale pour les sphaeroclones du genre *Crambe*.

Introduction

Many groups of sponges are subject of intense systematic debate, but the problems are particularly complicated for the lithistid group.

This taxon was formerly created with family rank (Lithistidae Schmidt, 1870), later reformulated to suborder (Lithistina Vosmaer, 1885) and finally established as order (Lithistida Sollas, 1888). It was subsequently claimed for subclass without issue (Topsent, 1894).

Numerous relationships among traditional lithistids and several families of different orders of Demospongiae have been repeatedly noticed by both paleontologists (e.g. Schrammen, 1910, 1924, 1936) and spongiologists (e.g. Hentschel, 1923 ; Burton, 1929 ; de Laubenfels, 1936 ; Pulitzer-Finali, 1970 ; Lévi, 1973 ; Van Soest & Stentof, 1988 ; Hooper & Lévi, 1989). No systematic position for the lithistid group seems to be suitable in order to explain, even partially, its diverse relationships with the remaining demosponges. Thus, the lithistid ensemble is rarely assumed as a single evolutive unity by recent authors, rather it is currently regarded as a polyphyletic, dust-bin order, which is undergoing a gradual dismembering. Then, Lévi (1973) distinguished a remarkable monophyly among lithistids having triaenes and he defined the order Desmophorida to keep them away from the remaining artificial mixture. Van Soest (1988) treated all lithistids in a single order for convenience's sake, but he considered this polyphyletic group to be divided up amongst Tetractinellids, Halichondrids and Hadromerids.

The artificial clustering into this taxon has been originated by the use of inadequate criteria for classification. Traditionally, the presence of desmas has been used as the single or at least the main diagnostic character for assigning species or genera to Lithistida, often diminishing the diagnostic role of the remaining spicules. The notable abundance of desmas and the generalized lack of accompanying spicules in the fossil record have led the authors to trust excessively in the desma role as indicator of phylogenetic relationships.

The skeletal features of the new species described in this paper contribute to attest the poecilosclerid affinities for some fossil species regarded traditionally as lithistid (i.e. *Cladodia kiliani* Moret, 1925 and *Exodictia canalifera* Moret, 1925). A new systematic location is proposed for the polemic genus *Crambe* and its affinities with the above mentioned fossil genera are discussed.

MATERIAL AND METHODS

The sponge material was obtained from a red coral fishery study carried out by the Instituto Español de Oceanografía in the Alboran sea (1982). An "italian bar" was used for collecting on a reef bottom 70-120 m deep (35° 54'-35° 52' N, 3° 9'-3° 5'). Additional information about this station can be obtained in Templado *et al.* (1986).

The holotype, one specimen and two slides marked as CEAB-ALB-44-C, stays on deposit in the collection of the Centre d'Estudis Avançats de Blanes (Spain).

RESULTS

Crambe tuberosa n. sp.
(Figs. 1-11)

Holotype : ALB-44-C (One specimen and two slides).

a) *Description*

A single specimen was collected on the sponge *Ircinia pipetta* (Schmidt). *C. tuberosa* is an encrusting sponge 0.88 mm thick, covering a 2.5 cm^2 area. The surface is strongly hispid because of the large tylostyles protruding. Oscules and ostia are indistinct to examination under binocular microscope. The specimen shows a grey color in alcohol, but the color while living is uknown.

b) *Spicules*

- *Subtylostyles* : straight, sharply pointed, with a distal nipple (Fig. 1c). Some slight swellings may occur along the shaft. They are 87-104 µm long and 4.6-5.8 µm thick.

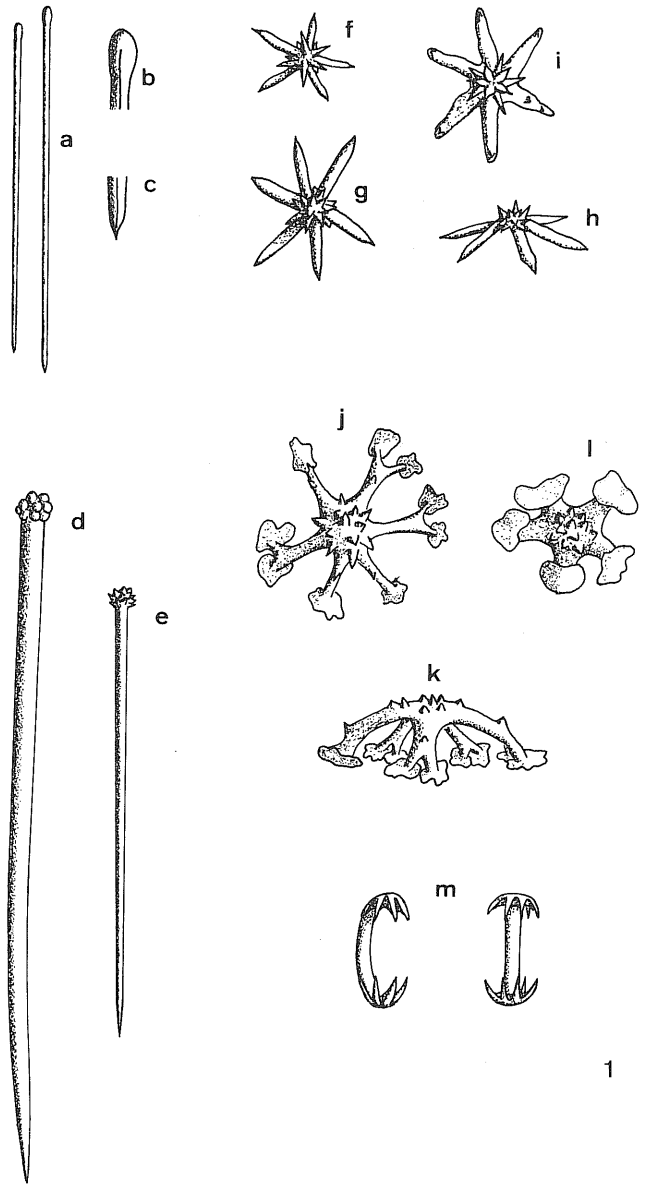


Fig. 1 : Spicule complement of *Crambe tuberosa*. a - Ectosomal subtylostyles. b - Head of subtylostyle (subtyle). c - Point of subtylostyle showing the distal nipple. d - Tylostyle I with tuberous tyle. e - Tylostyle II with spiny tyle. f - Asteroid initial corpuscle. g - Asteroid corpuscle obtaining appearance of young desma. h - Lateral view of young desma showing the curved actines. i - Young desma with incipient spines on the centrum and the clones. j - Desma with incipient zygomes. k - Lateral view of a mature desma showing the directional disposition of the clones. l - Mature desma displaying large zygomes and short actines. m - Isoanchorae with five teeth.

- *Tylostyles I* : slightly curved, rarely straight, gently conical and acutely pointed (Fig. 1d). The tyle is an irregular crown of rounded swellings (Figs. 1d, 8) similar to those of *Rhopaloconus tuberculatus* Sollas, 1880, *Discorhabdella incrustans* Dendy, 1924 or *Rotuloplocamia octoradiata* Lévi, 1952. They measure 500-700 µm x 20-30 µm. They are comparatively abundant in the choanosome in relation to the tylostyles II.

- *Tylostyles II* : slightly curved and acutely pointed. The tyle is a crown of big conical spines resembling an acanthostyle (Figs. 1, 10). They measure 150-330 µm x 5-10 µm. They are scarce and usually arranged in the periphery of the sponge. Both types of tylostyles (I & II) are belived to have an acanthostylic origin.

- *Desmas* : are sphaeroclones (*sensu* Schrammen, 1910) having a strongly swollen, subglobular centrum, from which a verticil of equatorial actines (clones) arises (Figs. 1f-I, 2, 3, 4, 5, 6, 7). All actines are curved towards one side of the centrum. The opposite side is ornamented with two alternating irregular crowns of conical spines. Actines of desmas are also ornamented with one to three small spines. The actine tip develops a laminar articulating expansion, the zygome. Some actines may be divided, then every secondary actine forms a zygome as well. Desmas measure 94-134 um in overall diameter.

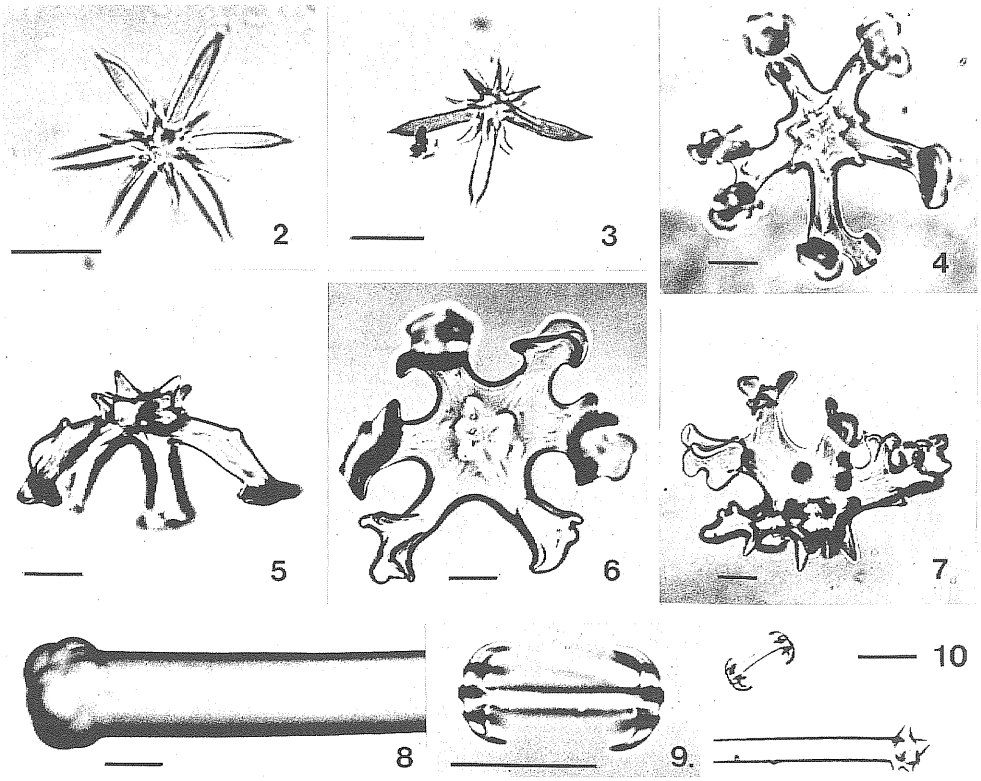
A "special asters" with a subglobular centrum and two kinds of actines (Figs. 1f-h, 2, 3) reveal to be young desmas. They have an equatorial verticil of five to seven actines being large, lanceolated in shape and sharply pointed ; such actines are growing to built up the definitive clones of the mature desma. A secondary type of actines, shorter and more numerous, are arranged in two alternating verticials ; these remain as ornamental spines on the centrum of the definitive desmas. The principal actines measure 30-134 µm long depending on the development stage) and the secondary ones, 3-5 µm. A distal nipple always occurs in the young actines. The nipple may be related to either a probable precursor of the zygome, whose development might be caused by presence of some foreign inclusions in the tip of the growing actine (Topsent, 1925 ; Lévi, 1958) or to the silica deposition during the growth of the actines. No distal inclusion has been detected in our study, although axial filaments have been noted into the actines of the asters and the young desmas. The visualization of this axial filaments in the mature desmas is difficult.

The development of desmas from polyaxial corpuscles (euasters) and the turning process in the actines are shown in the Figs. 1f-i, 2-7. Photographs were unable to show the axial filaments.

- *Isoanchorae* : with five teeth and measuring 27-30 µm in length. No malforrnations have been found in them (Fig. 1m).

c) *Skeletal arrangement*

Tangential subtylostyles and isoanchorae are reinforcing the ectosome (Fig. 11, a). Subtylostyles are scattered or forming light bundles. Both kinds of spicules occur exclusively in the ectosome.



PLANCHE

Fig. 2 : Superior view of an aster obtaining the morphology of a young desma (scale bar = 20 µm).
Fig. 3 : Lateral view of an aster in change to desma showing the progressive curvature of the actines (scale bar = 20 µm).
Fig. 4 : Lower view of young desma with five actines (clones) whose zygomes are hardly developed (scale bar = 20 µm).
Fig. 5 : Lateral view of an young desma showing the definitive curvation of the actines (scale bar = 20 µm).
Fig. 6 : Lateral view of a mature desma displaying large zygomes and short clones (scale bar = 20 µm).
Fig. 7 : Lateral view of a mature desma displaying an irregular morphology. Note the difference in appearance between the first photograph (Fig. 2) and this (scale bar = 20 µm).
Fig. 8 : Tuberous tylostyle I (scale bar = 20 µm).
Fig. 9 : Isoanchora with five teeth (scale bar = 20 µm).
Fig. 10 : Comparative sizes between one tylostyle II and one isoanchorae. Note the spiny look of the tyle (scale bar = 20 µm).

A network of desmas lies on a spongin basal layer (Fig. 11, c, d). The desma skeleton is articulate and built up by a double or triple layer of desmas, but a single layer may occur in the sponge periphery. Zygosis is usually established among the zygomes of one desma and the centrum of the subjacent ones. No cementation substance has been found in the zygosis among desmas. The zygomes of the basal desmas may be embedded into the spongin plate anchoring the skeletal structure.

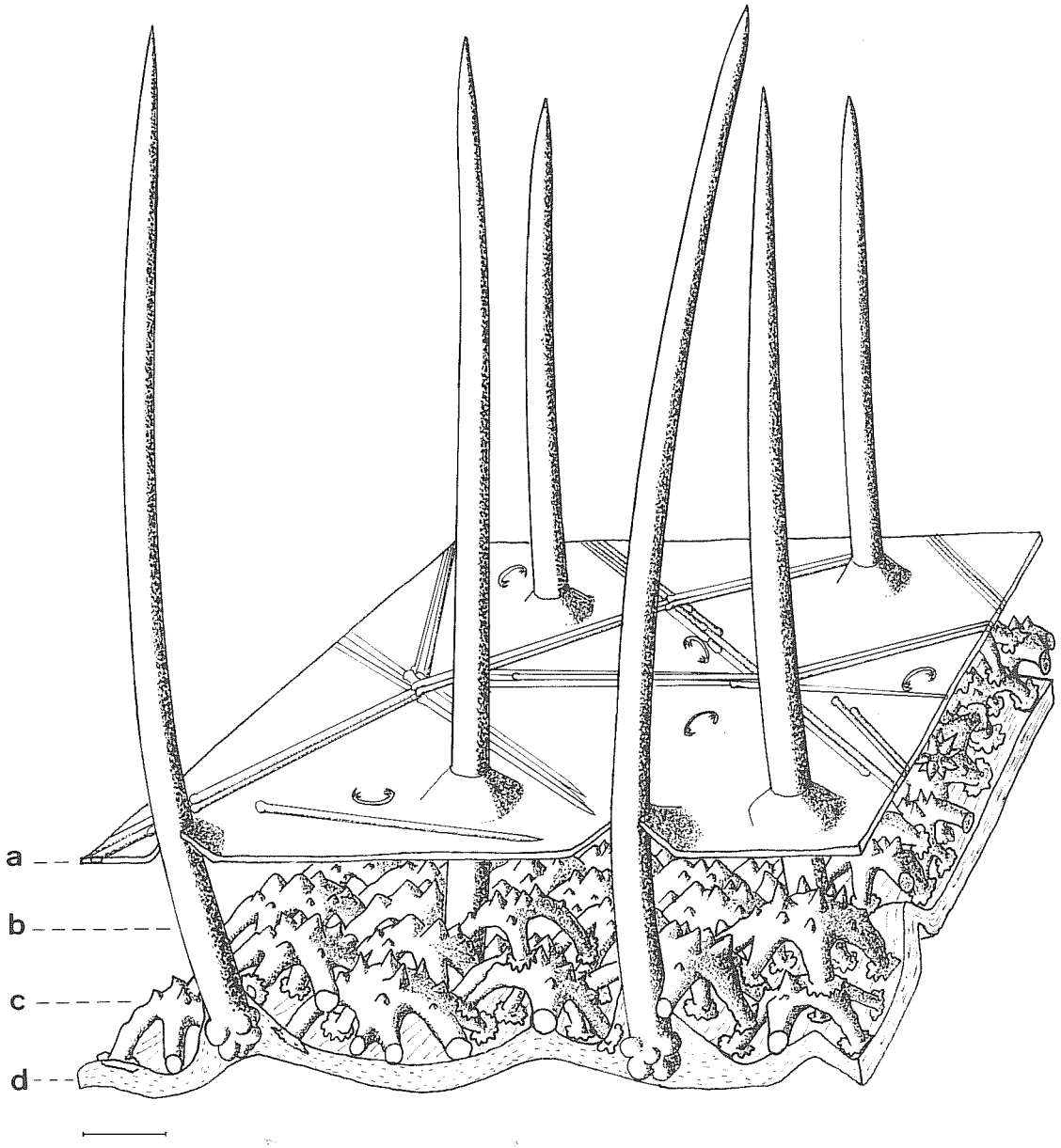


Fig. 11 : Skeletal arrangement of *Crambe tuberosa* (scale bar = 52.5 µm).
a - Ectosoma with tangential subtylostyles and isoanchorae.
b - Tylostyles I in hymedesmoid arrangement.
c - Network of desmas.
d - Spongin basal layer.

Tylostyles I and II dispay a hymedesmoid arrangement, piercing both the network of desmas and the ectosome (Fig. 11, b). Tylostyles II are scarce and placed in the peripheral zones of the plate.

DISCUSSION

Two important differences have been found between the sponge here described and other species of the genus *Crambe* :

1) Hymedesmoid arrangement instead of the plumose characteristic skeleton.

2) Presence of tuberous tylostyles (probably arised from acanthostyles) instead of the characteristic styles or subtylostyles.

Moreover, other additional features may be considered distinctive :

1) Presence of true isoanchorae with developed teeth instead of the isochelae with several malformations characteristic of certains species of this genus (i.e. *C. crambe*).

2) Presence of typical sphaeroclones instead of strongly modified sphaeroclones with pseudoasteroid appearance in the remainig species of *Crambe*.

The greatest skeletal affinities of *C. tuberosa* are established with *C. acuata* (Lévi, 1958), sponge known from the Indian Ocean (Lévi, 1958, 1961 ; Vacelet *et al.*, 1976) and the South Atlantic (Lévi, 1960, 1963, Uriz, 1988).

On the other hand, a critical survey of the descriptions for the species of *Crambe* makes evident that this genus does not fit the family Esperiopsidae, which is currently assigned to. Nevertheless, to propose a better systematic location is not a simple task, since anyother recent families can include the genus *Crambe* without contradicting notably their own taxonomic diagnosis. The complexity of this systematic problem is attested by the taxonomic history of the genus, which has been successively placed in Suberitidae (Schmidt, 1879), in Desmacidinidae (Vosmaer, 1880), in Lithistida (Lendenfeld, 1903), in Mycalidae (Topsent, 1928), in Myxillidae (Burton, 1929), in Halichondrina (De Laubenfels, 1936 as *Stylinos*) and finally in Esperiopsidae (Lévi, 1973).

A remarkable morphological affinty has been detected among desmas of some species of *Crambe* (specially *C. acuata* Lévi, 1958 and *C. tuberosa*) and desmas of some fossil lithistid genera as *Cladodia* Moret, 1925 and *Exodictia* Moret, 1925, belonging to the family Chiastoclonellidae De Laubenfels.

The family Chiastoclonellidae traditionally includes four genera : *Chiastoclonella* Rauff, 1894 ; *Cladodia* Moret, 1925 ; *Exodictia* Moret, 1925 and *Regnardia* Moret, 1925. The genus *Vetulina* Schmidt, 1879 was formerly placed in this family as well, and later transferred to Vetulinidae Lendenfeld. All these genera, except *Vetulina*, are fossil, and all of them have desmas only, except *Vetulina*, which has ectosomic strongyles as well. The presence of additional spicules together with desmas in living specimens of *Vetulina* is assumed as an evidence of the spicule loss during the fossilization, specially for the delicate skeleton of the pinacoderms. Thus, we belive that specimens belonging to *Cladodia* and *Exodictia* have

conserved only the desmas network after fossilization, but mey were probably poecilosclerids, closely related to *Crambe*. However, to group them together in the same family is blameworthy, since all accompanying spicules, the only solid evidences to verify the poecilosclerid nature of these fossil genera, have been mislayed during the fossilization.

On the other hand, an artificial clustering has been detected into the family Chiastoclonellidae during the revision work, since the pseudoasteroid desmas described in *Chiastoclonella* and *Regnardia* are nonhomologous to the sphaeroclones of *Cladodia* and *Exodictia*. The genus *Regnardia* has pseudoradiate megaclones, sometimes displaying a convergent sphaeroclonar morphology, in which a short central shaft containing a short crepidal canal denounces its monaxial origin. The genus *Chiastoclonella* has a smaller pseudoradiate desmas, probably with monaxial origin as well, named chiastoclones (a term ambiguously coined by Rauff, 1894 and missused by De Laubenfels, 1955 to design desmas from different lineages). The artificial clustering detected into Chiastoclonellidae dissuades the transference of the genus *Crambe* to this family in order to reflect in the systematics the above mentioned affinities with *Cladodia* and *Exodictia*.

Thus, we propose to create a new family (Family Crambidae) for the genus *Crambe* Vosmaer including the species *C. crambe* (Schmidt, 1862), *C. acuata* (Lévi 1958) *C. taillie-zi* Vacelet & Boury-Esnault 1982 and *C. tuberosa*. The fossil genera *Cladodia* Moret, 1925 and *Exodictia* Moret, 1925, could be included here, if their poecilosclerid natures are finally demonstrated. We notice that the name "Crambidae" was previously employed to include *Crambe* (Boury-Esnault, 1971), but no reason was added in this respect.

The diagnosis for this new family is as follows : 1) Recent memberships are encrusting or thin sponges. 2) Ectosomal megascleres are monactinal, usually subtylostyles. 3) The choanosomal skeleton is constituted by monactinal (styles or tylostyles) either in hymedesmoid or plumose arrangement. A network of sphaeroclonar desmas may occurs as well, either monolayered or multilayered and sometimes strongly reduced in certain species (i.e. *C. crambe*). The monactinal choanosomal megascleres cross the desma network perpendicularly. 4) Cheloid and monaxonic (microrhabds) microscleres may also occur.

The systematic location of the genus *Crambe* within Crambidae, is now close to Hymedesmiidae Topsent and Phorbasidae de Laubenfels. Obviously, relationships with Esperiopsidae Hentschel may be noticed as well, but we prefer to avoid the analytic comparison between them, since Esperiopsidae is actually a dust-bin family showing a strong artificial polyphyly.

We lay stress on the polyaxial origin for the sphaeroclones of *Crambe*. The term "sphaeroclon" (*sensu*. Schrammen, 1910) refers to desmas in which 4-8 clones are emitted from one side of a subglobular centrum ; the opposite side of the centrum is usually ornamented with conical spines ; the clones may be also spined and develop distally a thin, articulating expansion, the zygome. Similar desmas with simply radiating clones are named "astroclones" (*sensu* Reid, 1970). Desmas like astroclones whose clones develop zygomes with distal swellings instead of thin laminar expansions are named "anomoclones (*sensu* Schrammen, 1936 ; non *sensu* Rauff, 1895). An anaxial origin has been traditionally assu-

med for fhe three above mentioned desmas (the term "anaxial" implies that the spicules begin from the granular corpuscles lacking an elongated axial filament). The support of such assumption is a single description on one living specimen of *Vetulina stalactites* Schmidt (Schmidt, 1879). This author described asteroid desmas (astroclones *sensu* Reid, 1970) begining from an anaxial corpuscle whose centre contains a granular "nucleus" which is originated as an external pit. These observations have been generalized in excess to affect all sphaeroclones, in spite of the reports on small asters as initial corpuscles of the young desmas in *C. crambe* (Thiele, 1899, Topsent, 1925), *C. acuata* (Lévi, 1960) and *C. tuberosa* (Figs. 1f-l, 2-7). Although accurate details about the secretion of the asteroid microscleres are still unknown, the presence of axial filements in actines of the inmature desmas of *Crambe* leads to design them as polyaxial to be differentiated from those with an initial granular corpuscle, named anaxial. The terms "anaxial" and "polyaxial" are refering to number of axial axis ocurring in the initial corpuscles.

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