Calcareous sponges from New Caledonia

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ABSTRACT
We describe the most frequently collected Calcarea from the New Caledonia lagoons and adjacent coral reefs. We have identified ten species (six Calcinea and four Calcaronea), two of which have already been reported for New Caledonia. Five species are new to science: the Calcinean species *Clathrina chrysea* n. sp. and *Leucascus neocaledonicus* n. sp., and the Calcaronean species *Sycettusa tenuis* n. sp., *Vosmaeropsis hozawai* n. sp. and *Leucascandra caveolata* n. gen., n. sp. The latter, which is very frequent in the studied region, belongs to the newly described genus *Leucascandra* characterized by a complex cormus composed of copiously branched thin tubes. These tubes have a thin wall supported by the atrial and cortical skeletons, containing an inarticulate choanoskeleton composed of subatrial spicules only. The species already described, *Leucetta chagosensis*, *Leucetta microraphis*, *Pericharax heteroraphis* and *Sycon gelatinosum*, belong to the Indo-Pacific tropical region fauna, have been frequently observed and described, probably due to their large size and bright colours.

KEY WORDS
Porifera,
Calcarea,
Pacific Ocean,
New Caledonia,
Coral reef fauna.

RÉSUMÉ

Éponges calcaires de Nouvelle-Calédonie.

Nous décrivons les éponges de la classe Calcarea les plus fréquentes dans les lagons et les récifs coralliens de Nouvelle-Calédonie. Nous avons identifié dix espèces (six Calcinea et quatre Calcaronea), dont deux ont été déjà signalées en Nouvelle-Calédonie. Cinq espèces sont nouvelles pour la science : les Calcinea *Clathrina chrysea* n. sp. et *Leucascus neocaledonicus* n. sp. et les Calcaronea *Sycettusa tenuis* n. sp., *Vosmaeropsis hozawai* n. sp. et *Leucascandra caveolata* n. gen., n. sp. La dernière espèce, très fréquente dans la région étudiée, appartient au nouveau genre *Leucascandra,* caractérisé par un grand cormus de structure complexe, formé de tubes minces et copieusement ramifiés, soutenus par les squelettes atrial et cortical, et contenant un choanosquelette inarticulé formé seulement de spicules subatriaux. Les espèces déjà décrites, *Leucetta chagosensis*, *Leucetta microraphis*, *Pericharax heteroraphis* et *Sycon gelatinosum* sont typiques des régions tropicales des océans Indien et Pacifique. Elles ont été fréquemment observées et décrites, ce qui est probablement dû à leur grande taille et à leurs couleurs vives.

MOTS CLÉS
Porifera,
Calcarea,
océan Pacifique,
Nouvelle-Calédonie,
récifs coralliens.

INTRODUCTION

The study of Calcarea from New Caledonia started with the collections of marine fauna made by the Singer-Polignac Foundation in 1961. Sponges were collected in lagoons on the west-side of the Grande Terre, and in particular in St Vincent Bay. Four species of Calcarea were recorded: *Leucetta microraphis* (Haeckel, 1872), *Leucetta chagosensis* Dendy, 1913, *Grantessa syconiformis* Borojevic, 1967 and *Anamixilla torresi* Poléjaeff, 1883 (Borojevic 1967). Subsequently, extensive collections of sponges living in the lagoons and coral reefs of New Caledonia were carried out from 1976 onwards, by the scientists of the ORSTOM Research Centre in Nouméa: Pierre Laboute, Georges Bargibant and Jean-Louis Menou. Photographic records of these studies were recently published by Lévi (1998).

The present study concerns the most frequent Calcarea observed in New Caledonia. We have identified ten species, two of which have already been reported in a previous study (Borojevic 1967): *Clathrina chrysea* n. sp.; *Leucaltis clathria* Haeckel, 1872; *Leucascus neocaledonicus* n. sp.; *Leucetta chagosensis* Dendy, 1913; *Leucetta microraphis* (Haeckel, 1872); *Pericharax heteroraphis* (Poléjaeff, 1883); *Sycon gelatinosum* (Blainville, 1834); *Sycettusa tenuis* n. sp.; *Vosmaeropsis hozawai* n. sp.; *Leucascandra caveolata* n. gen., n. sp.

The collection and all the type specimens are deposited in the Muséum national d'Histoire naturelle in Paris.

ABBREVIATIONS USED

MNHN-LBIM — Muséum national d'Histoire naturelle, Paris, Laboratoire de Biologie des Invertébrés marins et Malacologie.

SYSTEMATICS

Class CALCAREA Bowerbank, 1864
Subclass CALCINEA Bidder, 1898
Order CLATHRINIDA Hartman, 1958

Family CLATHRINIDAE Minchin, 1900

DIAGNOSIS. — Clathrinidae whose organisation is essentially tubular. A continuous choanoderm lines all the internal cavities. The sponge growth occurs by longitudinal median divisions and anastomosis of tubes, often forming a large unit called the cormus. There is neither a common cortex nor a well-defined inhalant and exhalant aquiferous system.

Genus *Clathrina* Gray, 1867

TYPE SPECIES. — *Grantia clathrus* Schmidt, 1864 by monotypy.

DIAGNOSIS. — Clathrinidae in which the choanoderm is flat or occasionally raised up into conuli by the apical actines of large tetractines, but never forms true folds, at least when the sponge is in the extended state. The cormus is composed of anastomosed tubes. The skeleton contains regular, equiangular and equiradiate triactines and/or tetractines, to which diactines or tripods may be added.

Clathrina chrysea n. sp.
(Fig. 1)

TYPE MATERIAL. — MNHN-LBIM-C-1999-01.

ETYMOLOGY. — From the Greek *chrys*: "golden".

MATERIAL EXAMINED. — One specimen.

LOCALITIES. — South coast, Canal Woodin, R-1360, 28 m.

DESCRIPTION

The single specimen present in the collection has a clathrate cormus typical of the genus, measuring 4 × 1.5 cm, divided into irregular lobular protrusions. It is composed of thin, regularly anastomosed tubes of equal size, without any large superficial water-collecting tubes (photo in Lévi 1998: 74). The colour in life is bright yellow, but the alcohol-fixed specimen is white. The skeleton of the tubes is thin, composed of an irregular meshwork containing only triactines (Fig. 1).

Spicules (Fig. 1)

Equiangular and equiradiate triactines. Actines are straight, conical with a rather sharp distal end and measure 105 (± 8.5) / 9.8 (± 1.2) µm at the base. The distal part of the actines is often slightly and irregularly undulated.

REMARKS

The classification of *Clathrina* is difficult, due to the very few morphological criteria that can be used as descriptors. This is particularly the case of the species that have a single spicule type. The yellow *Clathrina* are usually classified in the species *C. clathrus* Schmidt, 1864, originally described from the Adriatic Sea, and very frequent in the Mediterranean Sea. In previous studies (Solé-Cava *et al.* 1991; Klautau *et al.* 1994), we have monitored the genetic characteristics of both allopatric and sympatric sibling species, and we have found that even very faint morphological differences are indicative of genetically distinct species. Based on these genetic studies, we have separated the SW-Atlantic species of yellow *Clathrina* under the name *C. aurea* Solé-Cava *et al.*, 1991 from the Mediterranean species *C. clathrus*. Following the same rationale, we now separate the New Caledonian yellow *Clathrina* from the other two similar species. *Clathrina chrysea* n. sp. has bigger triactines than *C. clathrus* (92 / 5.5 µm) and *C. aurea* (72 / 5.6 µm), and the major difference that distinguishes the spicules of *C. chrysea* from *C. clathrus* and *C. aurea* is the rather sharp distal end of the actines, which is blunt or rounded in the other two species. The common characteristic of all the species belonging to the group "*clathrus*" is the tendency to have the distal part of the actines slightly undulated. This character has already been pointed out by Haeckel (1872), and although his illustration of the *C. clathrus* spicules is somewhat arty, it clearly shows the undulated distal part of their actines. The cormus of *C. clathrus* is characterized by the large superficial tubes that collect the exhalant water and give rise to only a few large oscula. Both *C. aurea* and *C. chrysea* have no such tubes, and many oscula open independently at the external

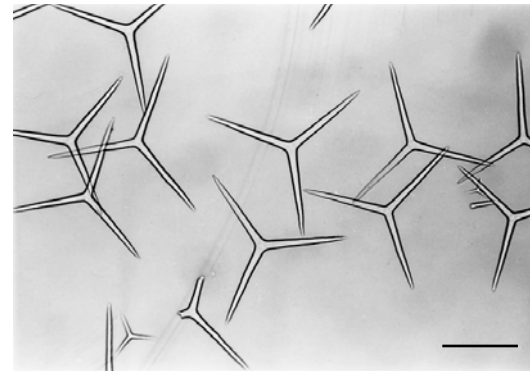

FIG. 1. — *Clathrina chrysea* n. sp. Triactines of the sponge wall. Scale bar: 30 µm.

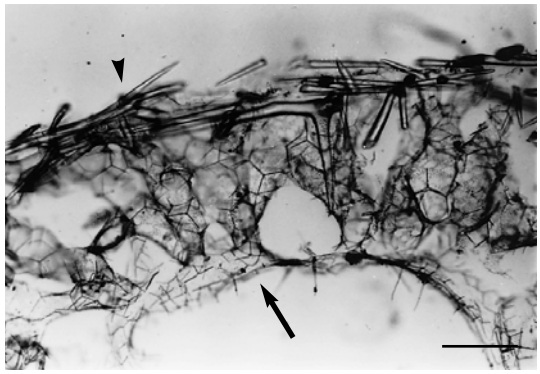

FIG. 2. — *Leucaltis clathria* Haeckel, 1872. Transverse section through the sponge wall. Note the thick cortex (arrow head), radially arranged choanocyte tubes, and a thin membrane surrounding the central atrial cavity (arrow). Scale bar: 80 µm.

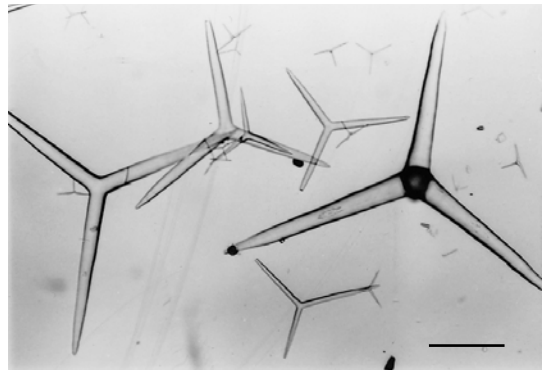

FIG. 3. — *Leucaltis clathria* Haeckel, 1872. Spicules of the sponge wall. Note the giant tetractine and triactines of the cortex, minute triactines and tetractines present in the choanosomal skeleton and sagittal triactines in the membrane delimiting the central atrial cavity. Scale bar: 80 µm.

surface. The diameter of the tubes is considerably larger in *C. aurea,* and they are loosely packed, giving the sponge a soft consistency, whilst those of *C. chrysea* are densely anastomosed and thin, giving the sponge a rather hard consistency.
We propose separating the New Caledonian species from both the Mediterranean and the Atlantic ones. Yellow *Clathrina* were previously reported from the Indo-Pacific region under the name of *C. clathrus*, e.g. by Breitfuss (1897) for Ternate, and he was probably referring to *C. chrysea*, but this question should be addressed in future studies.

Family LEUCALTIDAE Dendy & Row, 1913

DIAGNOSIS. — Clathrinida with either a tubular, ramified or anastomosed cormus with many oscula, or in the form of single tubes with a large terminal single osculum. The tubes have a large atrium surrounded by a strong wall composed of a distinct cortex and a choanosome. The cortical skeleton is composed of large tangential triactines and/or tetractines. The choanoskeleton can be absent, reduced to apical actines of cortical tetractines, or contains small and irregularly dispersed triactines and tetractines.

Genus *Leucaltis* Haeckel, 1872

TYPE SPECIES. — *Leucaltis* (*Leucaltusa*) *clathria* Haeckel, 1872 by subsequent designation (Dendy & Row 1913).

DIAGNOSIS. — Leucaltidae with a body composed of large, ramified and anastomosed tubes. Each tube has a distinct strong cortex supported by large triactines and tetractines. The choanosome is organized in elongate, radial chambers, which open to the central atrial cavity. It is supported by apical actines of cortical tetractines and small scattered triactines and tetractines.

Leucaltis clathria Haeckel, 1872
(Figs 2; 3)

Heteropegma nodus gordii Poléjaeff, 1883.

MATERIAL EXAMINED. — Several large specimens from localities R-1234 and R-1356.

LOCALITIES. — South coast, Canal Woodin, R-1234, 40 m. – Banc Gail, R-1356, 22 m.

DESCRIPTION
The specimens of *L. clathria* from New Caledonia are large, composed of ramified firm and friable tubes ending with wide oscula without the perioscular crown. The surface is smooth, shiny and rough, due to large cortical spicules (photo in Lévi 1998: 75).
The organization of the sponge body is typical of the genus. The cortical skeleton which is very thick, is supported by large triactines and the basal system of giant tetractines (Figs 2; 3). The choanosome is composed of rather irregular tubes, which maintain the general radial organi-

zation. They are supported by minute equiangular and equiradiate triactines and tetractines. The radial canals open into the central exhalant cavity or atrium, surrounded by a thin membrane that contains minute parasagittal triactines, which occasionally develop a fourth actine that is perpendicular to the atrial surface and points free into the atrial cavity.

Spicules (Fig. 3)

Cortical triactines are equiangular and equiradiate, with actines measuring 465 (± 160) / 47 (± 18) µm. Cortical tetractines are similar but larger: 890 (± 265) / 72 (± 20) µm. Small choanosomal triactines and the basal system of the tetractines are equiangular and equiradiate, or parasagittal when located in the periatrial membrane, and measure 50 (± 16) / 3.6 (± 1.2) µm.

REMARKS

Leucaltis clathria has been reported from all the tropical seas, and the described specimens are morphologically quite homogenous. Recent studies on genetic characteristics of sponge populations have questioned the taxonomic value of the supposedly cosmopolitan sponge species (Solé-Cava *et al.* 1991; Boury-Esnault *et al.* 1999). In contrast to many other Calcarea, *L. clathria* has a very characteristic external morphology, a particular body wall organization, and several well-characterized spicule types. Consequently, *L. clathria* may be an interesting model to address the question of the cosmopolitanism by an extensive morphological and genetic analysis comparing populations from distant regions.

Family LEUCASCIDAE Dendy, 1892

DIAGNOSIS. — Clathrinida with a body differentiated into a cortex and a choanosome whose organization is reminiscent of a clathroid body composed of anastomosed tubes. The cortex contains a specific skeleton composed of triactines and/or tetractines. Choanocyte chambers are tubular, often highly ramified and anastomosed. The choanoskeleton is restricted to the walls of the choanocyte chambers, maintaining a distinctly tubular organization.

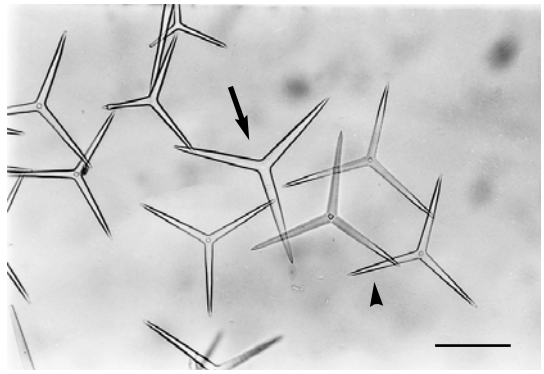

FIG. 4. — *Leucascus neocaledonicus* n. sp. Spicules of the cormus. The arrow indicates the larger triactine of the external surface, the arrow head indicates tetractines of the internal tubes with a thin apical actine. Scale bar: 30 µm.

Genus *Leucascus* Dendy, 1892

TYPE SPECIES. — *Leucascus simplex* Dendy, 1892 by subsequent designation (Dendy & Row 1913).

DIAGNOSIS. — Leucascidae with copiously branched and anastomosed choanocyte tubes. The exhalant aquiferous system is represented by a well-developed atrium delimited by a specific wall with no choanoderm.

Leucascus neocaledonicus n. sp.
(Fig. 4)

TYPE MATERIAL. — Holotype MNHN-LBIM-C-1999-02

ETYMOLOGY. — Refers to the type locality, New Caledonia.

MATERIAL EXAMINED. — Several large specimens from localities 114 and 1376.

TYPE LOCALITY. — Canal Woodin, stn 1376.

LOCALITIES. — Banc Gail, stn 114, 35 m. – Canal Woodin, stn 1376, 26-36 m.

DESCRIPTION

The collection contains several large specimens which can attain a height of up to 8 cm. Their body is hard, lobate, flattened and irregularly folded (photo in Lévi 1998: 76). The external surface is smooth, white, pierced by very small ostia opening into elongate inhalant chambers. The body wall is approximately 2 mm thick in the

upper parts, and can reach 4 mm in the basal parts. It surrounds a wide flattened central atrium, whose surface is pierced by large oval exhalant cavities. Inside the sponge wall, each cavity divides into several channels that run perpendicularly to the atrial surface. The surface of exhalant cavities is hispid due to the presence of the long apical actines of tangential tetractines. The surface of the main atrial cavity is smooth or only slightly echinated by short apical actines of atrial tetractines. The choanosome is composed of tubes, radially arranged at the distal part, and somewhat irregular in the proximal one, where they open into the exhalant canals and cavities.

The cortical skeleton is very thin and contains triactines that are barely larger than those of the choanosomal tubes. The skeleton of the tubes is also composed of triactines, some of which have a short and thin apical actine (Fig. 4). The exhalant canals have triactines and tetractines whose long and thin apical actines reach the central part of the lumen. On a transverse section, the choanosome contains a dense regular radial network of choanocyte tubes, intercalated with smooth inhalant and hispid exhalant canals. The canals are all the same size, i.e. larger than the choanocyte tubes, and also maintain an approximately radial organization.

Spicules (Fig. 4)

Cortical triactines, equiangular and equiradiate, measuring 130 (± 27) / 12 (± 2.5) µm; choanosomal triactines, measuring 100 (± 14) / 10 (± 1.5) µm; tetractines with the basal actines of the same size, and the apical actine thinner than the basal ones, with a long thin distal part, often slightly curved.

REMARKS

The classification of large Calcinea that retain the organization of the choanosome as a dense network of tubes corresponding to the ascon tubes is quite complex. We proposed the retention of only the sponges that have a cormus composed of typical asconoid tubes, without a defined cortex or the exhalant aquiferous system devoid of the choanoderm in the family Clathrinidae (Borojevic *et al.* 1990). Whilst the sponges of the genus *Ascaltis* have a cortex and, consequently, an inhalant aquiferous system, their central large tube or cavity that opens to the osculum is still covered by choanocytes, and hence they have no exhalant aquiferous system. Conversely, the genus *Leucascus* is characterized by the presence of a central exhalant cavity devoid of choanocytes, representing a true exhalant aquiferous system. In sponges that have not been properly preserved, this is not easy to see, and in older descriptions, attention has not always been given to these details. Consequently, *Leucascus neocaledonicus* is probably close to several of the large calcareous sponges described under the name *Leucosolenia* in the Indo-Pacific region, such as *L. ventricosa* Carter, 1886, *L. wilsoni* Dendy, 1891, *L. pelliculata* Dendy, 1891 and *L. protogenes* Haeckel, 1872 (*sensu* Dendy 1891). *Leucosolenia ventricosa* and *L. pelliculata* are characterized by large cortical triactines, and *L. protogenes* and *L wilsoni* have no tetractines. *Leucosolenia grisea* Dendy & Frederick, 1924 is quite similar to *Leucascus neocaledonicus* both in the general organization of the body and the skeleton, and in the preliminary study (in Lévi 1998) we included the sponges here described as *L. neocaledonicus* in *Ascaltis grisea* described by Dendy & Frederick (1924). However, these authors stated that in *L. grisea* the "tubes open into the main exhalant canals, which are also lined by basinucleate collared cells, and open to the exterior by true oscula", indicating that this sponge belongs to the genus *Ascaltis*, whilst the specimens described here have a true atrial cavity. The same authors also described *Ascoleucetta compressa* Dendy & Frederick, 1924 that we now place in the genus *Leucascus*. This sponge is very similar to *L. neocaledonicus* and can be distinguished only by the presence of a rather thick cortex composed of two types of tangential triactines, and a particular fringe of trichoxea that guards the inhalant apertures. A comparative study of this species complex will be necessary to identify the possible synonymies and the geographical distribution of each species.

Family LEUCETTIDAE Laubenfels, 1936 (*sensu* Borojevic 1968)

DIAGNOSIS. — Clathrinida with a solid body. The aquiferous system is always leuconoid. The

choanoskeleton is well-developed and in the form of a regular network composed of triactines and/or tetractines. The cortex is thin and composed of spicules similar to those of the choanoskeleton.

Genus *Leucetta* Haeckel, 1872

TYPE SPECIES. — *Leucetta (Leucettaga) primigenia* Haeckel, 1872 by subsequent designation (Dendy & Row 1913).

DIAGNOSIS. — Leucettidae with a homogeneous organisation of the wall and a typical leuconoid aquiferous system. There is neither a clear distinction between the cortex and the choanoskeleton, nor the presence of a distinct layer of subcortical inhalant cavities. The atrium is frequently reduced to a system of exhalant canals that open directly into the osculum.

Leucetta microraphis (Haeckel, 1872) (Fig. 5)

Leucetta primigenia var. *microraphis* Haeckel, 1872.

MATERIAL EXAMINED. — Several large specimens.

LOCALITIES. — Common in the south-west lagoon, Banc Gail, stn 114, 35 m and Baie Sainte Marie.

DESCRIPTION

The collection contains several large specimens, characterized by their massive form, a smooth surface in which the giant triactines can be readily seen, and a very hard and coarse consistency. They are typical of the genus, and resemble closely the specimens we described previously from New Caledonia (Borojevic 1967). Both the cortical and the choanosomal skeletons are composed of numerous giant and small triactines, scattered irregularly. Many giant triactines are present throughout the choanosome, giving it a very firm texture (Fig. 5). The aquiferous system is composed of rather narrow inhalant and exhalant canals that permeate a dense choanosome containing small spherical choanocyte chambers. Larger exhalant canals contain tetractines whose basal system is similar to the choanosomal triactines. The apical actine of the tetractines is short, thin, and curved at the distal part towards the osculum.

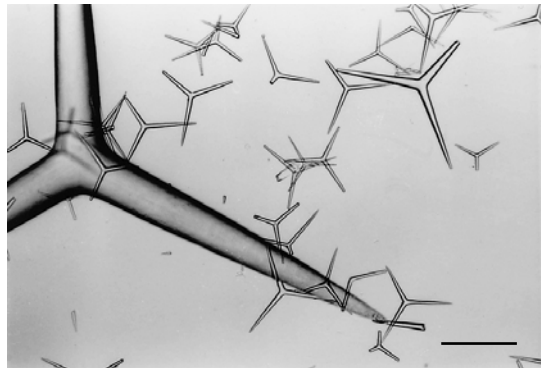

FIG. 5. — *Leucetta microrhaphis* (Haeckel, 1872). Triactines of the sponge wall. Giant triactines are present in the cortex and throughout the choanosome. Scale bar: 80 µm.

Spicules (Fig. 5)

Giant triactines, regular, measuring 1230 (± 456) / 85 (± 28) µm. Small triactines, regular, measuring 449 (± 56) / 39 (± 3.4) µm (as are the tetractines).

REMARKS

Numerous *Leucetta* species with triactines of two different sizes have been described from all the tropical and subtropical seas, under different names, probably representing a complex of species whose classification is very difficult due to the small number of morphological descriptors that can be used to distinguish them. In addition, in the tropical Atlantic region, similar sponges are found that have both giant triactines and tetractines, and that have usually been placed in the species described originally as *Leucaltis floridana* Haeckel, 1872. In our earlier studies, we proposed placing all these sponges in a single cosmopolitan species *L. microraphis* (Borojevic 1967; Borojevic & Peixinho 1976). However, subsequent genetic studies have shown that such an extensive lumping was wrong, and that it does not correspond to genetically defined species (Solé-Cava *et al.* 1991; Klautau *et al.* 1994). Consequently, the whole complex of tropical and subtropical *Leucetta* deserves revision. Until an extensive morphological and genetic comparative study of this complex becomes available, we propose the following division according to spicule types and geographical distribution.

Leucetta microraphis Haeckel, 1872, *sensu* Lendenfeld (1885) and Dendy (1892) includes the Pacific species. In the original description, Haeckel (1872) has grouped all the *Leucetta* with regular equiangular and equiradiate triactines in the species *L. primigenia*, among which the subspecies *L. microraphis* and *L. megaraphis* had two types of triactines of very different sizes. No localities were attributed to the described subspecies, but the Indo-Pacific origin, and in particular the south coast of Australia were cited. In the description of Australian Calcarea, Lendenfeld (1885) proposed elevating *L. microraphis* to the species level, and this position was subsequently confirmed by Dendy (1892) who reported the species from Port Phillip Heads. In the same study, Dendy included *Leuconia dura* Poléjaeff, 1883 as a synonym of *L. microraphis*. Poléjaeff (1883) reported this species from Bermuda and the Torres Straits, and we now consider that the specimen from Australia belongs to the "*microraphis*" complex; while the specimen from Bermuda belongs to the tropical Atlantic complex described below. Borojevic (1967) has previously proposed including the sponge described by Poléjaeff (1883) as *Pericharax carteri* var. *homoraphis* from Tristan da Cunha, in the species *L. microraphis*, as well as the sponge described by Carter (1886) as *L. floridana* var. *australiensis* and subsequently renamed by Dendy (1892) as *L. carteri*. We now prefer to follow Dendy & Row (1913) in retaining them provisionally as valid species. Haeckel (1872) indicated that occasional choanosomal tetractines could be found in *L. microraphis*, with rather a long apical actine, and Dendy (1892) confirmed this finding. Therefore, the presence of tetractines in our specimen supports its identification as *L. microraphis.*

Leucetta floridana (Haeckel, 1872), characterized by the presence of both giant cortical triactines and tetractines, was originally described from Florida, and subsequently reported in the studies of Calcarea from the West Indies and tropical West Atlantic coasts. Borojevic & Peixinho (1976) have analysed an extensive series of specimens from North-East Brazil, and discussed the variability of the relative quantity of giant tetractines. However, since Australian and New Caledonian specimens never have giant tetractines, we now consider that the two species should be distinguished, and the sponges we described as *L. microrhaphis* from Brazil (Borojevic & Peixinho 1976) should be included into the "*floridana*" complex. *Leucetta floridana* was also reported for Wasin, East Africa, by Jenkin (1908). Its description is quite short, and the identity of this African species remains to be verified.

Leucetta chagosensis Dendy, 1913
(Fig. 6)

Leucetta pyriformis Dendy, 1913.
L. infrequens Row & Hôzawa, 1931.

MATERIAL EXAMINED. — Many large specimens from localities 110, 113, 571, 1523.

LOCALITIES. — South-west coast, Dumbea, coral reefs, stn 113. – Dumbea, lagoon, stn 1523. – Nouméa, Redika Island, stn 110, 20 m. – St Vincent, external coral reef, stn 571.

DESCRIPTION

The collection contains several specimens of this sponge, which is reported to be common in the coral reef lagoons. The colour in life is bright yellow, but the preserved specimens are white or brown. The smaller specimens are pyriform, the larger ones are elongate and reach 6 / 2.5 cm. They generally have a single or only a few naked oscula. The surface is either very regular and smooth or bearing small protuberances (photo in Lévi 1998: 77). The sponge wall is 0.3 to 1 cm thick, surrounding a wide central atrium, with a smooth surface bearing the large openings of the exhalant cavities. The inhalant pores are small, opening to larger inhalant cavities that run under the thin cortex. The inhalant canals are tubular, running perpendicular to the surface. The general organization of the wall is somewhat reminiscent of the clathrate structure found in *Leucascus*, with a distinct radial organization. The exhalant canals are more irregular, hispid due to the presence of tetractines, widen in the proximity of the atrium

and form irregular exhalant cavities. The skeleton is composed of triactines of two sizes (Fig. 6). The difference between the two categories of triactines is much smaller than that observed in *L. microraphis.* The larger triactines are frequent in the cortex, and rather scarce in the choanosome, but the quantity of internal large triactines varies among different specimens. Tetractines with a thin apical actine are found only in the wall of exhalant canals.

Spicules (Fig. 6)
Large triactines measuring 480 (± 80) / 38 (± 3.9) µm; small triactines measuring 145 (± 25) / 15 (± 1.2) µm; tetractines with the basal system slightly smaller than triactines, and a slender apical actine.

REMARKS
As previously stated (Borojevic 1967), we have found tetractines in the exhalant canals of the specimens of *L. chagosensis* described by Dendy (1913) from the Chagos Islands, as well as from the Abrolhos Islands (Dendy & Frederick 1924), and deposited in the Natural History Museum, London. We also pointed out that the larger triactines may be more or less frequent in the choanosome. Consequently, we consider that *L. chagosensis* is characterized by a regular form; subcortical inhalant cavities; radial organisation of the choanosome as defined by parallel interdigitating inhalant and exhalant canals; the presence of two types of triactines, and of tetractines only in the exhalant canals. In this interpretation of *L. chagosensis,* we consider that *L. pyriformis* Dendy, 1913 and *L. infrequens* Row & Hôzawa, 1931 are probably synonyms of this species, commonly found in the Indo-Pacific region.

Genus *Pericharax* Poléjaeff, 1883

TYPE SPECIES. — *Pericharax heteroraphis* Poléjaeff, 1883 by subsequent designation (Dendy & Row 1913).

DIAGNOSIS. — Leucettidae with a large central atrium surrounded by a thick wall. The wall is divided into a choanoderm and a thin subcortical layer of inhalant cavities supported by a peculiar skeleton partially composed of the centripetal actines of the special cortical triactines.

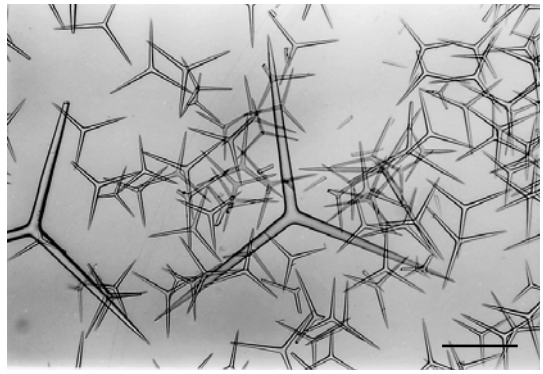

FIG. 6. — *Leucetta chagosensis* Dendy, 1913. Triactines of the sponge wall. Note a larger triactine, most frequent in the cortical skeleton. Scale bar: 80 µm.

Pericharax heteroraphis (Poléjaeff, 1883)

Pericharax carteri var. *heteroraphis* Poléjaeff, 1883.

MATERIAL EXAMINED. — Several very large specimens from localities 169 and 213.

LOCALITIES. — Passe de la Sarcelle, stn 169. – Kouaré Island, south coast, stn 213, 30 m.

DESCRIPTION
The collection contains a few large specimens reaching up to 10 cm in height. They are massive and lobose, with the external surface thrown into irregular folds. The texture is firm. The external surface is smooth but harsh, while the atrial surface is spiny. The organisation is typical of the genus. The choanosome is leuconoid with only a few rather large exhalant canals opening to the wide central atrium. It contains numerous triactines of two very different sizes. The atrial skeleton contains tetractines, with a short apical actine. The characteristic subcortical inhalant chambers are supported by a very thick skeleton of small triactines with irregularly bent actines.

Spicules
Giant triactines, regular, measuring 730 (± 139) / 64 (± 12) µm. Small triactines, regular, measuring 140 (± 23) / 12 (± 2) µm. In the atrial wall,

tetractines have a basal system similar to the triactines, with an apical actine shorter than the basal ones. Curved irregular triactines or tripods of the cortical layer measure 64 (± 11) / 8 (± 1) µm.

REMARKS

Pericharax heteroraphis has been reported from Tristan da Cunha, the Indian Ocean and from the tropical Pacific regions (Great Barrier Reef, Indonesia).

Subclass CALCARONEA Bidder, 1898
Order LEUCOSOLENIIDA Hartman, 1958

Family SYCETTIDAE Dendy, 1892

DIAGNOSIS. — Leucosoleniida with a central atrial tube and perpendicular regularly arranged radial tubes lined by a choanoderm. The distal cones of the radial tubes, which may be decorated with tufts of diactines, are clearly noticeable on the sponge surface. They are never covered by a cortex supported by tangential triactines and/or tetractines. The proximal skeleton of the radial tubes is composed of a row of subatrial triactines and/or tetractines with rows of tubar triactines and/or tetractines behind. Distal pseudosagittal spicules are absent. A tangential layer of triactines and/or tetractines supports the atrial wall.

Genus *Sycon* Risso, 1826

TYPE SPECIES. — *Sycon humboldtii* Risso, 1826 by subsequent designation (Dendy & Row 1913).

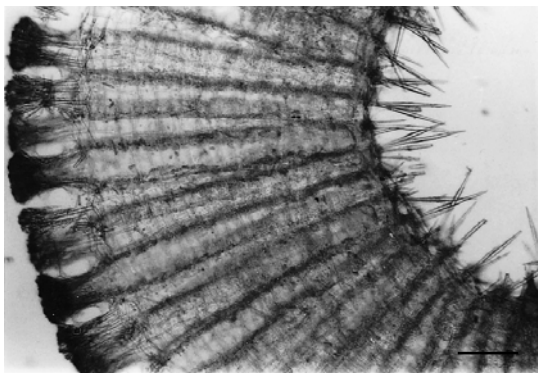

FIG. 7. — *Sycon gelatinosum* (Blainville, 1834). Transverse section. Scale bar: 80 µm.

DIAGNOSIS. — Sycettidae with radial tubes partially or fully coalescent; distal cones are decorated by tufts of diactines. The inhalant canals are generally well-defined between the radial tubes and are often closed at the distal end by a membrane that is perforated by an ostium; they are devoid of a skeleton. There is no continuous cortex covering the distal ends of the radial tubes. Atrial and tubar skeletons are composed of triactines and/or tetractines.

Sycon gelatinosum (Blainville, 1834)
(Fig. 7)

Alcyoncellum gelatinosum Blainville, 1834.

MATERIAL EXAMINED. — One specimen.

LOCALITIES. — Canal Woodin, 25-30 m.

DESCRIPTION

Sponge arborescent (2.5 cm high), with the cormus formed by regular bifurcations of the larger syconoid tubes at their bases, into smaller distal ones. A single osculum is found at the apex of each tube, which is surrounded by a thick layer of triactines arranged in parallel with a wide unpaired angle, which supports a short fringe of trichoxea. The external surface is smooth and granular, due to the thick bundles of short diactines that decorate the distal ends of radial channels, forming a typical, regular hexagonal pattern on the sponge surface (photo in Lévi 1998: 78). The inhalant spaces between the bundles are closed by a thin membrane, which is never supported by spicules. The sponge wall contains very regular radial choanocyte chambers intercalated by inhalant channels of the same size. The choanoskeleton is articulate, with numerous triactines arranged in parallel, and the unpaired actine directed towards the distal cones. Their size increases distally, and the spicules participating in the skeleton of the distal cone are larger and thicker than those in the tubes. The atrial cavity is slightly enlarged in the suboscular region, where the sponge wall is thinner. The atrial skeleton is composed of tetractines with large apical actines, which are bent towards the osculum, and are occasionally long enough to reach those arising from the opposite side of the atrium (Fig. 7).

Spicules
Triactines of the choanosomal tubes are sagittal, with paired actines measuring 68.6 / 9.8 µm; the unpaired one is of the same size in the proximal part of the tubes, but measures 122.5 / 9.9 µm in the distal cones. The actines in the basal system of the atrial tetractines measure 58.8 / 9.8 µm. The apical actine measures 150 / 9.9 µm. The diactines of the distal tufts are irregular in size and shape, with the two actines of similar size, or with the proximal actine thinner, and the distal one conical or club-shaped, or irregularly bent (80.4 / 9.8 µm to 176.4 / 9.8 µm).

REMARKS
Sycon gelatinosum has been frequently reported from the Indian Ocean and the tropical regions of the Pacific Ocean.

Family HETEROPIIDAE Dendy, 1892

DIAGNOSIS. — Leucosoleniida with a syconoid or leuconoid organization. The choanoskeleton is composed of a proximal layer of subatrial triactines and a distinct distal layer of pseudosagittal triactines and/or pseudosagittal tetractines, often separated by an intermediate layer that is supported by several rows of triactines and/or tetractines. The atrial skeleton is well-developed.

Genus *Sycettusa* Haeckel, 1872

TYPE SPECIES. — *Sycetta (Sycettusa) stauridia* Haeckel, 1872 by monotypy.

DIAGNOSIS. — Heteropiidae with a syconoid organization. Atrial and cortical skeletons are formed by tangential triactines and/or tetractines. The choanoskeleton is inarticulate, and is composed of unpaired actines of the subatrial triactines, and of centripetal actines of the pseudosagittal subcortical triactines.

DESCRIPTION
We propose splitting the genus *Grantessa* (in the scope defined by Dendy & Row 1913) into two groups: one with the inarticulate choanoskeleton, named *Sycettusa* and the other with the articulate one, named *Grantessa*. The former has potentially evolved by corticalization of sponges with an inarticulate skeleton similar to the sponge described in New Caledonia under the name *Grantessa syconiformis* Borojevic, 1967.
In the Indo-Pacific region, the genus *Sycettusa* includes *S. stauridia* Haeckel, 1872, *S. (Grantessa) glabra* (Row, 1909) and *S. (Grantessa) hastifera* (Row, 1909) from the Red Sea; *S. (Grantessa) simplex* (Jenkin, 1908) from Zanzibar; *S. (Sycortis) sycilloides* (Schuffner, 1877) from Indonesia and *S. (Amphoriscus) poculum* (Poléjaeff, 1883) from Australia.
Haeckel (1872) proposed the subgenus *Sycettusa* for the single species *S. stauridia* from the Red Sea, which is a typical syconoid Heteropiidae with an inarticulate choanoskeleton. We retain the same combination at the genus level, and consider *S. stauridia* to be the type species of the genus.

Sycettusa tenuis n. sp.
(Fig. 8)

TYPE MATERIAL. — Holotype MNHN-LBIM-C-1999-03.

ETYMOLOGY. — From Latin *tenu*: thin, fragile.

MATERIAL EXAMINED. — One specimen.

TYPE LOCALITY. — South Lagoon, stn 274.

LOCALITY. — South Lagoon, between Vatia and Kauré, 2.6 miles from the Great Reef, stn 274, 44 m.

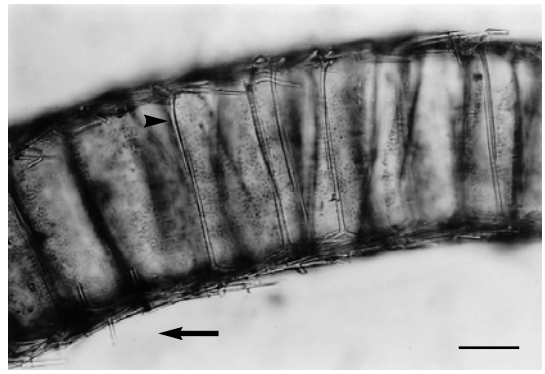

FIG. 8. — *Sycettusa tenuis* n. sp. Transverse section. Note the pseudosagittal subcortical triactines (arrow head) and the rare atrial tetractines with a short apical actine (arrow). Scale bar: 30 µm.

DESCRIPTION

Sycettusa tenuis is typical of the genus, with a thin and regular inarticulate skeleton. The cormus is composed of separated tubes that reach up to 3 mm in diameter. A thin wall of only 0.3 mm surrounds a wide central atrial cavity. The external surface is smooth. The skeleton (Fig. 8) is composed of a thin cortex containing only triactines, scattered irregularly in a single layer. The choanoskeleton is supported by the inward actine of the subcortical pseudosagittal triactines, and the unpaired actine of the subatrial sagittal triactines. The thin atrial skeleton is composed of triactines, which occasionally develop a fourth short apical actine, and the atrial surface is thus decorated with very short spines (apical actines), which can be easily overlooked. All the spicules are approximately of the same size, but can be distinguished by their characteristic form.

Spicules (Fig. 8)

Cortical triactines with the unpaired actine straight, and the paired actines slightly curved, conical and ending with a sharp point, measuring 220 (± 25) / 18 (± 2) µm. Subcortical triactines are typically pseudosagittal, with the paired actines of similar size and shape, and the unpaired one sharply bent at the point that reaches the cortex, measuring 230 (± 20) / 20 (± 2) µm. The subatrial triactines have a wide unpaired angle. The short paired actines, measure 210 (± 20) / 20 (± 2) µm, while the longer unpaired one, measures 380 (± 50) / 20 (± 2) µm. In the atrial triactines and tetractines with long straight actines, the paired ones are only slightly curved at the distal part and measure 299 (± 50) / 20 (± 1) µm, while the unpaired one measures 350 (± 40) / 20 (± 1) µm.

REMARKS

Sycettusa tenuis n. sp. is certainly close to *Sycettusa simplex* (Jenkin, 1908), which has a similar skeletal structure and spicules. The only distinction is the presence of atrial tetractines in *S. tenuis*. *Sycetta stauridia* Haeckel, 1872 is also apparently similar, but we distinguish it following Haeckel's observation that the subatrial spicules are twice as thick as the subcortical ones. These species can be easily distinguished from *S. poculum* (Poléjaeff, 1883), *S. hastifera* (Row, 1909), *S. glabra* (Row, 1909) and *S. sycilloides* (Schuffner, 1877), which all have radial diactines.

Genus *Vosmaeropsis* Dendy, 1892

Type species. — *Heteropia macera* Carter, 1886 by subsequent designation (Dendy & Row 1913).

Diagnosis. — Heteropiidae with a sylleibid or leuconoid organisation. The choanoskeleton is composed of proximal subatrial triactine spicules and an irregular layer of scattered triactines and tetractines.

Vosmaeropsis hozawai n. sp.

TYPE MATERIAL. — Holotype MNHN-LBIM-C-1999-04.

ETYMOLOGY. — The name of the species is proposed to acknowledge the excellent descriptions of a series of *Vosmaeropsis* from Japan and from the Hamburg Museum collections provided by the late Professor Sanji Hôzawa.

MATERIAL EXAMINED. — One specimen.

TYPE LOCALITY. — Banc Gail, stn 114.

LOCALITY. — South-west coast, Banc Gail, stn 114, 25-30 m.

DESCRIPTION

The collection contains one large dark brown specimen, partially fragmented, but which was originally more than 5 cm high. It is sac-shaped, flattened and folded with a single apical naked osculum. The external surface is smooth but harsh. The cortical skeleton is composed of tangential triactines of variable size arranged without any order. The largest ones are easily seen under low magnification. The sponge wall is 2-5 mm thick. It surrounds a large atrial cavity that has a smooth surface, pierced by openings of large exhalant cavities and smaller exhalant canals. The sponge wall is hard, composed of a strong skeleton, which supports a choanosome with a leuconoid organization. Branching exhalant canals permeate the internal part of the choanosome.

The skeleton contains only triactines and is divided into two regions. The subcortical region has a clearly radially arranged skeleton, containing large pseudosagittal subcortical spicules with one of the paired actines pointing towards the atrium. In the same region, large choanosomal triactines point their unpaired actine towards the cortex. The subjacent internal region of the choanosome, in which exhalant canals are irregularly scattered, has no defined orientation of spicules. No defined layer of subatrial spicules can be identified in the vicinity of the atrial surface. Very large, nearly equiangular, triactines are irregularly scattered throughout the sponge wall. The atrial skeleton and that of the exhalant cavities contain triactines similar in form to those of the cortex, but smaller.

Spicules

The giant triactines of the choanosome measure up to 1500 / 100 µm. They are equiangular and equiradiate, with conical sharp actines. Smaller sagittal spicules are also present in the choanosome. The pseudosagittal subcortical spicules measure 650 (± 120) / 47 (± 15) µm. These pseudosagittal spicules are similar to the choanosomal ones, with only a slight difference in the length and in the curvature of the paired actines. The cortical and atrial triactines which are of variable size, have paired actines bent in form of an arc, and the unpaired one is straight. They are approximately of a similar length, 420 (± 230) / 47 (± 22) µm.

REMARKS

Vosmaeropsis hozawai is probably close to *V. triradiata* Hôzawa, 1940 described from Mexico. These two species share the characteristic of having neither diactine nor tetractine spicules, which distinguishes them from all the other *Vosmaeropsis* species. *Vosmaeropsis triradiata* is characterized by the fact that the largest triactines are found in the cortex, whilst in *V. hozawai* the giant choanosomal triactines are much larger than those observed in the cortex. Hôzawa (1940) also pointed out that the organization of the choanosome is sylleibid in *V. triradiata*, whilst the choanosome of *V. hozawai* is thick and leuconoid.

The external layer of *V. hozawai* exhibits the typical structure of the Heteropiidae, with subcortical pseudosagittal spicules facing the regular layer of sagittal spicules, whose unpaired actines point towards the cortex. Conversely, the innermost part of the choanosome is permeated by exhalant canals and has an irregular organization. We believe that this layer is a secondary structure with a proper secondary skeleton that supports a region intercalated between the original subatrial and atrial regions. This interpretation is suggested by the fact that the choanosomal spicules that face the subcortical pseudosagittal ones retain the form and remain in the position of subatrial spicules, although they are separated from the atrial surface by the exhalant canal-containing layer. In accordance with this hypothesis, there are no true subatrial triactines associated with the atrial skeleton.

Family JENKINIDAE Borojevic, Boury-Esnault & Vacelet, 2000

DIAGNOSIS. — Leucosoleniida with a syconoid, sylleibid or leuconoid organisation. The thin wall surrounding the large atrial cavity is supported by tangential atrial and cortical skeletons, and an inarticulate choanoskeleton consisting of unpaired actines of the subatrial triactines and/or tetractines, and occasionally with small radial diactines. The proximal part of the large radial diactines that protrude from the external surface, or the tangential triactines scattered irregularly in the cortex, may also form the choanoderm. Large cortical tetractines or subcortical pseudosagittal triactines are not present.

DESCRIPTION

In the revision of Calcaronea also published in the present volume, Borojevic *et al.* propose to separate a group of sponges characterized by an inarticulate choanoskeleton in the family Jenkinidae (Borojevic *et al.* 2000). The new genus *Leucascandra* is a typical member of this family.

Leucascandra n. gen.

TYPE SPECIES. — *Leucascandra caveolata* Borojevic & Klautau, 2000 by monotypy.

DIAGNOSIS. — Jenkinidae with a complex cormus composed of copiously branched and anastomosed

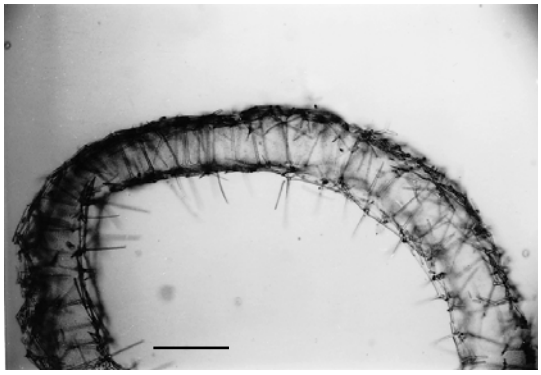

FIG. 9. — *Leucascandra caveolata* n. gen. n. sp. Transverse section through the sponge wall. Scale bar: 80 µm.

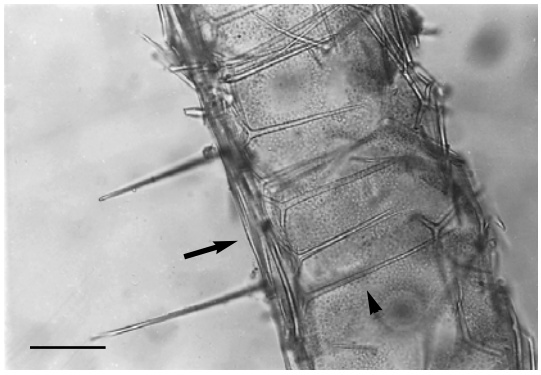

FIG. 10. — *Leucascandra caveolata* n. gen. n. sp. Transverse section. Note the choanoskeleton composed only of subatrial triactines (arrow head), and atrial skeleton containing triactines and tetractines (arrow). Scale bar: 30 µm.

tubes. Each tube has a thin wall with a rather irregular alveolar type of leuconoid aquiferous system, and an inarticulate choanoskeleton that is supported only by unpaired actines of subatrial triactines. Both cortical and atrial skeletons consist of a thin layer of tangential triactines and/or tetractines.

Leucascandra caveolata n. sp.
(Figs 9; 10)

TYPE MATERIAL. — Holotype MNHN-LBIM-C-1999-05.

ETYMOLOGY. — The name refers to the honeycomb appearance of the internal surface of the sponge.

MATERIAL EXAMINED. — Many large specimens.

TYPE LOCALITY. — Passe de Nakéty, stn 303.

LOCALITIES. — This sponge is common on the east and south coasts of New Caledonia. Poindimié, south coast, stn 227, 15-30 m. – South Lagoon, coral reefs Cineria, stn 263. – Passe de Nakéty, east coast, stn 303, 20 m; *idem* north coast, south of the Grande Fausse Passe, 30 m.

DESCRIPTION

The sponge forms large cormi (up to 10 cm high) of a rather loose meshwork, composed of delicate tubes, the larger ones attaining nearly 1 cm in diameter. The smaller ones (in general no more than 2 mm in diameter) rise perpendicularly from the larger ones. They are ramified at the distal part, and occasionally anastomosed, bearing a naked osculum at the end (photos in Lévi 1998: 73; 79). They are brown red in life, but the alcohol-preserved specimens are white.

The wall of the tubes (Fig. 9) is supported by a thin cortex, composed of triactines only, and a parallel atrial skeleton composed of tetractines. In both layers, most spicules are arranged in parallel, with the unpaired angle directed towards the osculum. The thin choanosome is only supported by the unpaired actines of the subatrial triactines (Fig. 10). All the spicules are of a similar thickness.

Spicules (Fig. 10)

Cortical triactines, with slightly curved paired actines measuring 180 (± 50) / 20 (± 2) µm, and a shorter, straight unpaired actine, measuring 105 (± 28) / 20 (± 2) µm. The small subatrial triactines have a wide unpaired angle. The paired actines are curved in order to fit into the atrial skeleton. They measure 78 (± 9) / 15 (± 1.5) µm, while the straight unpaired one measures 85 (± 12) / 18 (± 2) µm. The atrial triactines and tetractines with the unpaired straight actine measure 382 (± 68) / 20 (± 2) µm, and the paired ones, 264 (± 26) / 21 (± 2) µm.

Acknowledgements
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