Sponges of the genus *Clathrina* Gray, 1867 from Arraial do Cabo, Brazil

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ABSTRACT
Although rich in species, the fauna of Porifera in Brazil is inadequately known. During a study of the Porifera of Arraial do Cabo (Rio de Janeiro), we found eight species of the genus *Clathrina* (Porifera, Calcarea). *C. ascandroides*, *C. aurea* and *C. brasiliensis* were already described; three of them, *C. conifera* n. sp., *C. quadriradiata* n. sp. and *C. tetractina* n. sp., are new to science; *C. aspina* and *C. cylindractina* are being fully described for the first time. *C. ascandroides* has a cormus formed by large, irregular and loosely anastomosed tubes. Water-collecting tubes are absent. Its spicules are triactines and two populations of tetractines. While the short triactines and tetractines occur outside the tubes, the large tetractines are found inside them. *C. aspina* has a well-delimited cormus formed by thin, regular and tightly anastomosed tubes. Water-collecting tubes are present. Spicules are triactines, tetractines and tripods. The apical actine of the tetractines is smooth. Tripods surround the cormus, delimiting it. *C. aurea* is a yellow *Clathrina*, whose cormus is formed by large, irregular and loosely anastomosed tubes. Water-collecting tubes are not present. Spicules are triactines. Actines are cylindrical, undulated and have rounded ends. *C. brasiliensis* is morphologically very similar to *C. aspina*. However, the apical actine of its tetractines has short spines. The cormi of *C. conifera* n. sp. and *C. cylindractina* are formed by large, irregular and loosely anastomosed tubes, without water-collecting tubes. Both have

KEY WORDS
Porifera,
Calcarea,
Calcinea,
Clathrina,
Arraial do Cabo,
Rio de Janeiro,
Brazil.

only triactines composing their skeletons. However, the triactines of *C. conifera* n. sp. have conical actines, while *C. cylindractina* has triactines with cylindrical to conical actines. *C. quadriradiata* n. sp. and *C. tetractina* n. sp., both have tetractines as their main spicule. However, the apical actine of their tetractines has different shapes, being conical in *C. quadriradiata* n. sp. and cylindrical in *C. tetractina* n. sp.

RÉSUMÉ
Éponges du genre Clathrina *Gray, 1867 d'Arraial do Cabo, Brésil.*
Quoique riche en espèces, la faune de Porifera au Brésil est très peu connue. En étudiant les éponges à Arraial do Cabo (Rio de Janeiro), nous avons trouvé huit espèces du genre *Clathrina* (Porifera, Calcarea). *C. ascandroides*, *C. aurea* et *C. brasiliensis* ont dejà été décrites ; trois de ces espèces, *C. conifera* n. sp., *C. quadriradiata* n. sp. et *C. tetractina* n. sp., sont nouvelles et deux, *C. aspina* and *C. cylindractina*, sont décrites de façon complète pour la première fois. *C. ascandroides* a un cormus formé par des tubes larges, irrégulièrement anastomosés. Les tubes externes collecteurs d'eau ne sont pas présents. Les spicules sont des triactines et deux populations de tétractines. Tandis que les petites triactines et tétractines se trouvent dans les tubes extérieurs, les grands tétractines sont trouvés à l'intérieur des tubes. *C. aspina* a un cormus bien délimité, formé par des tubes fins, denses, réguliers et anastomosés. Les tubes extérieurs collecteurs d'eau sont présents. Les spicules sont des triactines, tétractines et tripodes. Les actines apicales des tétractines sont lisses. Les tripodes ne sont trouvés que dans les tubes extérieurs du cormus. *C. aurea* est une *Clathrina* jaune, avec le cormus formé par des tubes larges et irrégulièrement anastomosés. Les tubes extérieurs collecteurs d'eau ne sont pas presents. Les spicules sont des triactines. Les actines sont cylindriques, ondulées et arrondies à leur extrémité. *C. brasiliensis* est similaire à *C. aspina*. Cependant, l'actine apicale de ses tétractines porte de petites épines. Les cormi de *C. conifera* n. sp. et de *C. cylindractina* sont formés par des tubes larges, irréguliers et irrégulièrement anastomosés. Les tubes collecteurs d'eau ne sont pas présents. Les deux espèces ont seulement des triactines. Cependant, les triactines de *C. conifera* n. sp. ont des actines coniques, tandis que celles de *C. cylindractina* ont des actines plus cylindriques. *C. quadriradiata* n. sp. et *C. tetractina* n. sp. ont le squelette composé principalement de tétractines. Elles peuvent être differenciées par l'actine apicale qui est conique chez *C. quadriradiata* n. sp. et cylindrique chez *C. tetractina* n. sp.

MOTS CLÉS
Porifera,
Calcarea,
Calcinea,
Clathrina,
Arraial do Cabo,
Rio de Janeiro,
Brésil.

INTRODUCTION

The fauna of Porifera is very rich along the Brazilian Coast (Boury-Esnault 1973; Hechtel 1976; Muricy *et al*. 1991; Hajdu *et al.* 1992). However, despite the high diversity of species, only a few taxonomic works have been written, and this is particularly true for the sponges of the Class Calcarea.

In contrast to the Indo-Pacific, in Brazil the Calcareous sponges are frequently very small and have cryptic habitats, living in caves or crevices or under rocks or sessile animals like tunicates and corals. These hidden habitats complicate the collection of specimens, which by necessity has to be by indirect means, and only scuba diving and snorkelling permit an efficient study of these animals.

We collected Calcareous sponges from Arraial do Cabo, a small village 170 km North of Rio de Janeiro, by scuba diving and snorkelling in different seasons over a period of 13 years. Arraial do Cabo is a particularly interesting locality for the study of marine organisms. It has two very distinct environments: a tropical shallow-water bay (20 m depth), with warm water (22 °C), called "Oasis Coralino", and a subtropical coast (50-70 m depth), exposed to an upwelling, where the water is cold (12 °C) and rich in nutrients (Fig. 1) (Hajdu *et al.* 1992). These two distinct environments are thought to be responsible for the diversified marine fauna of the region. Although sponges are very abundant, they are poorly known. The few studies that have been carried out on the sponge fauna of Arraial do Cabo (Mothes de Moraes 1985; Muricy 1989; Muricy *et al.* 1991; Hajdu *et al.* 1992) resulted in the discovery of several new records for the Atlantic and new species to science. Our research will be the first one dedicated to the study of Calcareous sponges from that region. As many of the specimens studied are new for science, we decided to include only the species of the genus *Clathrina* in this article.

The genus *Clathrina* has the simplest organisation among sponges: it has an asconoid aquiferous system, tubular form, and its skeleton is composed of few spicule types, which can be diactines, triactines and/or tetractines. As a result of this paucity of morphological characters, the classification of *Clathrina* is far from being clearly established, and many of the species are defined essentially by negative characteristics. Divergent interpretations on morphological differences among the studied specimens created two mainstream classification strategies. Traditionally, a relatively high variability of morphological characteristics was admitted, and a broad geographical distribution of species was associated with the variations in spicule size and in relative abundance of certain spicule types. More recently, comparative cytologic and genetic studies have shown that the variability was frequently overestimated, and that similar sponges can have distinct cytological and biochemical characteristics

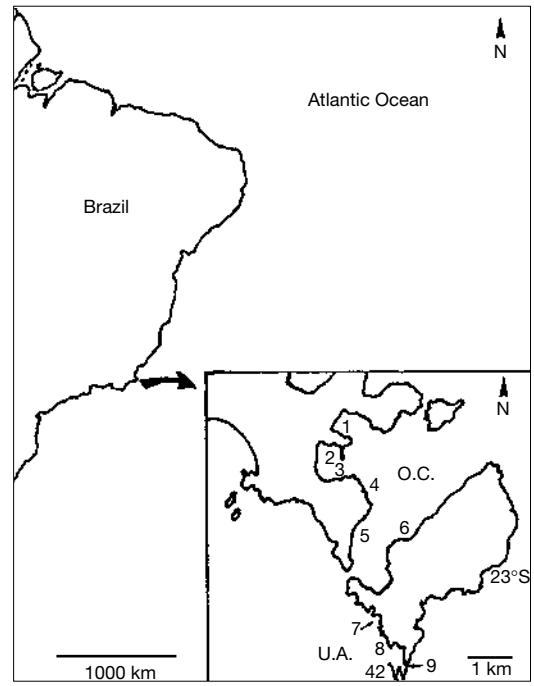

FIG. 1. — Map of the Brazilian Coast with Arraial do Cabo in detail and the 9 collection sites (numbered). Abbreviations: **O.C.**, Oasis Coralino; **1**, Forno; **2**, Harbour; **3**, Anjos; **4**, Enseada; **5**, Pontal do Atalaia; **6**, Pedra Vermelha U.A., Upwelling Area; **7**, Gruta Azul; **8**, Saco da Saia; **9**, Focinho do Cabo.

(Boury-Esnault *et al.* 1999). In order to validate the use of morphological characteristics in Calcarea, we decided to address the question of the plasticity and real specific differences in the genus *Clathrina*, and we have analysed allopatric and sympatric populations of a selected set of species of *Clathrina* by allozyme electrophoresis. In previous works we described how small morphological differences frequently corresponded to clear genetic differences among the species of the genus (Solé-Cava *et al.* 1991; Klautau *et al.* 1994), and we have given preliminary descriptions of several new species from the studied region. In the present work, we are giving the full morphological descriptions of the *Clathrina* species of Arraial do Cabo, including a series of new species: *Clathrina ascandroides* Borojevic, 1971; *Clathrina aspina* Klautau, Solé-Cava & Borojevic, 1994; *Clathrina aurea* Solé-Cava,

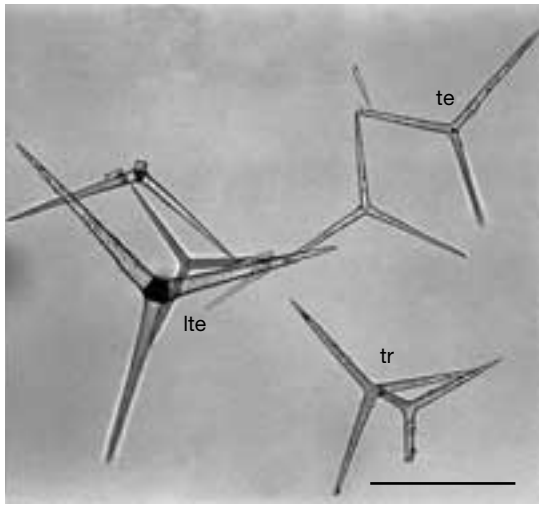

FIG. 2. — *Clathrina ascandroides* Borojevic, 1971, spicules. Abbreviations: **tr**, triactines; **te**, tetractines; **lte**, large tetractines. Scale bar: 200 µm.

Klautau, Boury-Esnault, Borojevic & Thorpe, 1991; *Clathrina brasiliensis* Solé-Cava, Klautau, Boury-Esnault, Borojevic & Thorpe, 1991; *Clathrina conifera* n. sp.; *Clathrina cylindractina* Klautau, Solé-Cava & Borojevic, 1994; *Clathrina quadriradiata* n. sp.; *Clathrina tetractina* n. sp.

MATERIAL AND METHODS

The sponges were collected by scuba diving or snorkelling in different areas of Arraial do Cabo, Rio de Janeiro (Fig. 1). Observations about the habitat of each specimen and the external features were made immediately and, whenever possible, in situ underwater photographs were taken to help us in the description of the cormus.

The specimens were fixed for 24 hours in a solution 3% formaldehyde in seawater. After fixation, they were rinsed with distilled water and stored in 80% ethanol.

Several specimens were analysed during this work. Each specimen was first observed under a stereoscopic microscope for the analysis of the anastomosis pattern of the cormus and the presence or absence of water-collecting tubes.

For the analysis of the spicules, small pieces of the cormus were dissolved in sodium hypochloride. After digestion, the spicules were washed in distilled water five times and twice in absolute ethanol. Several drops of ethanol containing the spicules were transfered to microscope slides and the ethanol was heat-evaporated. "Entellan" (Merck) was used as the mounting medium.

Sections of the specimens were prepared for the observation of the organisation of the skeleton, and for the presence or absence of characteristic cells. To make the sections, a small piece of the cormus was stained with an alcoholic solution of acid Fuchsin for 20 minutes. Excess Fuchsin was removed by rinsing the sponge fragment in absolute ethanol. The fragment was clarified in xylene for one hour and transferred to molten paraffin wax for one hour at 60 °C. The fragment of sponge was embedded in paraffin wax and sectioned with a microtome (Stiassnie) at various thicknesses. Sections were transferred to a microscope slide and the paraffin wax was removed with xylene. "Entellan" was used as mounting media.

Photographs of the spicules and sections were taken with an Olympus microscope. For the micrometry analyses we measured the base of the facial actines and also the base of the apical actine, in the case of the tetractines. All these measurements were taken using a micrometric ocular. The results of the micrometry of the spicules are presented as tables after the description of each species.

SYSTEMATICS

Class CALCAREA Bowerbank, 1864
Subclass CALCINEA Bidder, 1898
Order CLATHRINIDA Hartman, 1958
Family CLATHRINIDAE Minchin, 1900

Genus *Clathrina* Gray, 1867

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

TABLE 1. — *Clathrina ascandroides* Borojevic, 1971, spicule size.

Spicule	Length (mm)				Width (µm)		n
	min	mean	σ	max	mean	σ	
Triactines	83	123	± 21	168	11	± 2	20
Tetractines	123	153	± 18	173	13	± 1	20
Apical actine	39	64	± 26	109	12	± 4	05
Large tetractines	183	204	± 18	225	23	± 2	20
Apical actine	63	95	± 26	152	34	± 12	09

TABLE 2. — Comparisons between specimens of *Clathrina ascandroides* Borojevic, 1971 currently described.

	Southeast of Brazil (type locality)	Northeast of Brazil	Bay of Biscay	Arraial do Cabo
Triactines	60-110 µm / 8-12 µm	30 -200 µm / 10-20 µm	142-164 µm / 13 mm	83-168 µm / 11 µm
Tetractines		80 -270 µm / 10-20 µm Apical actine: 45 µm	161-200 µm / 11.7-13 µm Apical actine: 52 µm / 5.2 µm	123-173 µm / 13 µm Apical actine: 64 µm / 12 µm
Large tetractines	300 µm / 40 µm	270-400 µm / 20-45 µm Apical actine: 160 µm	299-364 µm / 26.6-31.2 µm Apical actine: 62.4-114.4 µm / 15.6-20.8 µm	183-225 µm / 23 µm Apical actine: 95 µm / 34 µm

DIAGNOSIS. — Clathrinidae in which the choanoderm is flat or occasionally raised up into conuli by the apical actines of large tetractines, but it 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 (Borojevic *et al.* 1990).

Clathrina ascandroides Borojevic, 1971 (Fig. 2; Table 1)

Clathrina ascandroides Borojevic, 1971: 527, figs 6; 7.

TYPE MATERIAL. — Holotype, attached to *Laminaria brasiliensis*, coll. by H. de Souza Lima, Museu Nacional do Rio de Janeiro (MNRJ 2096).

TYPE LOCALITY. — Cabo de São Tomé, Rio de Janeiro, Brazil.

MATERIAL EXAMINED. — **Oasis Coralino.** Harbour, Forno and Pedra Vermelha, several specimens collected in crevices or under rocks held together by the soft coral *Palythoa* sp., 1 to 3 m depth.

DESCRIPTION

Specimens of this species are white in life but become brown in alcohol or when frozen. The cormus is composed of large, loosely anastomosed tubes, which are free in the apical region. Oscula are spread through the tubes and there are no water-collecting tubes. The histological sections showed no special characteristics.

The skeleton is composed of triactines and two populations of tetractines (Fig. 2), the triactines being the most abundant spicules. Spicules (Table 1) are equiangular and equiradiate, but parasagittal spicules can also be found. The triactines and the smaller tetractines are of the same size. Their actines are cylindrical or slightly conical with a sharp end. These small spicules are localised outside the tubes, giving them a smooth surface. The apical actine of the tetractines is conical, smooth, thinner and shorter than the facial actines. It projects inside the tubes. The large tetractines surround the interior of the tubes, and also project their apical actines into the central lumen. Actines are conical and sharp; the apical actine is straight and smooth, shorter than the basal ones, with very sharp and thin end.

The habitat of this species is sciaphilous, and it can be easily found under rocks in the Oasis Coralino, in summer.

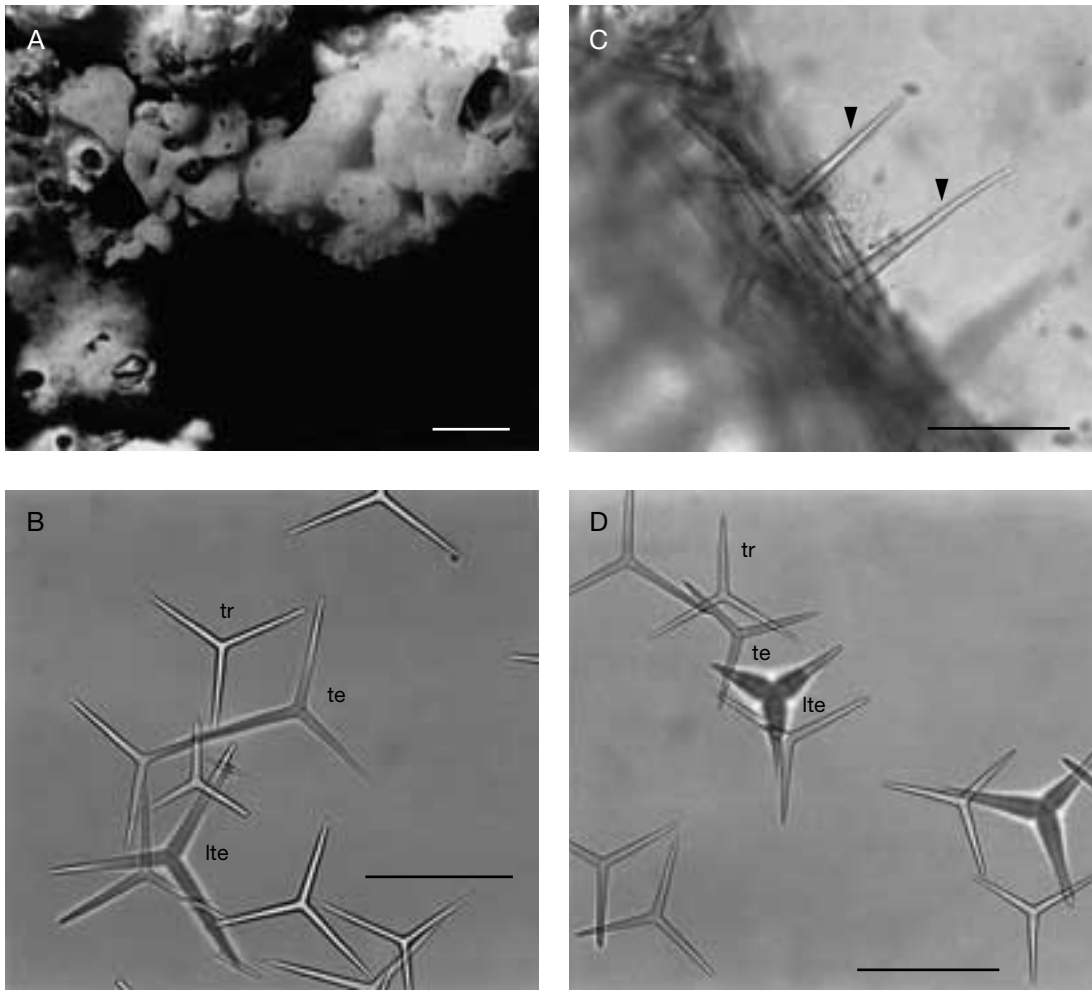

FIG. 3. — *Clathrina aspina* Klautau *et al.,* 1994*;* **A**, underwater photo by E. Hajdu; **B**, spicules, holotype (BMNH 1999.9.16.3); **C**, apical actine of the tetractines (arrow), holotype; **D**, spicules, another specimen. Abbreviations: **tr**, triactines; **te**, tetractines; **lte**, tripods as large triactines. Scale bars: A, 1 cm; B, D, 100 µm; C, 50 µm.

REMARKS

Clathrina ascandroides was first described in 1971 by Borojevic, who found some specimens of this species attached to *Laminaria brasiliensis*, from Cabo de São Tomé (Rio de Janeiro). This species is very similar to *C. atlantica*, although it differs from that species in the absence of diactines. In the original description, Borojevic (1971) did not distinguish between the two populations of tetractines (Table 2).

Later on, Borojevic and Peixinho (1976) cited this species from the Northeast of Brazil and, at that time, they distinguished between the two tetractine populations (Table 2).

In 1987, Borojevic and Boury-Esnault widened the distribution of *C. ascandroides*, describing it from the Bay of Biscaye, France (Table 2), which gave to this species an amphi-atlantic distribution.

TABLE 3. — *Clathrina aspina* Klautau *et al.*, 1994, spicule size.

Spicule	Length (µm)				Width (µm)		n
	min	mean	σ	max	mean	σ	
Triactines	55	70	± 8	80	6	± 1	30
Tetractines	53	69	± 8	83	6	± 1	30
Apical actine	40	50	± 6	63	5	± 0	30
Tripods	63	79	± 9	93	10	± 1	30

Clathrina aspina
Klautau, Solé-Cava & Borojevic, 1994
(Fig. 3; Table 3)

Clathrina aspina Klautau *et al.*, 1994: 373, tabs 1; 2, fig. 4.

TYPE MATERIAL. — Holotype, 13.VI.1987, coll. G. Muricy, The Natural History Museum, London (BMNH 1999.9.16.3).

TYPE LOCALITY. — Arraial do Cabo (Gruta Azul), Rio de Janeiro, Brazil.

ETYMOLOGY. — From the Latin *spina:* spine; *a*, from the Greek prefix of negation. For the absence of spines in the apical actine.

MATERIAL EXAMINED. — **Upwelling Area.** Gruta Azul and **Oasis Coralino.** Forno, Enseada, several specimens collected on the walls of a cave.

DESCRIPTION
Specimens of this species have a white compact cormus in life and in alcohol. It is composed of thin, regular and tightly anastomosed tubes. Oscula are simple apertures surrounded by a thin membrane. They are localised on the top of conical projections distributed throughout the cormus and receive the excurrent water from water-collecting tubes (Fig. 3A). In fixed specimens it is difficult to recognise the oscula. No special characteristic was found on the histological sections.

The skeleton is composed of triactines, tetractines and tripods (Fig. 3B). Triactines and tetractines are equiangular and equiradiate, but parasagittal spicules are also present. They have no special organisation. Actines are conical and blunt at the end. The apical actine of the tetractines (Fig. 3C) is shorter and thinner than the facial ones (Table 3), conical, sharp and smooth. It is always projected into the lumen of the tubes. Tripods are mainly large conical triactines in the holotype, however, typical tripods (Fig. 3D), with a raised centre and conical actines can be found in other specimens of *C. aspina*. They are localised on the external tubes, delimiting the cormus.

C. aspina has sciaphile habitat, being found in caves, crevices and under the soft coral *Palythoa* sp. It is abundant in the Oasis Coralino and in the upwelling habitat of the Gruta Azul.

REMARKS
C. aspina is very similar to another species found in Arraial do Cabo, *C. brasiliensis*. Both species have the same cormus organisation and the same type of spicules. However, the apical actine of the tetractines of *C. brasiliensis* is covered with spines, while in *C. aspina* the apical actine is smooth. We have already compared specimens from both populations using allozyme electrophoresis (Klautau *et al*. 1994), and our results showed that, even when living in sympatry, there is no gene flow between them.

Clathrina aurea
Solé-Cava, Klautau, Boury-Esnault, Borojevic & Thorpe, 1991
(Fig. 4; Table 4)

Clathrina aurea Solé-Cava *et al.*, 1991: 382, tabs 1; 2.

TYPE MATERIAL. — Holotype, 15.XI.1987, coll. E. Hajdu, Muséum national d'Histoire naturelle, Paris (LBIM.C.1989.1).

TYPE LOCALITY. — Arraial do Cabo (Anjos), Rio de Janeiro, Brazil.

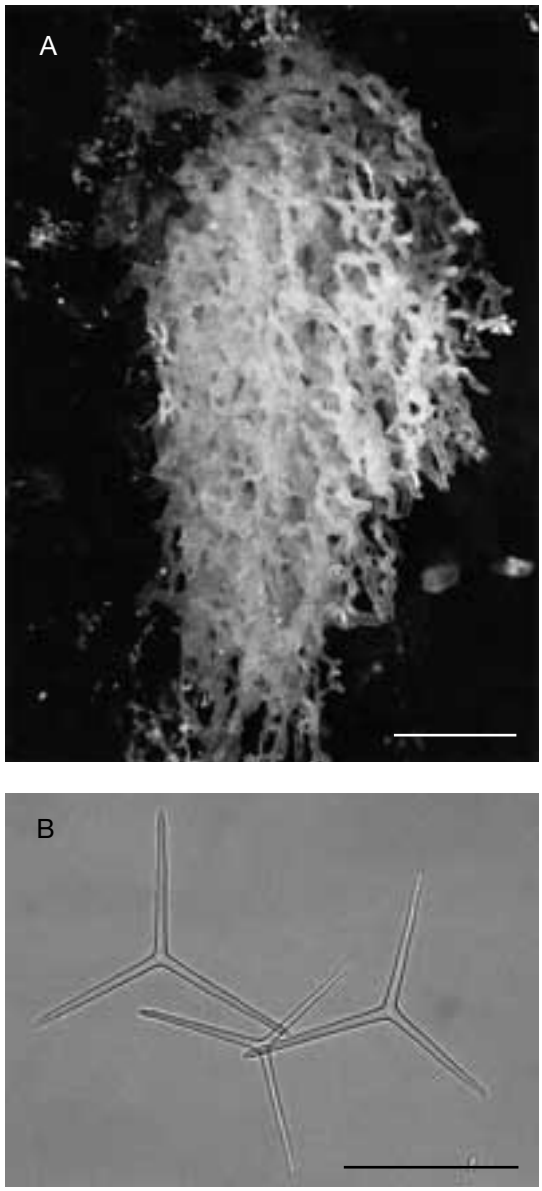

FIG. 4. — *Clathrina aurea* Solé-Cava *et al.*, 1991; **A**, underwater photo by E. Hajdu; **B**, spicules, holotype (LBIM.C.1989.1), triactines. Scale bars: A, 1 cm; B, 100 µm.

ETYMOLOGY. — From Latin *Aureus:* golden. For the yellow colour of the cormus.

MATERIAL EXAMINED. — **Oasis Coralino.** Forno, Anjos, Enseada, Pontal do Atalaia, Pedra Vermelha, several specimens collected in small crevices in the Oasis Coralino.

DESCRIPTION

Living specimens of this species have a clathrate golden-yellow cormus, which becomes beige in alcohol. The cormus is composed of large, irregular and loosely anastomosed tubes, where several oscula are spread. No water-collecting tubes are present (Fig. 4A). Special characteristics were not found on the histological slides.

The skeleton has no special organisation. It is composed of equiangular and equiradiate triactines (Fig. 4B; Table 4). Actines are characteristically undulated at the distal part, and their ends are rounded.

C. aurea is common in the warm water of the Oasis Coralino. Its habitat is sciaphilous which means it is exposed to very little sunlight, and protected from the action of waves. It is frequently found on the roof of small caves or in crevices.

REMARKS

Clathrina aurea is morphologically very similar to its sibling *C. clathrus* (Schmidt, 1864) from the Mediterranean Sea. Both species are yellow and have only triactines with undulate actines and rounded ends. Comparing both populations by allozyme analysis (Solé-Cava *et al.* 1991), we found very low levels of genetic identity between them, indicating no gene flow between the Mediterranean and the Atlantic populations and, consequently, no cospecificity. Although they are morphologically very similar, some differences can be recognised between specimens of the two species. The spicules of *C. clathrus* are larger

TABLE 4. — *Clathrina aurea* Solé-Cava *et al.*, 1991, spicule size.

Spicule	Length (µm)				Width (µm)		n
	min	mean	σ	max	mean	σ	
Triactines	65	74	± 5	83	6	± 1	30

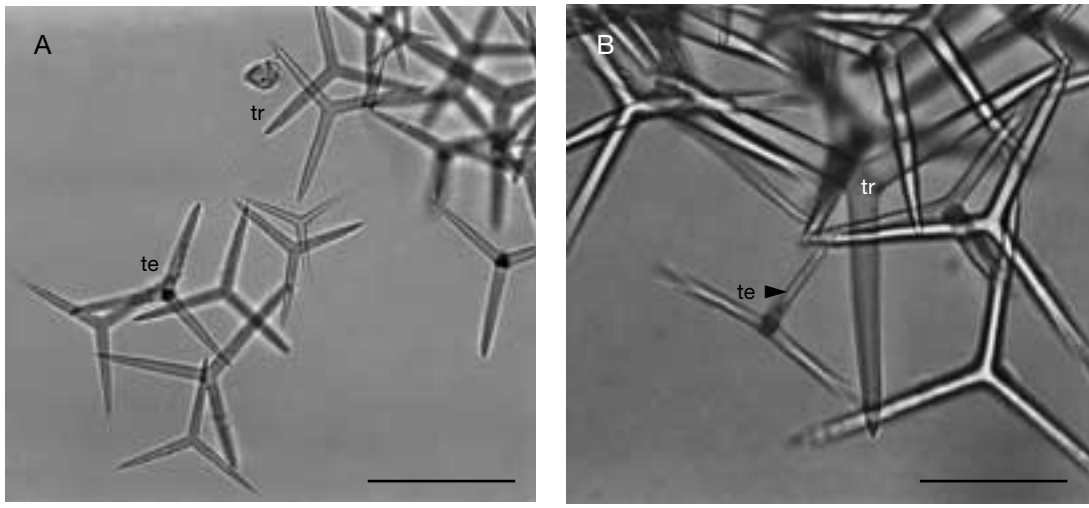

FIG. 5. — *Clathrina brasiliensis* Solé-Cava *et al.*, 1971, holotype (LBIM.C.1989.2); **A**, spicules; **B**, tripod, as a large triactine and the spined apical actine of a tetractine. Abbreviations: **tr**, triactines; **te**, tetractines. Scale bars: A, 100 µm; B, 50 µm.

TABLE 5. — *Clathrina brasiliensis* Solé-Cava *et al.*, 1971, spicule size.

Spicule	Length (µm)				Width (µm)		n
	min	mean	σ	max	mean	σ	
Triactines	61	78	± 11	102	11	± 2	20
Tetractines	57	75	± 10	91	10	± 1	20
Apical actine	17	36	± 9	50	8	± 2	20
Tripods	67	81	± 8	96	11	± 2	20

(92 µm [± 7 µm] / 6 µm [± 1 µm]) than those of *C. aurea.* Moreover, the organisation of the cormus in each species is different. While *C. aurea* has several oscula spread through the tubes, *C. clathrus* has water-collecting tubes, i.e. tubes that collect the excurrent water and conduct it to a few apical oscula. We could also consider the shape of the end of the actines, which is more rounded and protuberant in *C. clathrus* than in *C. aurea*.

Another species that can be confused with *C. aurea* is its New Caledonian sibling *C. chrysea* Borojevic & Klautau, 2000. *C. chrysea* also has no water collecting tubes. However, instead of triactines with round ended actines, the triactines of *C. chrysea* are sharp and they are larger (105 µm [± 9 µm] / 10 µm [± 1 µm]) than those of *C. clathrus*.

Clathrina brasiliensis
Solé-Cava, Klautau, Boury-Esnault, Borojevic & Thorpe, 1991
(Fig. 5; Table 5)

Clathrina brasiliensis Solé-Cava *et al.,* 1991: 382, tabs 1; 2.

TYPE MATERIAL. — Holotype, 16.XII.1986, coll. G. Muricy, Muséum national d'Histoire naturelle, Paris (LBIM.C.1989.2).

TYPE LOCALITY. — Arraial do Cabo (Enseada), Rio de Janeiro, Brazil.

ETYMOLOGY. — For the type locality.

MATERIAL EXAMINED. — **Oasis Coralino.** Enseada and the **Upwelling Area.** Gruta Azul, some specimens collected under rocks held together by *Palythoa* sp. and on the walls of the Gruta Azul.

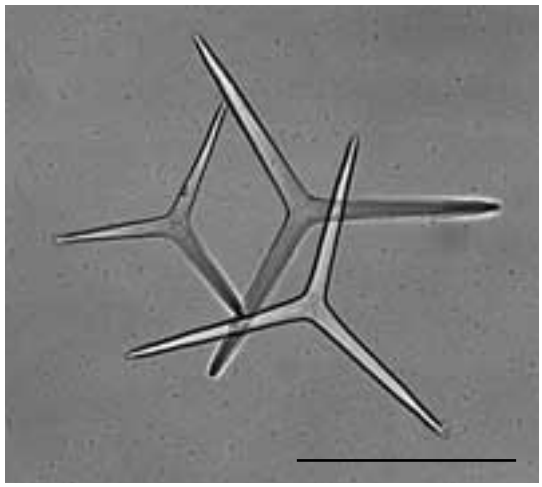

FIG. 6. — *Clathrina conifera* n. sp., holotype (BMNH 1999.9.16.19), spicules. Scale bar: 100 µm.

DESCRIPTION

Specimens of this species are white in life and in alcohol. The cormus is composed of thin, regular and tightly anastomosed tubes. Oscula are simple apertures surrounded by a thin membrane, and localised on the top of conical projections. They receive the water from water-collecting tubes. No special characteristic features were found on the histological slides.

Three types of spicules compose the skeleton: triactines, tetractines (Fig. 5A) and tripods (Fig. 5B). The triactines and the tetractines are equiradiate and equiangular, with conical actines and blunt ends. They have no special organisation. The apical actine of the tetractines (Fig. 5B) is shorter and thinner than the basal ones, and it is conical, sharp and covered with short spines. The apical actine is always projected into the tubes. Tripods are less equiangular, sometimes they are even sagittal. They have frequently their centre arisen, but sometimes they only appear as large conical triactines. They are strictly localised on the surface of the external tubes, delimiting the cormus. *C. brasiliensis* has a sciaphile habitat, and can be found under rocks; under the soft coral *Palythoa* sp. in the Oasis Coralino; and also on the walls of the Gruta Azul.

REMARKS

Specimens of *C. brasiliensis* are morphologically very similar to the specimens of *C. cerebrum* from the Adriatic and the Mediterranean Sea. They were recognised as distinct species only after genetic studies (Solé-Cava *et al.* 1991), which have shown that there was no gene flow between these two populations. They are morphologically very similar indeed. The only differences we could find to date are the size of the spicules (Table 5), a little longer and thinner in the Mediterranean specimens (triactines: 85 [± 7] / 7 [± 1] µm; tetractines: 83 [± 9] / 7 [± 1] µm; tripods: 89 [± 15] / 11 [± 2] µm); and the size of the spines of the apical actine, which is also larger in *C. cerebrum*.

Clathrina conifera n. sp.
(Fig. 6; Table 6)

Clathrina primordialis (Haeckel, 1872) *in* Klautau *et al.*, 1994: 372, tabs 1; 2, fig. 1.

TYPE MATERIAL. — Holotype, 15.XI.1987, coll. G. Muricy, The Natural History Museum, London (BMNH 1999.9.16.19).

TYPE LOCALITY. — Arraial do Cabo (Anjos), Rio de Janeiro, Brazil.

ETYMOLOGY. — From Latin *conifer*: cone-bearing. For the shape of the actines.

MATERIAL EXAMINED. — **Oasis Coralino.** Forno, Anjos, Enseada and the **Upwelling Area.** Saco da Saia,

TABLE 6. — *Clathrina conifera* n. sp., spicule size.

Spicule	Length (µm)				Width (µm)		n
	min	mean	σ	max	mean	σ	
Triactines	63	77	± 9	98	9	± 1	30

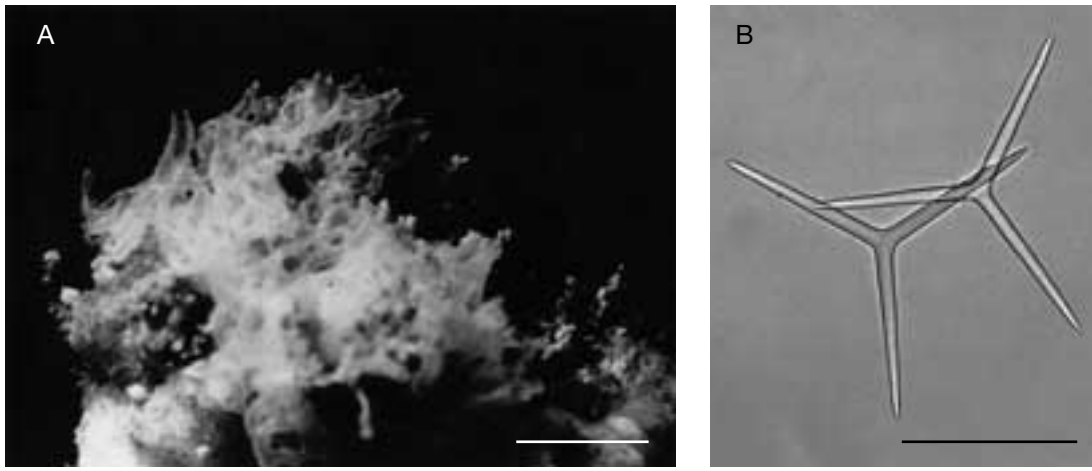

FIG. 7. — *Clathrina cylindractina* Klautau *et al.,* 1994*;* **A**, underwater photo by E. Hajdu; **B**, spicules, holotype (BMNH 1999.9.16.21), triactines. Scale bars: A, 1 cm; B, 100 µm.

TABLE 7. — *Clathrina cylindractina* Klautau *et al.*, 1994, spicule size.

Spicule	Length (µm)				Width (µm)		n
	min	mean	σ	max	mean	σ	
Triactines	48	84	± 12	100	8	± 1	30

Focinho do Cabo, several specimens collected under rocks and under the soft coral *Palythoa* sp.

DESCRIPTION

The cormus of this species is white in life and in alcohol. It is composed of large, irregular and loosely anastomosed tubes. Oscula are distributed throughout the cormus and no water-collecting tubes are present. The massive, delicate cormus becomes a mass of loose tubes spread on rocks when the sponge is young. No special characters were found on the histological slides.

One kind of spicule composes the skeleton, which has no special organisation: the triactine (Fig. 6; Table 6). Triactines are equiangular and equiradiate, and their actines are straight and conical, with blunt ends.

C. conifera n. sp. is very abundant in the Oasis Coralino, particularly in summer. Its habitat is sciaphilous. Specimens are frequently found under rocks or other animals, such as other sponges, tunicates (*Ascidia*) and soft corals (*Palythoa* sp.).

REMARKS

The species we now name *C. conifera* n. sp., we described in a previous article (Klautau *et al.* 1994) as *C. primordialis* (Haeckel, 1872). In Haeckel's description of *C. primordialis*, he did not give the type locality of this species, but indicated several origins, including Rio de Janeiro (Brazil). As the holotype of this species was considered to have disappeared, and the specimen from Arraial do Cabo had a morphology that matched with the description given by Haeckel as *C. primordialis*, we suggested Rio de Janeiro should become the type locality of this species.

However, two types of *C. primordialis* were finally found last year, one in the Phyllestische Museum, in Jena (Germany) (I.N.P. 154), and the other in the Zoological Museum of Berlin (Z.M.B. 1306). The specimen from Jena was collected in Lesina,

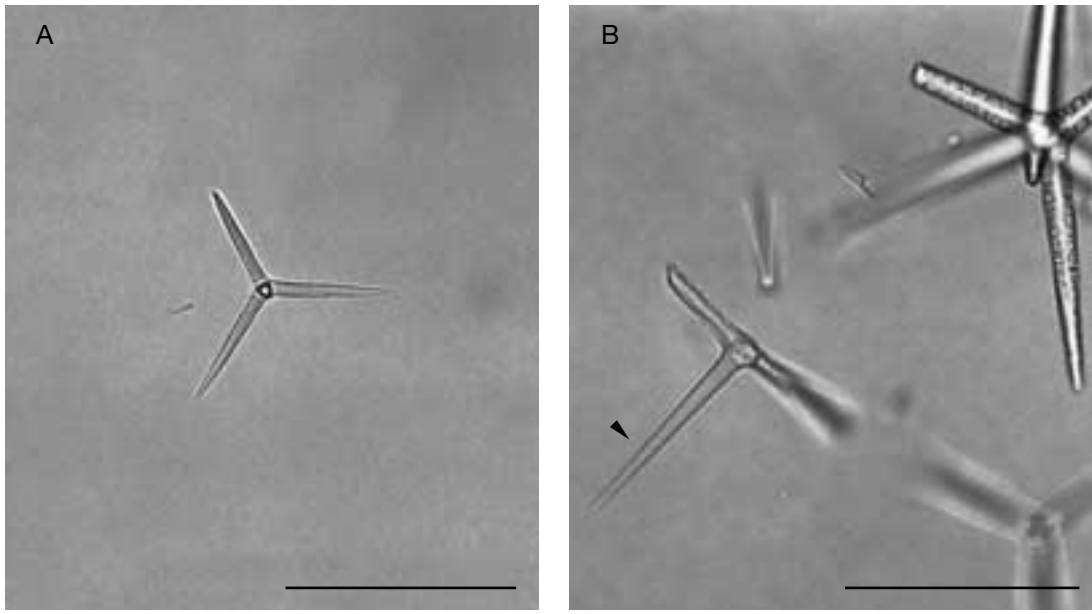

FIG. 8. — *Clathrina quadriradiata* n. sp., holotype (BMNH 1999.9.16.30); **A**, spicule, tetractine; **B**, apical actine (arrow) of a tetractine. Scale bars: A, 100 µm; B, 50 µm.

TABLE 8. — *Clathrina quadriradiata* n. sp., spicule size.

Spicule	Length (µm)				Width (µm)		n
	min	mean	σ	max	mean	σ	
Triactines	48	56	± 5	68	6	± 1	30
Tetractines	43	54	± 5	63	6	± 1	30
Apical actine	20	35	± 8	55	4	± 1	30

the Adriatic Sea, while the specimen from Berlin was collected in Naples. Studying both specimens and comparing them to the original description of *primordialis*, we elected the specimen from Naples as the neotype of *C. primordialis* (further details will be published in a revision of the Genus *Clathrina*, which is being prepared by Klautau and Valentine). Consequently, Rio de Janeiro is not the type locality of this species. Comparing the neotype of *C. primordialis* to the specimens from Arraial do Cabo, we found some important morphological differences in the shape and size of the spicules. *C. primordialis* has two populations of triactines: triactines with conical actines (132 [± 22] / 15 [± 2 µm]) and triactines with cylindrical actines (131 [± 17] / 12 [± 1 µm]), while *C. conifera* n. sp. has only spicules with shorter conical actines.

C. conifera n. sp. is also morphologically similar to another species from Arraial do Cabo: *C. cylindractina*. These species live in sympatry and have similar morphology (morphologies). However, the actines of the triactines of *C. cylindractina* are more cylindrical and not conical as in *C. conifera* n. sp. Analysing both populations by allozyme electrophoresis, we found no gene flow between them (Klautau *et al.* 1994).

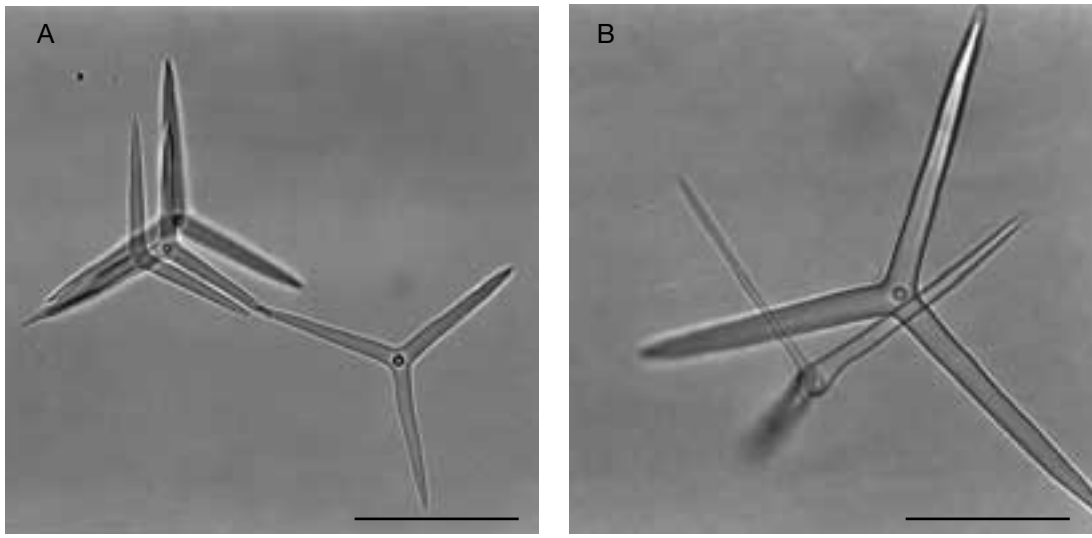

FIG. 9. — *Clathrina tetractina* n. sp., holotype (BMNH 1999.9.16.33); **A**, spicules of tetractines; **B**, apical actine (arrow) of a tetractine. Scale bars: A, 100 µm; B, 50 µm.

TABLE 9. — *Clathrina tetractina* n. sp., spicule size.

Spicule	Length (µm)				Width (µm)		n
	min	mean	σ	max	mean	σ	
Tetractines	63	88	± 10	108	10	± 1	30
Apical actine	33	71	± 18	105	4	± 1	30

Clathrina cylindractina
Klautau, Solé-Cava & Borojevic, 1994
(Fig. 7; Table 7)

Clathrina cylindractina Klautau *et al.*, 1994: 372, tabs 1; 2, fig. 2.

TYPE MATERIAL. — Holotype, 20.VIII.1987, coll. G. Muricy, The Natural History Museum, London (BMNH 1999.9.16.21).

TYPE LOCALITY. — Arraial do Cabo (Anjos), Rio de Janeiro, Brazil.

ETYMOLOGY. — From Latin C*ylindrus*: cylinder. For the shape of the actines.

MATERIAL EXAMINED. — **Oasis Coralino.** Forno, Anjos, several specimens collected under rocks and in small crevices.

DESCRIPTION

Specimens of this species are white in life and in alcohol. The cormus is very delicate, composed of large, irregular and loosely anastomosed tubes. Oscula are spread through the cormus and no water-collecting tubes are present (Fig. 7A). No special characteristics were found on the histological sections.

The skeleton has no special organisation. It is composed of equiangular and equiradiate triactines (Fig. 7B; Table 7). Actines are straight, cylindrical to conical, with blunt ends.

This species is very abundant in the Oasis Coralino, particularly on summer. Its habitat is sciaphilous and protected from the waves. Specimens can be found under rocks and other organisms,

such as sponges, tunicates (*Ascidia*) and soft coral (*Palythoa*).

REMARKS
C. cylindractina is morphologically very similar to *C. conifera* n. sp. as previously discussed. However, their status as distinct, valid species was demonstrated by allozyme electrophoresis (Klautau *et al.* 1994), showing that, even living in sympatry, they do not exchange genes.

Clathrina quadriradiata n. sp.
(Fig. 8; Table 8)

TYPE MATERIAL. — Holotype, 18.III.1990, coll. G. Muricy, The Natural History Museum, London (BMNH 1999.9.16.30).

TYPE LOCALITY. — Arraial do Cabo, Rio de Janeiro, Brazil.

ETYMOLOGY. — From the Latin *Quatuor*: four. For the presence of tetractine as main spicule.

MATERIAL EXAMINED. — **Oasis Coralino.** Forno, one specimen.

DESCRIPTION
The cormus of this species is white in life and in alcohol. It is composed of very thin, regular and tightly anastomosed tubes. Oscula are simple openings located on the top of conical projections, receiving the excurrent-water from several water-collecting tubes. No relevant features were found on the histological sections.
The skeleton has no special organisation. It is composed of tetractines (Fig. 8A) and a few triactines. Actines are straight and conical, with blunt ends. The apical actine of the tetractines (Fig. 8B) is only a little thinner than the facial ones at the base. It is also shorter, conical, sharp and smooth.
Only one specimen of this species was collected, and it was from the Oasis Coralino. The habitat of this species is sciaphilous.

REMARKS
This species resembles *C. aspina* and *C. brasiliensis*. However, it has no tripods and tetractines are more abundant than triactines, while in the two other species, triactines are the main spicule. The anastomosis of the tubes is also different, being less regular in *C. quadriradiata* n. sp.

Clathrina tetractina n. sp.
(Fig. 9; Table 9)

TYPE MATERIAL. — Holotype, 14.VI.1987, coll. G. Muricy, The Natural History Museum, London (BMNH 1999.9.16.33).

TYPE LOCALITY. — Arraial do Cabo (Pedra Vermelha), Rio de Janeiro, Brazil.

ETYMOLOGY. — From the Greek *Tetra*: four. For the presence of only tetractines.

MATERIAL EXAMINED. — **Oasis Coralino.** Pedra Vermelha, one specimen.

DESCRIPTION
The cormus of this species is white in life and in alcohol. It is composed of large, irregular and loosely anastomosed tubes. Large superficial tubes (water-collecting tubes) collect the excurrent water, converging to a few apical oscula. No special characteristics were found on the histological sections.
The skeleton has no special organisation, and it is composed only of tetractines (Fig. 9A), although a few, rare triactines can be found. Spicules are equiradiate and equiangular, but parasagittal spicules are also present. Actines are conical, with sharp ends, and they are slightly undulated at the distal part. The apical actine of the tetractines (Fig. 9B; Table 9) is very thin even at the base. It is straight, sharp, long and smooth, and it is projected into the tubes.
Only one specimen of this species was found in the Oasis Coralino. This species has a sciaphilous habitat.

REMARKS
This species is morphologically similar to *C. contorta* (Bowerbank, 1886) in the shape of the tetractines, particularly the apical actine, which is very thin and long. However, it has no triactines or diactines as in *C. contorta*.
In relation to *C. quadriradiata* n. sp., the only similarity is the presence of tetractines as main spicule. The shape of the actines (including the

apical actine), however, is different, as is their size. Moreover, while triactines can be found in *C. quadriradiata* n. sp., in *C. tetractina* n. sp. they are very rare.

KEY OF *CLATHRINA* SPECIES FROM ARRAIAL DO CABO

1. Skeleton composed of only triactines 2
— Skeleton has tetractines 4

2. Actines are only conical ..... *C. conifera* n. sp.
— Cylindrical actines are present 3

3. Actines are undulated and rounded at the tip ..... *C. aurea*
— Actines are straight and blunt at the tip ..... *C. cylindractina*

4. Tripods are present 5
— No tripods 6

5. The apical actine of the tetractines has spines ..... *C. brasiliensis*
— The apical actine of the tetractines is smooth ..... *C. aspina*

6. There is one population only of tetractines 7
— There are more than one population of tetractines ..... *C. ascandroides*

7. The apical actine of the tetractines is conical ..... *C. quadriradiata* n. sp.
— The apical actine of the tetractines is cylindrical ..... *C. tetractina* n. sp.

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