New *Tethya* species (Porifera, Demospongiae) from the Pacific area

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ABSTRACT
Four new species of the genus *Tethya* (Porifera, Demospongiae, Hadromerida) from different localities of the Pacific area are described. The new species are *T. ornata* n. sp. from Hawaii, *T. simi* n. sp. from Korea, *T. strongylata* n. sp. from the Galapagos and *T. topsenti* n. sp. from New Caledonia. *T. ornata* has a globose-ellipsoidal body with small conical tubercles. Spherasters, placed in the middle and inner cortical layers, are extremely variable in size and shape with truncated, forked, bent or rounded rays. Micrasters are tylasters, sometimes strongylasters, similar in the cortex and choanosome. *T. simi* has a globose body with flattened tubercles. Spherasters, placed in the whole cortex, have short, often apically bent or forked rays. Cortical micrasters are tylasters 8-12 µm, choanosomal micrasters oxyasters 15-20 µm in diameter. *T. strongylata* has a globose body with flattened tubercles. Strongyloxeas, often transformed in anisostrongyles, may be shortened in plump styles, anisostrongyles and styles. Spherasters, placed in the whole cortex, more densely in the inner layer and scatterly in the choanosome, have short rays often distorted, forked, spined or reduced to hemispherical outgrowths. Micrasters are tylasters, similar in the cortex and choanosome. *T. topsenti* has a body irregularly globose with indented tubercles and large cortical lacunes. Strongyloxeas, often transformed in anisostrongyles, run obliquely to the sponge surface. Spherasters, placed in the whole cortex and scatterly in the choanosome, are variable in size and shape and sometimes with flask-shaped rays. Micrasters are tylasters, similar in the cortex and choanosome with thick rays and swollen tylote tips.

KEY WORDS
Porifera,
systematics,
new species,
Tethya,
Pacific area.

RÉSUMÉ

Nouvelles espèces de Tethya (*Porifera, Demospongiae*) *du Pacifique.*

Quatre nouvelles espèces du genre *Tethya* (Porifera, Demospongiae, Hadromerida) sont décrites de diverses localités de la zone Pacifique. Les nouvelles espèces sont *T. ornata* n. sp. d'Hawaii, *T. simi* n. sp. de Corée, *T. strongylata* n. sp. des Galapagos et *T. topsenti* n. sp. de Nouvelle-Calédonie. *T. ornata* a un corps globulaire ellipsoïdal avec de petits tubercules coniques. Les sphérasters, présents dans la couche corticale médiane et interne, sont de dimensions et de formes très variables, avec des actines tronquées, fourchues, courbées ou arrondies. Les micrasters sont des tylasters, parfois des strongylasters, identiques dans le cortex et dans le choanosome. *T. simi* a un corps globulaire avec des tubercules aplatis. Les sphérasters, présents dans l'ensemble du cortex, ont des actines courtes, souvent courbées ou fourchues à l'extrémité. Les micrasters corticaux sont des tylasters de 8-12 µm de diamètre, les micrasters choanosomaux sont des oxyasters de 15-20 µm. *T. strongylata* a un corps globulaire avec des tubercules aplatis. Les strongyloxes, souvent transformés en anisostrongyles, peuvent être raccourcis en styles renflés, en anisostrongyles et styles. Les sphérasters, présents dans l'ensemble du cortex mais plus densément dans la couche interne et dispersés dans le choanosome, ont des actines courtes souvent déformées, fourchues, épineuses ou réduites à des excroissances hémisphériques. Les micrasters sont des tylasters identiques dans le cortex et le choanosome. *T. topsenti* a un corps irrégulièrement globulaire, avec des tubercules dentelés et de grandes lacunes corticales. Les strongyloxes, souvent transformés en anisostrongyles, sont dirigés obliquement vers la surface de l'éponge. Les sphérasters, présents dans l'ensemble du cortex et dispersés dans le choanosome, sont de taille et de forme variable, parfois avec des actines en forme de bouteille. Les micrasters sont des tylasters identiques dans le cortex et le choanosome, avec des actines épaisses à extrémités renflées.

MOTS CLÉS
Porifera,
taxonomie,
nouvelles espèces,
Tethya,
région Pacifique.

INTRODUCTION

Four new species of *Tethya* from different Pacific localities are described here: *T. ornata* from Hawaii, *T. simi* from Korea, *T. strongylata* from the Galapagos and *T. topsenti* from New Caledonia. *T. strongylata* and *T. topsenti* are described from specimens located respectively in the Museum of Natural History of London (BMNH) and in the Muséum national d'Histoire naturelle of Paris (MNHN), *T. ornata* and *T. simi* from specimens sent to us by collectors and which are now deposited at the Museum of Natural History of Genova (MSNG).

With these new species, total number of *Tethya* known from the Pacific area amounts to 40 species, but there are considerable differences in numbers of species between different Pacific zones (Sarà 1998). Published records of species from the Australian, Tasmanian and New Zealand coasts amount to 21 and 8 species are known from Papua New Guinea where prolonged research at a single station has been performed (Sarà 1992). On the contrary, for the remaining Pacific, only 15 species were known prior to this work. The difference is in part due to the extraordinary concentration of *Tethya* species in the Australian and New Zealand waters but also to the very scanty research performed elsewhere. Besides the species of *Tethya* described here, only one species is known for the Hawaii and the Galapagos Islands, none for Korea and three for New Caledonia. A prolonged and methodic research also in these sites would certainly enlarge the present list.

ABBREVIATIONS USED
BMNH Natural History Museum, London;
MNHN Muséum national d'Histoire naturelle, Paris;
MSNG Museum of Natural History, Genova.

MATERIAL AND METHODS

All species were studied from Museum-based ethanol-preserved material and unfortunately notes on their characteristics in life and habitat conditions are scarce or lacking. Spicule slides obtained by dissolving the sponge fragments in boiling nitric acid, paraffin-embedded or hand transverse body sections were prepared in order to study spiculation and skeleton architecture. Electron micrographs under Scanning Electron Microscope SEM (Philips 515) were obtained to study spicule details. Spicule terminology follows Sarà (1994).

SYSTEMATICS

Family TETHYIDAE Gray, 1848
Genus *Tethya* Lamarck, 1814

Tethya ornata n. sp.

TYPE MATERIAL. — Holotype (MSNG 49675).

ETYMOLOGY. — After the frequent occurrence of spines and other anomalies of the spherasters.

TYPE LOCALITY. — **Coconut Island**. Hawaii, under floating dock, 0.5 m, 7.XII.1985, coll. P. Karuso.

DESCRIPTION

Morphology

Body globose (Fig. 1A), a little ellipsoidal with axes of 2.5 and 3 cm. Tubercles small, less than 1 mm high, and irregularly conical. Several tubercles support small stalked buds. Yellow ochre in alcohol, consistency firm. Choanosomal cavities host commensal polychaetes.

Skeleton (Fig. 2)

Megasclere bundles stout and not apically branched. Spherasters fill the middle and inner cortical layers, with larger spicules in the middle one. Few spherasters in the outer layer and absent in the choanosome. Microscleres cover the sponge surface (Fig. 1C) and the cavities and channels of the cortex and choanosome.

Spicules

Megascleres. (Fig. 1B) Main strongyloxeas 600-1600 × 10-25 µm and auxiliary strongyloxeas, often transformed in anisostrongyles and styles, 300-800 × 4-18 µm. The two categories, however, intergrade.

Megasters. Spherasters 25-100 µm in diameter, R/C (ratio between ray length and centre diameter) = 0.2-1.5. Their shape, as their size, is extremely variable (Fig. 1D-F). Their rays, 15-20, are very frequently spined, forked or truncated at the tip, sometimes bent or shortened and rounded. Each spheraster may express a different set of these abnormal traits. Normal spherasters are more frequent among the small spicules. Abnormal spherasters are the large majority of the full grown spicules. The rare large normal spherasters show 90-100 µm in diameter and R/C = 1.

Microsters. Generally tylasters (Fig. 1G-H), sometimes strongylasters similar in the cortex and choanosome. Generally 6-8 µm in diameter, but their size is heterogeneous with a range of 2-15 µm including some very small or large asters. Also their shape is variable and dependent on the presence or absence of an enlarged centrum, and by the development of the knob at the tips of the rays. There are eight to twelve rays and these generally have a well-developed spiny knob at the tip. Some very small microsters are irregularly shaped.

REMARKS

T. ornata is well characterized by the spinosity and other anomalies of the majority of its megasters, an exception in the genus *Tethya*. Only another species of *Tethya*, *T. tethya*, an encrusting species from the Hawaii Aquarium of Honolulu, has been described for the Hawaii Islands (Laubenfels 1954). It differs from *T. ornata* for its smaller spherasters without spines and the presence of oxyasters among the microsters. One of us (Sarà) has studied one specimen collected at Oahu, Black Point, labelled "*Tethya japonica*", in the California Academy of Sciences, Natural History Museum. Spicular slides show that it is not *T. japonica* but more likely *T. deformis* (Thiele 1898). Unfor-

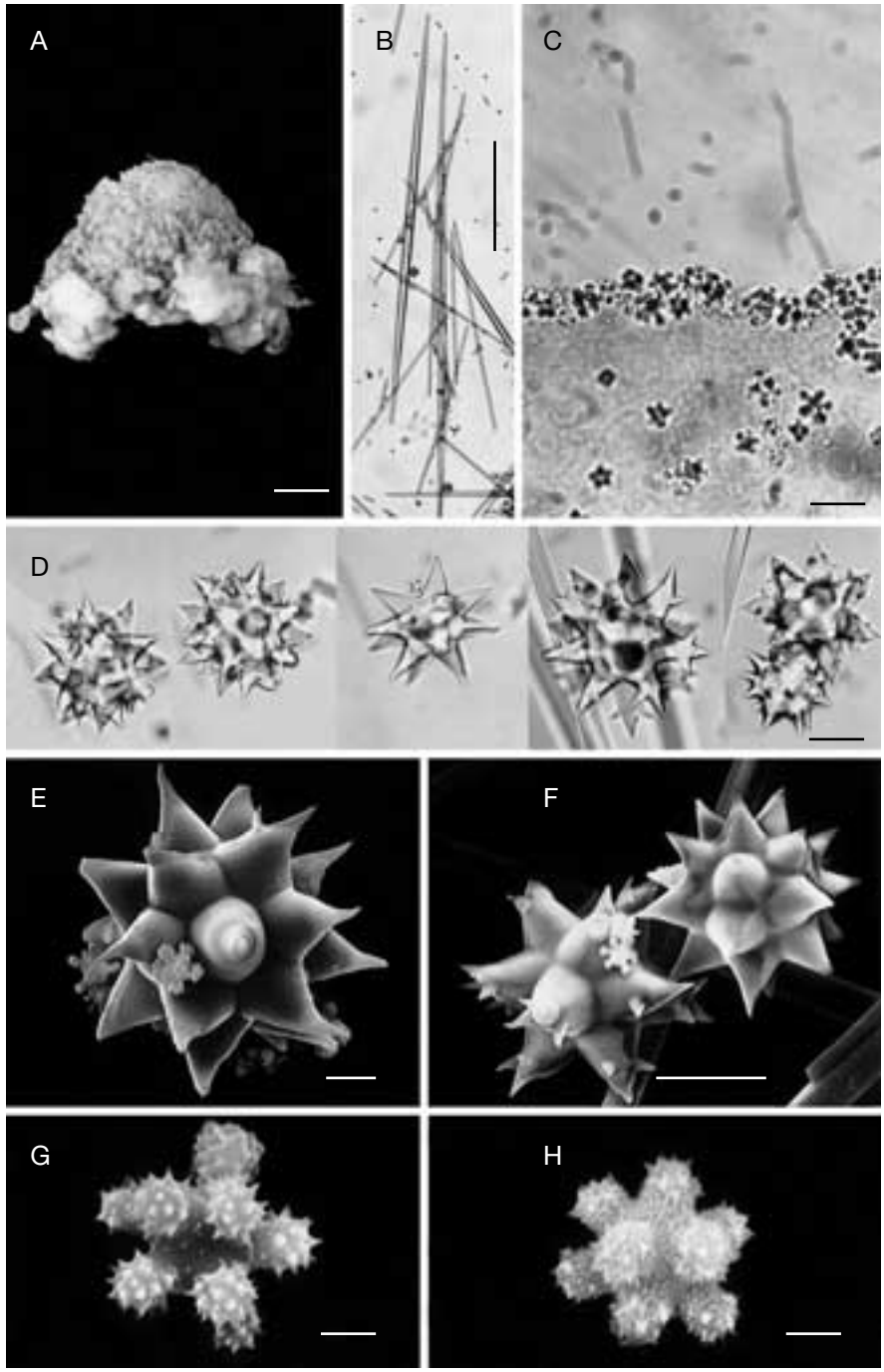

FIG. 1. — *Tethya ornata*; **A**, holotype; **B**, strongyloxeas; **C**, the superficial layer of tylasters; **D**, the variable shape of ornate megasters; **E**, **F**, SEM views of megasters; **G**, **H**, SEM views of tylasters. Scale bars: A, 6 mm; B, 130 µm; C, 15 µm; D, 30 µm; E, 8 µm; F, 25 µm; G, 2.5 µm; H, 1.5 µm.

tunately, without a comparison with the type of *T. deformis* recorded for the Museum für Naturkunde of Berlin but until now not found, we cannot be sure on this determination.

Tethya simi n. sp.

TYPE MATERIAL. — Holotype (MSNG 49676).

ETYMOLOGY. — After C. J. Sim, the Korean spongologist who collected the specimens.

OTHER MATERIAL. — Paratype (MSNG 49677).

TYPE LOCALITY. — **Songsampo** (**Korea**). 30.VI.1984, coll. C. J Sim.

DESCRIPTION

Morphology

Body globose, 2.5 cm in diameter, consistency firm, yellow ochre in alcohol (Fig. 3A). Tubercles flattened and little evident, 1.5 mm wide.

Skeleton (Fig. 4)

Megasclere bundles with large terminal fans. Megasters through entire cortex (Fig. 3C) but not in the choanosome. Micrasters represented by two different categories in the cortex and choanosome. Sponge surface covered by cortical micrasters (Fig. 3D).

Spicules

Strongyloxeas. (Fig. 3B) Main strongyloxeas, with a thin proximal rounded end, 1200-1800 × 10-20 µm. Auxiliary megascleres 300-700 × 3-11 µm. The two categories have however many intermediates.

Megasters. (Fig. 3E, F) Spherasters 40-80 µm in diameter, R/C = 0.2-0.5. Rays often apically bent or forked (Fig. 3F), about 20.

Micrasters. Cortical micrasters are generally tylasters (Fig. 3G) with indistinct knobs on their ray tips, being spines diffused along the ray. Several tylasters have a more or less developed centrum and shortened rays, 8-12 µm in diameter, ray number 8-14, generally 14. Choanosomal micrasters are oxyasters with conical rays, sometimes without spines (Fig. 3J) but generally more or less spined (Fig. 3H, I). Some oxyasters are spiny at the ray tips, 15-20 µm in diameter, generally 20 µm. Ray number eight to fourteen, commonly twelve to fourteen.

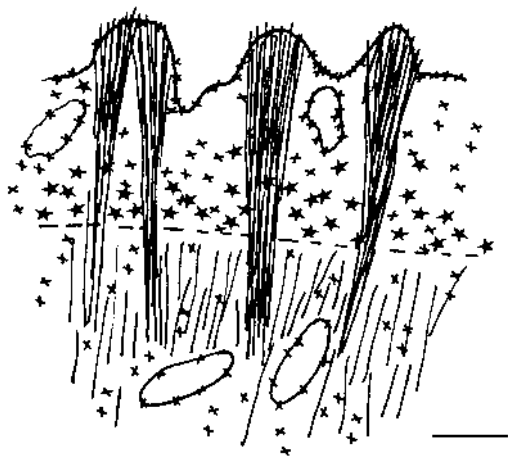

FIG. 2. — *Tethya ornata*, schematic drawing of the skeletal arrangement. Scale bar: 0.4 mm.

REMARKS

T. simi specimens were originally labelled *T. aurantium.* There are in fact some traits in common between the two species, both living in the northern temperate seas, as the existence of two micraster categories in the cortex and choanosome and the features of the oxyaster choanosomal category. But *T. simi* is distinguished clearly by the tylaster features of its cortical micrasters and by the megaster distribution in the cortex. In addition, in *T. simi,* the fibrous cortical inner layer, which is well developed in *T. aurantium*, is absent.

Tethya strongylata n. sp.

TYPE MATERIAL. — Syntypes (BMNH 1938:4:8:1, slide 1938:4:8).

ETYMOLOGY. — For the occurrence of many strongyles in the spicule complement some of which are very short and plump.

TYPE LOCALITY. — **Galapagos Islands.** West side of James Island.

DESCRIPTION

Morphology

The two specimens are globose and respectively of 2 and 3 cm in diameter. The larger specimen has a large bud of 8 mm in diameter attached to

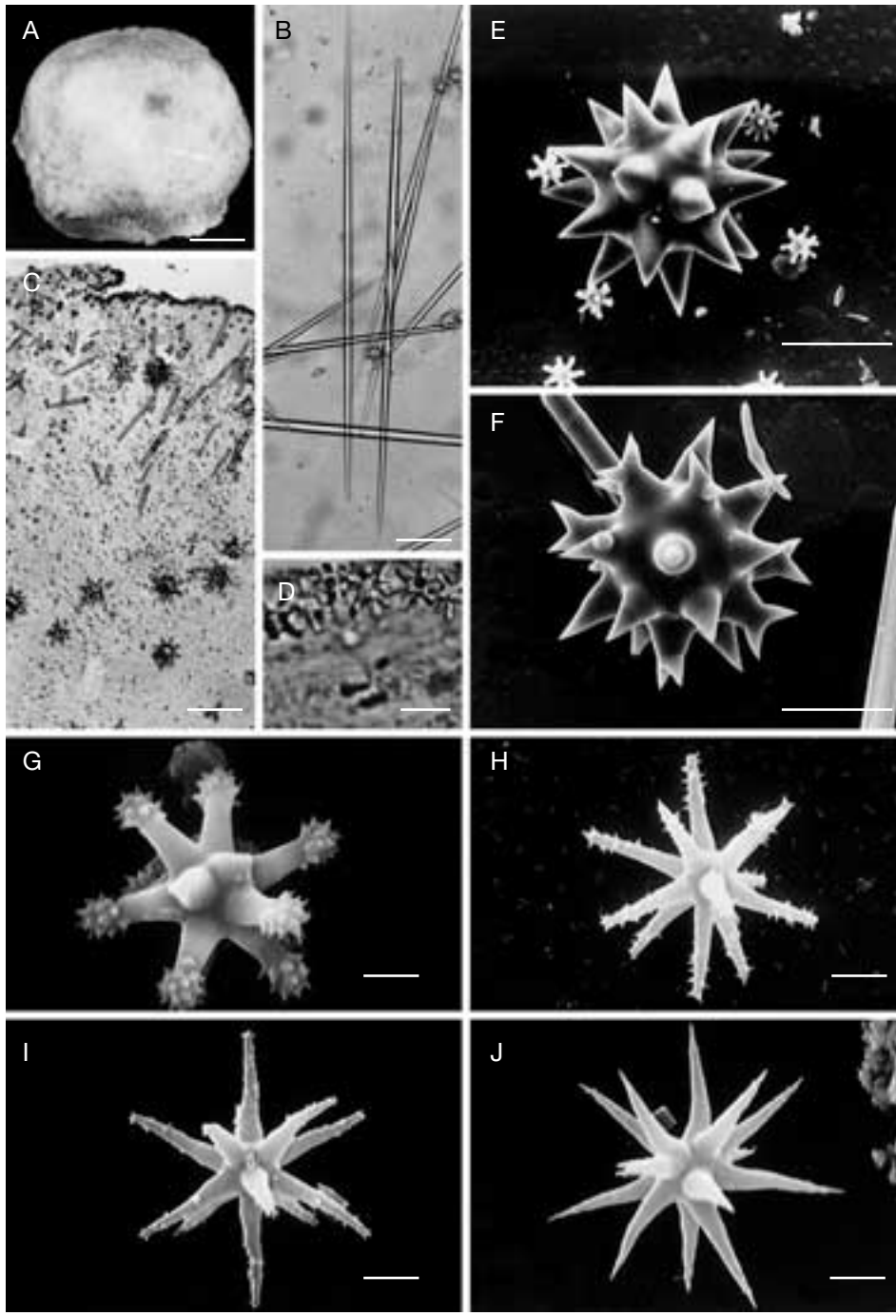

FIG. 3. — *Tethya simi*; **A**, holotype; **B**, strongyloxeas; **C**, the cortical region showing the megaster distribution; **D**, the superficial layer of tylasters; **E**, **F**, SEM views of megasters; **G**, SEM view of a tylaster; **H**-**J**, SEM views of oxyasters. Scale bars: A, 5 mm; B, 170 µm; C, 160 µm; D, 10 µm; E, F, 30 µm; G, 3.5 µm; H-J, 4 µm.

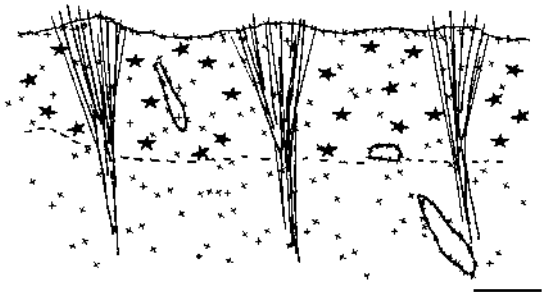

FIG. 4. — *Tethya simi*; schematic drawing of the skeletal arrangement. Scale bar: 0.7 mm.

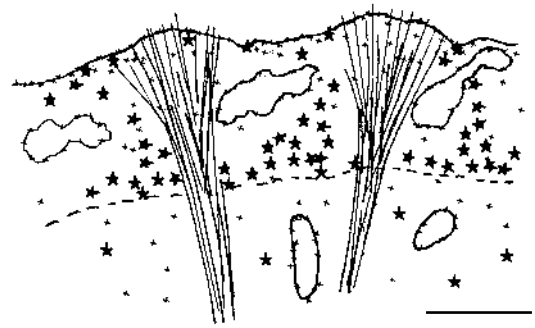

FIG. 5. — *Tethya strongylata*; schematic drawing of the skeletal arrangement. Scale bar: 1 mm.

the mother sponge by a short peduncle 2 mm long. Tubercles flattened and cortex with lacunae.

Skeleton (Fig. 5)
Radial megasclere bundles not branched. Spherasters throughout the whole cortex, more densely in the inner layer (Fig. 6A). Some small spherasters in the choanosome. Sponge surface covered by cortical micrasters.

Spicules
Megascleres. Strongyloxeas (Fig. 6B) or anisostrongyles (Fig. 6C) frequently shortened, 500-2000 × 18-33 µm. Some spicules are short and plump strongyles, anisostrongyles and styles (Fig. 6D, E, G) 140-300 × 40-60 µm.
Megasters. (Fig. 6F) Spherasters with short rays, in the cortex 40-85 µm and in the choanosome 35-48 µm in diameter, R/C = 0.1-0.7, frequently 0.5. Rays may be distorted, forked, spined or reduced to hemispherical outgrowths (Fig. 6H), often with different ray aspects in the same spicule. Ray number 24-30.
Micrasters. (Fig. 6I, J) Tylasters 10-14 µm in diameter, generally 11-12 µm. As the rays are entirely spined the apical knob, a little more densely spined, is not distinct. Some tylasters have a small centrum. Ray number generally 12-14.

REMARKS
T. strongylata is characterized by the shortened megascleres which are often anisostrongyles with some short and plump strongyles and styles. The megasters are also peculiar as they are frequently reduced and irregular. The rays are unusually short and numerous. In contrast, micrasters show a great uniformity in size and shape. They differ from the *T. japonica* Sollas, 1888 tylasters for their greater size, number and robustness of rays, and from those of *T. deformis* Thiele, 1898 for the less frequent and smaller development of the centrum. *T. strongylata* is the second species of *Tethya* described for the Galapagos Islands. The other species is *T. sarai* Desqueroux-Faundez & Van Soest, 1997 which is distinguished from *strongylata* not only by the lack of the peculiar traits of this species but also in possessing a category of choanosomal strongylasters/tylasters which are well distinguished from the cortical tylasters.

Tethya topsenti n. sp.

TYPE MATERIAL. — Holotype (LBIM/N 814) labelled "*T. japonica*" from MNHN.

ETYMOLOGY. — After Émile Topsent, the great French spongologist who has contributed greatly to our knowledge of *Tethya*.

TYPE LOCALITY. — **Îlot Testard Sud.** Baie de Saint-Vincent, New Caledonia, 17.XI.1961, coll. B. Salvat.

DESCRIPTION
Morphology
Body irregularly globose, about 1.5 cm in diameter with irregular surface and indented tubercles. Smooth, yellow ochre in alcohol. Large cortical lacunae.

Skeleton (Fig. 7)
Strongyloxea bundles distorted in their cortical tract running obliquely to the sponge surface.

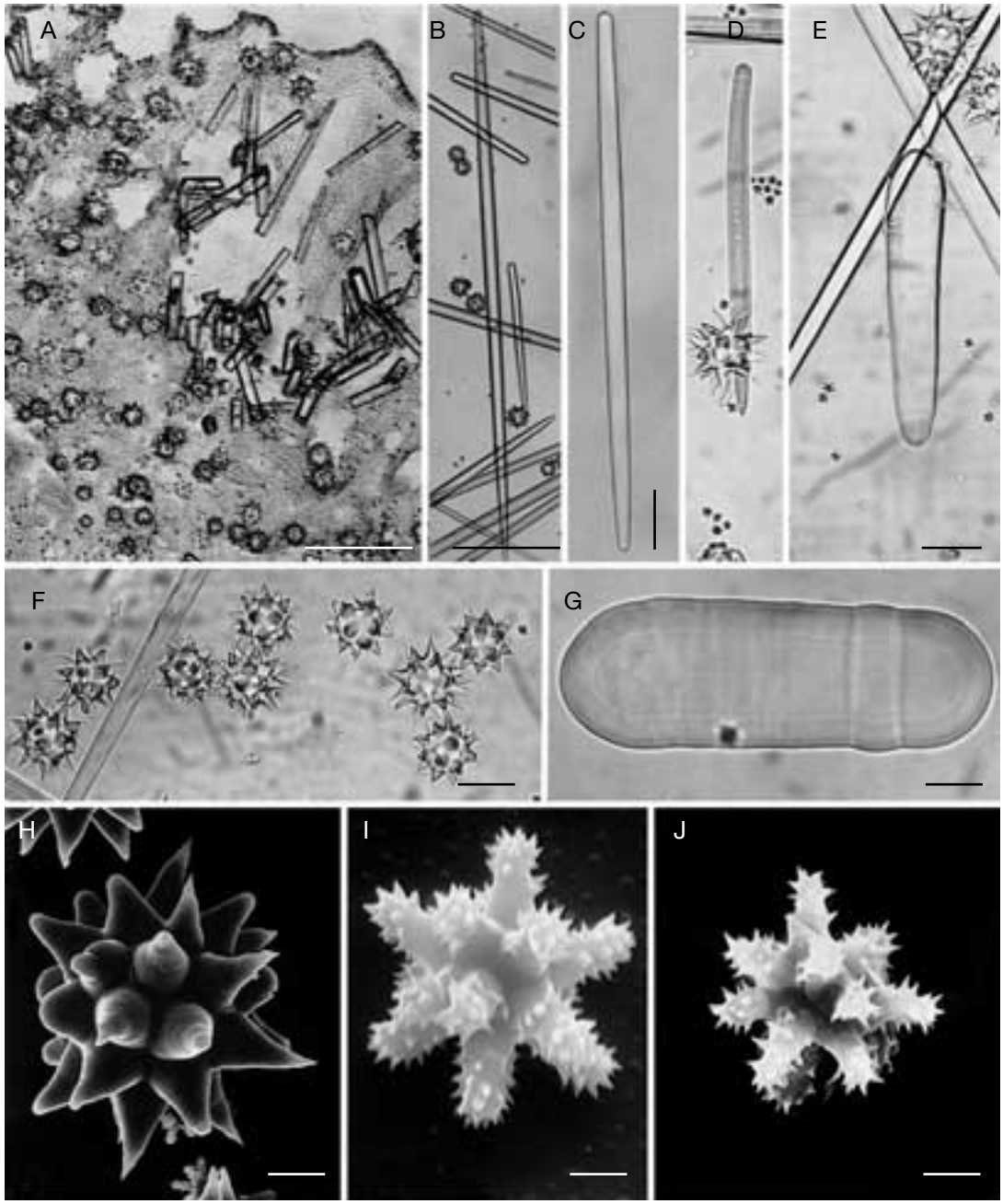

FIG. 6. — *Tethya strongylata*; **A**, the cortical region showing the megaster distribution; **B**-**E**, megascleres showing different steps of lenght reduction and width increase; **F**, megasters; **G**, a very short and plump strongyle; **H**, SEM view of a megaster; **I**, **J**, SEM views of tylasters. Scale bars: A, 250 µm; B, 300 µm; C-E, 60 µm; F, 50 µm; G, 25 µm; H, 11 µm; I, 2 µm; J, 4 µm.

They branch and terminate in fans. Megasters diffused throughout the entire cortex and more rare and scattered in the choanosome. One category of micrasters in the cortex and in the choanosome, where they coat the sponge surface.

Spicules

Main strongyloxeas 800-1500 × 10-26 µm. Often these strongyloxeas have their distal end more or less rounded and are then transformed to anisostrongyles (Fig. 8A). Auxiliary strongyloxeas 450-600 × 3-12 µm. The two categories intergrade.

Megasters. (Fig. 8B-D) Spherasters 15-70 µm (generally 30-60) in diameter. R/C = 0.4-0.8. Size variable with many young spicules. In the choanosome 15-44 µm in diameter with R/C = 0.2-0.5. Ray number 16-22. The short rays are conical but sometimes flask-shaped.

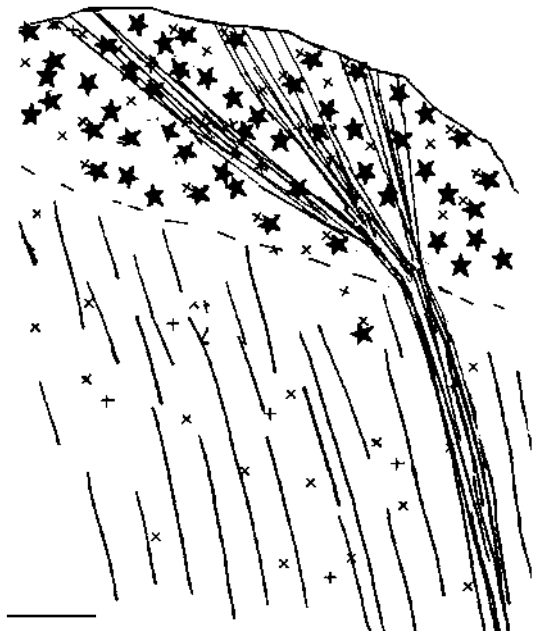

FIG. 7. — *Tethya topsenti*; schematic drawing of the skeletal arrangement Scale bar: 0,2 mm.

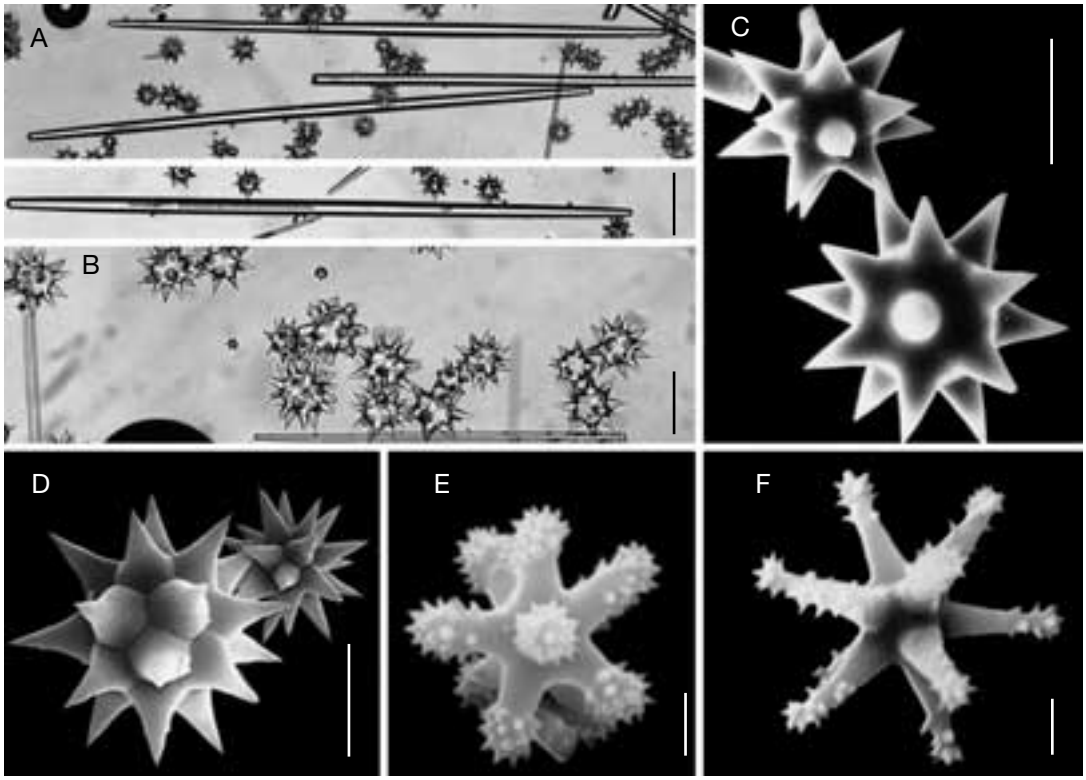

FIG. 8. — *Tethya topsenti*; **A**, anisostrongyles; **B**, megasters; **C**, **D**, SEM views of the megasters; **E**, **F**, SEM views of the tylasters. Scale bars: A, 70 µm; B, 60 µm; C, D, 30 µm; E, 3 µm; F, 2 µm.

Micrasters. (Fig. 8E, F) Tylasters generally 10-12 μm both in the cortex and in the choanosome. The more frequent shape has rays rather thick with a swollen tylote tip formed by a tuft of spines which are lacking on the stem. Variants have more slender, and sometimes tapering rays with less distinct terminal knobs. Ray number is generally eight to ten, with a range from six to ten. In two spicular slides we found chiasters with short rays and a big centrum, 15 μm in diameter. As they are absent in the other spicular slides and in the sponge sections, they are likely foreign to this species.

REMARKS

T. topsenti is only roughly similar to *T. japonica* Sollas, 1888 but can be separated by the clear distinction in the size and shape of its micrasters. The tylasters of *topsenti* have a greater size, stouter and shorter rays, and more distinct terminal knobs. Other distinctive traits in *T. topsenti* are the megaster distribution and the megaster shape; the megasters are present throughout the whole cortex and even the choanosome and have shorter rays. *T. topsenti* is comparable to *T. deformis* Thiele, 1898 for the irregular body shape and distorted megasclere bundles, but these growth characters occasionally occur in a range of different species. In spicular traits, as the tylasters thick rays and absence of a centrum, *T. topsenti* is different from *T. deformis*.

Other *Tethya* species described from New Caledonia are *T. levii* Sarà, 1992 and *T. novaecaledoniae* Sarà, 1992, both from deep waters, and *T. sollasi* Bergquist & Kelly-Borges, 1991 found under plate-coral rubble of intertidal flats. From this last species *T. topsenti* differs in several traits but especially for the micrasters features, and for the lack of a category of small microxyasters.

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