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Family Tethyidae Gray, 1848

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Tethyidae Gray (Demospongiae, Hadromerida) includes sponges with stylote megascleres and two types of asters: microasters and megasters. The body shape is typically globose but also irregularly massive or encrusting, and in some genera is supported by a stalk. The surface is verrucose with tubercles. A cortex is frequently more-or-less developed around a softer choanosomal core. The skeleton structure is usually made by radiate bundles of stylote megascleres (strongyloxeas). The type genus *Tethya* contains the greatest number of species but the family contains 14 valid genera and approximately 80 described species distributed worldwide, in tropical, temperate seas and one species in the arctic. They are mainly found in shallow waters but also occasionally in the deep-sea. Genera are differentiated essentially on the basis of their skeletal structure, which may determine changes in the body shape and spicular types.
Keywords: Porifera; Demospongiae; Hadromerida; Tethyidae; *Tethya*; *Anthotethya*; *Burtonitethya*; *Columnitis*; *Halicometes*; *Laxotethya*; *Nucleotethya*; *Oxytethya*; *Stellitethya*; *Tectitethya*; *Tethyastra*; *Tethycometes*; *Tethytimea*; *Xenospongia*.

DEFINITION, DIAGNOSIS, SCOPE

Synonymy

Tethyadae Gray, 1848, 1867. Donatiadae Gray, 1872. Xenospongiidae Carter, 1882. Tethyidae Sollas, 1888. Donatiidae Baer, 1906. Type genus: *Tethya* Lamarck, 1814.

Definition

Hadromerida usually with stylote megascleres, mainly strongyloxeas, generally in radiate tracts and two categories of euasterose microscleres, microasters and megasters, sometimes rhabds.

Diagnosis

Body shape typically globose (spherical, hemispherical, ovoid), but also sometimes irregularly massive, lobate or encrusting. Sometimes with a basal stalk. The surface is verrucose with tubercles, typically hispid and frequently flattened. Oscules rarely visible, generally apical, and the pores are in grooves between tubercles. A cortex may be well-developed and sharply distinct from the choanosome, but sometimes poorly developed or indistinct (pseudocortex). The skeleton structure is constructed by stylote (or modified stylote) megascleres, usually in radiate tracts (but in some genera in parallel tracts running from the substrate to the tubercles). The main bundles may branch and sometimes are loose in confused tracts, or crossed by thinner transverse bundles. Interstitial megascleres may also be scattered between the tracts. Spicules generally include stylote megascleres and two types of asters: megasters and microasters. Stylote megascleres are frequently strongyloxeas (fusiform styles), but may be also styles, subtylostyles, tylostyles or anisostrongyles. In one case (*Oxytethya*) the megascleres are oxeas. Megasters are spherasters, oxyspherasters and oxyasters. Microasters are euasters of the tylaster, strongylaster and oxyaster type. Exceptionally one category of aster (megasters or microasters) may be lacking, a presumed secondary loss. Other spicules occasionally found are polyrhabds, microstrongyles, exotyles and spheres. Reproduction may be oviparous with a parenchymella larvae, or asexual by external (and sometimes internal) buds.

Scope

Fourteen valid genera.

History and biology

The family Tethyidae is widely attributed to Gray (1867a), as Tethyadae, but this name was used twenty years earlier by Gray (1848: 1) to define a family that included a genus *Tethya*, with two species *Tethya cranium* and *T. aurantium*, and also embracing all existing eight genera of 'Silicea'. Although *Tethya cranium* was subsequently assigned to another genus (*Craniella*), and the other genera to other families and orders, and despite that it was also originally considered the only family of the 'order Silicea', the name Tethyadae (corrected as Tethyidae) must be considered to date from 1848 because it includes the type species of the genus *Tethya* Lamarck, *T. aurantium*. Gray (1867a) provided a diagnosis of the family that is now considered obsolete as it included many tetractinellids and hadromerids (25 genera). *Tethya aurantium* was referred to *Donatia* Nardo 1833, because, erroneously, the name *Tethya* was conserved for *C. cranium*. In a second system Gray (1872) provides a narrower concept of the family including only *Donatia* (=*Tethya*), *Collingsia*, according to Schmidt *Stelletta*, and *Tethyopsis*, another Ancorinidae. Vosmaer (1887) assigned to the family, now correctly named Tethyidae, the genera *Tethya, Tuberella* and *Aaptos* (although *Tuberella* was later placed into synonymy with *Aaptos*).

Sollas (1888) provided a clearer diagnosis of Tethyidae, placing in it *Tethya, Columnitis* and *Xenospongia* (three genera included in this present revision), plus *Magog* which is now recognised as a synonym of *Chondrilla*. For Topsent (1898a) the family included in addition to *Tethya* the genera *Tethyorrhaphis* Lendenfeld, *Tuberella* Keller (=*Aaptos*), *Trachya* Carter (=*Aaptos*) and *Heteroxya* Topsent. None of these genera, with the exception of *Tethya*, is presently included in the family. *Tethyorrhaphis* is a synonym of *Tethya* (Bergquist & Kelly-Borges, 1991; Sarà, 1994a); *Aaptos* has been removed from Tethyidae and assigned to Suberitidae (see Van Soest, this volume); *Heteroxya* is assigned to Desmoxyidae (see Hooper, this volume). Baer (1906), following Gray (1867a, 1872) and Thiele (1903a), placed *Tethya aurantium* into synonymy with *Donatia lyncurium* (=*aurantium*) because, in

his opinion, the name *Tethya* should be assigned, following the nomenclature rules to *Craniella*. The family name became Donatiidae and this name was used by all authors for the following two decades. In general reviews of the family made by Burton (1924) and Wilson (1925) the name Donatiidae was conserved.

For Hentschel (1909, 1912) and Dendy (1916c) Donatiidae included three genera: *Donatia* Nardo, *Tuberella* Keller and *Xenospongia* Gray. The large revision by Burton (1924) included four genera in Donatiidae: *Donatia* Nardo, 1833, *Halicometes* Topsent, 1898a, *Tethyorrhaphis* Lendenfeld, 1888 and *Xenospongia* Gray, 1858. The genus *Halicometes* refers to *Cometella stellata* Schmidt, 1870, which Topsent (1898a) had previously assigned to *Halicometes* but included the taxon in the family Stylocordylidae. However, Topsent (1920a), re-describing *Cometella stellata* as *Halicometes stellata*, referred *Halicometes* to the family Tethyidae. Significantly, in the revision of Burton, *Tuberella* (=*Aaptos*) was not included in Donatiidae. By the end of 1920s nearly all authors returned to the names *Tethya* and Tethyidae on the basis of the criticisms made by Topsent (1920d, 1928c) and Vosmaer (1933).

De Laubenfels (1936a) included Tethyidae in the order Epipolasida Sollas instead of in Hadromerina Topsent, defining Epipolasida as having as principal spicules oxeas and occasionally styles instead of tylostyles. This assignment was not followed and cannot be applied to Tethyidae in which oxeas are normally lacking and tylostyles can sometimes be present, and Tethyidae is currently assigned to Hadromerina (emended to Hadromerida). De Laubenfels (1936a) included in the family only *Tethya, Tethycordyla* (a new genus erected for *T. thyris* de Laubenfels, 1934 but later synonymised with *Halicometes* (Sarà, 1994)), and *Tethytimea* (a new genus established for *Donatia tylota* Hentschel, 1912). *Aaptos, Tethyorrhaphis, Halicometes* and *Xenospongia* were referred to other families.

Lévi (1973) included in Tethyidae the genera *Tethya*, *Aaptos* and *Xenospongia*, whereas Bergquist (1978) included only *Tethya* and *Aaptos*. Bergquist & Kelly-Borges (1991) placed *Tethyorrhaphis* into synonymy with *Tethya*. More recently, Hooper & Wiedenmayer (1994) included *Tethya* and *Xenospongia* in the family, with *Aaptos* referred to Polymastiidae based on evidence from morphology (e.g., Boury-Esnault, 1987) and biochemistry (Kelly-Borges *et al*., 1991). *Tethyorrhaphis* Lendenfeld, *Tethycordyla* de Laubenfels and *Tethytimea* de Laubenfels are considered synonyms of *Tethya*.

In the first revision of Tethyidae sincer Burton (1924), Sarà (1994) recognized eight valid genera in the family, based on a study of types and description of new material: *Tethya* Lamarck, *Burtonitethya* Sarà, *Columnitis* Schmidt, *Halicometes* Topsent, *Stellitethya* Sarà, *Tectitethya* Sarà, *Tethycometes* Sarà and *Xenospongia* Gray. Three of the four genera included in the revision of Burton (*Tethya* for *Donatia, Halicometes* and *Xenospongia*) were maintained, while *Tethyorrhaphis* was considered as a synonym of *Tethya. Burtonitethya* and *Tethycometes* were erected for new material discovered in the BMNH. *Columnitis* Schmidt was kept as valid, while *Stellitethya* and *Tectitethya* referred to species previously included in *Tethya*. However, *T. crypta* was originally described by de Laubenfels (1949b) as belonging to *Cryptotethya* Dendy (whose type species is *C. agglutinans*, a non-Tethyidae species). *Tethycordyla* de Laubenfels was placed in synonymy with *Halicometes*, and *Aaptos* was not included in the family Tethyidae at all. Successively Sarà & Bavestrello (1996), on the basis of new material from the Caribbean, redescribed *Columnitis* and *Tectitethya* and established the new genus *Nucleotethya*. More recently, three new genera from Australia (*Anthotethya, Laxotethya, Oxytethya*) were described (Sarà & Sarà, 2002). In this present chapter I recognize the validity of the generic name *Tethytimea* de Laubenfels, 1936a for *Donatia tylota* Hentschel, 1912, and *Tethyorrhaphis oxyaster* Burton, 1934a as type species of the new genus *Tethyastra*.

The family Tethyidae presently contains fourteen genera. A cladistic analysis of the family (Sarà & Burlando, 1994) included eight genera, and showed that Tethyidae are divided into three clades. One clade, the closest to the family root, is represented by *Tethya*, a cosmopolitan and speciose genus, with species living mainly in shallow tropical and warm-temperate areas, but with some species recorded from deep waters and cold-temperate areas. One species (*T. norvegica*) lives also in arctic waters. The other two clades give rise to two adaptive radiations: (1) stalked forms, developed in deep-water, soft bottom habitats (*Burtonitethya, Halicometes, Tethycometes*); (2) massive and encrusting forms specialized for shallow-water environments (*Columnitis, Xenospongia, Stellitethya, Tectitethya*). A subsequent cladistic analysis including three other genera showed that *Nucleotethya* and *Tethytimea* were placed in two successive bifurcations at the basis of the massive-encrusting clade, while *Tethyastra*, although not stalked, lies at the basis of the stalked clade in a position near *Tethya*. The suggested phylogenetic position of *Anthotethya* and *Laxotethya* is near the massive shallow water clade, while that of *Oxytethya* is near *Tethya* (Sarà & Sarà, 2002).

Distribution

The family is widely distributed in the tropical and warm-temperate regions but the genus *Tethya* has some cold temperate and one arctic representative. The depth ranges from intertidal habitats to 2100 m (*Halicometes hooperi* Lévi, 1993).

DIAGNOSTIC FEATURES OF THE FAMILY

Main diagnostic features

Tethyidae is distinctive for its spicular pattern with stylote megascleres and two categories of euasters (megasters and micrasters). Tethyidae is placed in the Hadromerida based on the absence of triaenes and of any other tetractinal form of spicules, but species show a clear relationship with the Astrophorida based on the common occurrence of euasters. On the other hand, the relationship between *Tethya* and other Hadromerids (Suberitidae and Clionaidae) has been demonstrated by Kelly-Borges *et al*. (1991) using RNA sequence analysis. *Aaptos*, previously included in the Tethyidae, is suggested, on the basis of a cladistic analysis of the family (Sarà & Burlando, 1994) to represent the sister group of the Tethyidae and *Aaptos* is now arranged among the Suberitidae (Van Soest, this volume). The generic classification of the Tethyidae is chiefly centered on some general features of the skeleton structure. Among these are the radiate, parallel or branched megasclere tracts, the megasclere shape, the megaster shape and distribution, the occurrence of a central spicular nucleus and of transversal bundles of secondary megascleres, and the inclusion of sediment grains. However, genera are usually recognizable also by their body shape that may be globular, ovoid and stalked, massive, or encrusting. In globose and ovoid stalked genera the megascleres

form radiate bundles. Radiate bundles occur also in some massive genera as *Tectitethya, Nucleotethya* and *Columnitis*. In *Tectitethya, Anthotethya, Oxytethya*, and especially *Laxotethya*, the radiate bundles show branching and anastomosing tracts, and in *Columnitis* and *Nucleotethya* are crossed by transverse bundles of auxiliary megascleres. In *Stellitethya* and in the encrusting genera, *Tethytimea* and *Xenospongia* the megasclere skeleton shows parallel tracts coming from the substrate to the upper surface of the sponge. The megasclere tracts end always with diverging fans that make the surface tubercles bristly. Megascleres may be strongyloxeas (globose and stalked genera), styles, anisostrongyles, subtylostyles and tylostyles (massive and encrusting genera). In the globose *Oxytethya* they are, exceptionally, oxeas. Megasters are generally spherasters or oxyspherasters but may be represented by oxyasters in genera such as *Burtonitethya, Halicometes, Tethyastra, Tethycometes* and *Xenospongia*, and by anthasters in *Anthotethya*. Micrasters in the genus *Tethya* may be uniform, generally tylasters, or polymorph, oxyasters, strongylasters, tylasters, mingled or split in two categories, different in size and shape, for the cortex (smaller tylasters) and the choanosome (larger oxyasters). In several other genera micrasters are uniform, generally strongylasters, but in *Columnitis, Anthotethya, Laxotethya* and *Oxytethya* they are split into two different categories. Other types of microscleres occur in some genera: polyrhabds in two species of *Tethya* and in *Tethyastra*, exotyles in *Halicometes*, spheres in *Tethytimea*, microstrongyles in *Tethycometes*.

The number of genera has gradually increased over recent years. The revision of Burton (1924) listed four genera; Sarà (1994) included eight genera; Sarà & Bavestrello (1996) nine genera, Sarà & Sarà (2002) 12, and now 14 are recognised in the present work. Described valid species of Tethyidae number 81 (56 alone for the genus *Tethya*), with about 40 recognizable but still undescribed new species remaining. The family is practically cosmopolitan, particularly rich in tropical seas, but there appears to be a special zone of diffusion in the temperate shores of south-eastern Australia and New Zealand. (Sarà, 1998). The number of Indo-Pacific species is significantly greater than Atlantic species. One species of *Tethya* occurs in arctic seas and scattered spicules have been recorded on the shores of Antarctica. Of the 14 genera, two are cosmopolitan, nine Indopacific and three Atlantic. Bathymetric distribution is from intertidal to 2100 m, although the majority of known species live in shallow waters between 0–50 m depth.

Terminology

Spicular terminology for Tethyidae differs among recent authors as, for example, in the aster classification and terms reported by Bergquist & Kelly Borges (1991). Some of these differences are not trivial but concern basic assumptions that require further clarification. In this chapter I follow the indications of Sarà (1994), which agree with the common use of terms in the majority of papers on Tethyidae. Accordingly, I have adopted the following terminology for asters. Asters are separated into two categories, megasters and micrasters. Megasters are named spherasters, when the R/C ratio (ray length compared to center diameter) is less than 1; oxyspherasters (=spheroxyasters) when R/C is 1 or between 1–2; oxyasters when this exceeds 2. Micrasters have spiny rays and are differentiated into tylasters with tylote ray tips, chiasters with truncated, strongylasters with rounded, and oxyasters with pointed ray tips. This difference between the micraster types, using optical microscopy, is based essentially on the spinosity of the ray tips (and confirmed by electron micrographs), which is maximal in tylasters and minimal in strongylasters and oxyasters. Chiasters represent an intermediate situation. The difference between strongylasters and oxyasters is related not only to the tip, rounded or pointed, but also to the ray shape that is cylindrical in strongylasters and more-or-less conical in oxyasters. Incorporated sediment is important in the genera *Columnitis, Tectitethya, Anthotethya, Laxotethya* and *Xenospongia* and may represent a skeleton support.

KEY TO GENERA

(1) Without basal stalk (or with stalk not exceeding half of the body diameter) 2
With basal stalk longer than half of the body diameter 8
(2) With a well developed and distinct cortex, body spherical or subspherical 3
With a little developed or indistinct cortex, irregularly massive or encrusting body 4
(3) Megasters spherasters or oxyspherasters, rather homogenous in size not exceeding 180 μm in diameter ..... ***Tethya***
Megasters oxyasters, very heterogeneous in size even exceeding 180 μm in diameter ..... ***Tethyastra***
Without megasters, megascleres oxeas ..... ***Oxytethya***
(4) Megascleres styles, subtylostyles or strongyles 5
Megascleres tylostyles ..... ***Tethytimea***
(5) Megascleres in radiate tracts proximally crossed by thinner megascleres ..... ***Nucleotethya***
Megascleres in radiate ascending tracts, branching and anastomosing 6
Megascleres in parallel ascending tracts 7
(6) Megasters anthasters ..... ***Anthotethya***
Megasters spherasters or oxyspherasters ..... ***Tectitethya***
Without megasters, megasclere tracts partially loosened or confused ..... ***Laxotethya***
(7) With megasclere tracts arising from a central sediment core, proximally crossed by thinner megascleres, with a winding cylindrical body ..... ***Columnitis***
With megasclere tracts arising from a sediment basis, discoid body ..... ***Xenospongia***
With giant megasters, thick encrusting or massive body ..... ***Stellitethya***
(8) With stalk about the same length of body diameter ..... ***Burtonitethya***
With stalk about two to four times the body diameter ..... ***Halicometes***
With stalk about eight times the body diameter ..... ***Tethycometes***

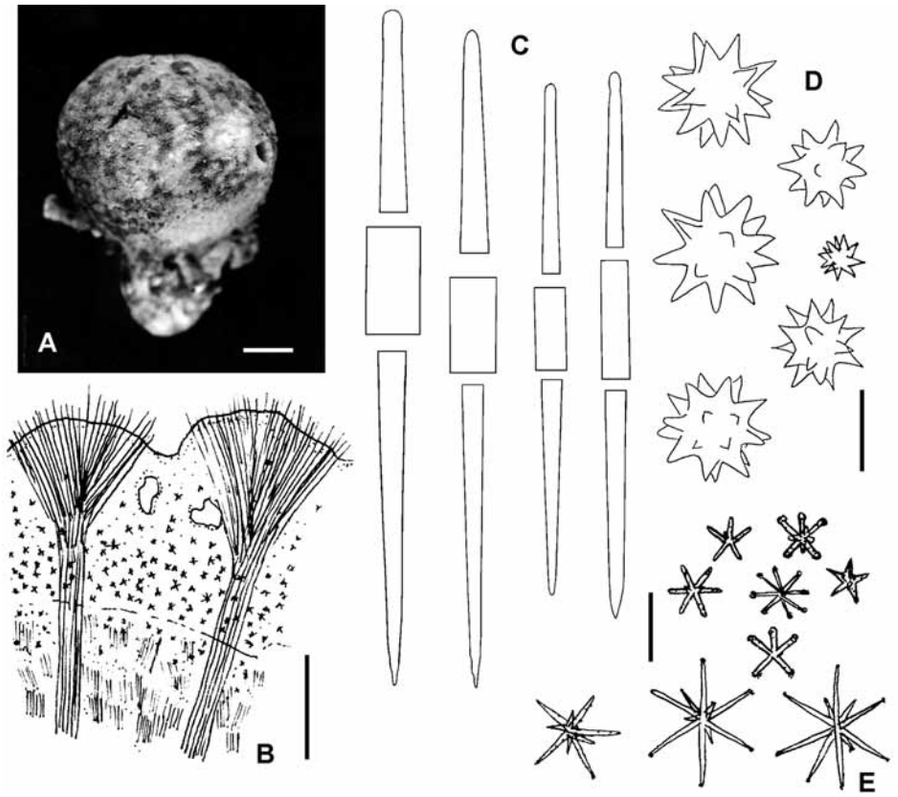

Fig. 1. *Tethya aurantium*. A, neotype. B, skeleton structure. C, strongyloxeas. D, spherasters. E, cortical (above) and choanosomal (below) microscleres (scales: A, 1 cm; B, 1 mm; C, D, 50 μm; E, 12 μm).

TETHYA LAMARCK, 1814

Synonymy

Tethya Lamarck, 1814: 71; Selenka, 1880: 472; Lendenfeld, 1888: 48; Sollas, 1888: 427; Thiele, 1898: 11. *Donatia* Nardo, 1833: 522. *Lyncuria* Nardo, 1833: 715. *Amniscos* Gray, 1867a: 549. *Alemo* Wright, 1881: 16. *Tethyorrhaphis* Lendenfeld, 1888: 51. *Taboga* de Laubenfels, 1936a: 452.

Type species

Alcyonium aurantium Pallas, 1766: 357 (subsequent designation by Topsent, 1920d: 643).

Diagnosis

Tethyidae with a spherical, sometimes hemispherical body with a well-developed cortex, distinct from the choanosome (medulla), dense or rich in lacunae. Main skeleton formed by strongyloxea bundles radiating from the center of the sponge and bristling, generally flattened, sometimes conical, tubercles on the surface. The whole choanosome or its periphery may be filled by thinner auxiliary megascleres that accompany the distal fans of megasclere bundles in the tubercles. Main megascleres are usually strongyloxeas, interstitial (auxiliary) megascleres are often styles. Megasters and microscleres are variously distributed in the cortex and choanosome. Megasters are spherasters or oxyspherasters. Microscleres are tylasters, strongylasters or oxyasters, normally with spined rays, with polyrhabds in some species.

Description of type species

Tethya aurantium (Pallas) (Fig. 1A–E).

Synonymy. *Alcyonium aurantium* Pallas, 1766: 357. *Alcyonium lyncurium* Linnè, 1767: 1295; *Tethya lyncurium* Lamarck, 1814: 71; *Donatia lyncurium* Nardo, 1833: 522. *Tethya morum* Schmidt, 1862: 44. *Tethya aurantium* Topsent, 1920d: 640; Sarà & Melone, 1965: 123. *Tethya limski* Müller & Zahn, 1968: 473. Taxonomic decision for synonymy: Topsent, 1920d, and Sarà & Melone, 1965.

Material examined. Holotype: unknown, "seas of Europe". Neotype: MSNG 49670 – Bay of Naples. Other material. Many specimens from different Mediterranean localities: Azores, western North African coast; spicular slides from the Caribbean. Electrophoretic allozyme patterns of Mediterranean populations (Sarà *et al*., 1989; Sarà, 1990; Sarà & Manara, 1991; Sarà *et al*., 1992; Bavestrello & Sarà, 1994).

Description. Shape spherical, 1–5 cm in diameter, surface orange with rounded and flattened tubercles, consistency moderately hard, with a thick and dense cortex without large subdermal lacunes. One oscule is sometimes visible, as in the neotype. Megascleres represented by main, thicker, and auxiliary, thinner, strongyloxeas but the two categories overlap in their lengths and widths. Length 400–2500 μm, width 5–30 μm. Fans of radiating megasclere bundles not forked. Interstitial megascleres fill the

space among the main megasclere bundles. Megasters represented by spheraster 18–105 μm in diameter, generally 50–80 μm (mean 62.04 ± 11.34) with R/C = 0.4–0.6 (mean 0.49 ± 0.14) (Bavestrello & Sarà, 1992). Megasters densely packed in many layers in the endocortex. Some megasters also in rows or scattered in the mesocortex, especially along the canals and in the outer choanosome. Micrasters are different between the cortex and choanosome. In the cortex they are represented by a heterogeneous set of tylasters, strongylasters and slender oxyasters, 10–15 μm in diameter (mean 12.5 μm), with 9–14 apically spined rays. They are distributed both as a dense layer on the surface of the sponge and around the canals and lacunae of the cortex. In the choanosome they are represented by an uniform set of oxyasters, 15–25 μm in diameter (mean 18.5 μm) with 12–14 rays bearing few scattered microspines, and ray tips are more spined and slightly knobbed under light microscopy. Both types of micrasters occur jointly in the inner cortex. Reproduction is sexual (in summer) and asexual, by external buds (in winter).

Geographic distribution. Mediterranean, Atlantic North-African coasts, Azores. This restricted distribution depends from the distinction between *T. aurantium* and *T. citrina*, and from a critical evaluation of the existing data. In the Mediterranean both *aurantium* and *citrina* occur, but in North European seas only *T. citrina* is present, eventually flanked by *T. norvegica*. All the museum specimen labelled '*aurantium*' or '*lyncurium*' examined by myself, and the newly collected material of *Tethya* coming from the Channel and northern seas, belong to *T. citrina* Sarà & Melone or *T. norvegica* Bowerbank. The attribution of Caribbean populations to this species, as well as its reported occurrence along the South-European Atlantic coasts, should be confirmed. Californian (Monterey Bay) specimens of *T. aurantia* var. *californiana* de Laubenfels, 1932 have been assigned to the new species *T. californiana* (Sarà & Corriero, 1993). The material labelled *T. aurantium* coming from Australia and New Zealand and deposited in BMNH, partially described as *T. aurantium* by Bergquist & Kelly-Borges (1991), does not belong to *T. aurantium* but to a different species (based on its described traits and from my personal observations on this material). Depth range: 0.3–40 m (Pulitzer-Finali, 1970; Bavestrello & Sarà, 1994).

Remarks. As noted by Topsent (1920d), the first figures of *Tethya* are by Aldrovandi (1642) and Marsilli (1725), and the first description and assigned name is *Tethya sphaerica* by Donati (1750). But, as this name is prior to 1758, the first valid name for the type species is *Alcyonium aurantium* Pallas, 1766. The taxonomic identity of *T. aurantium* has been well defined by Sarà & Melone (1965), with indication that two different species *T. aurantium* (Pallas, 1766) and *T. citrina* (Sarà & Melone, 1965) have often been confused. Pallas' description refers clearly to *T. aurantium*, but under the name '*aurantium*' or '*lyncurium*' the successive authors have also described *T. citrina*.

Tethya contains the most species of the family, with 56 species presently described and about 40 others recognized but hitherto not yet described. Its distribution (Sarà, 1998) is nearly cosmopolitan, mainly tropical, with a peculiar biodiversity in the temperate Australia–New Zealand area. Indo-pacific species represent about 85% of the total diversity. The occurrence in Arctic seas is evidenced by only one species, and in Antarctica only by scattered spicules in the sediment. Depth distribution is between 0–805 m. Most species have been found in shallow waters (Burton, 1958). External features are important in distinguishing species but the growth form of *Tethya* may be influenced by environmental, mainly hydrodynamic conditions. In coral reefs *Tethya* may grow under coral or in small crevices in an irregular, often cushion-like shape. Some species, also in temperate seas, have anchoring rhizoids. External color is often a specific trait and ranges from red, pink, orange, yellow, green, gray, brown to black. The surface may be covered by sediment. Consistency may be hard or soft, related to the different development of lacunes and the distribution and density of the megasters. Oscules are rarely visible, and when they are there is only a single apical osculum. Cyanobacterial filamentous symbionts occur frequently in the cortex, influencing its color. Aster shape, size and distribution represent the main diagnostic features for distinguishing species. Megasters may be different in shape and size, and their distribution in the cortex and choanosome follows specific patterns. Micrasters may be uniform in the cortex and choanosome, and are generally tylasters, or there may be different shapes mingled in the same part of the sponge, or they may also differ in shape and size between the cortex and the choanosome. Buds frequently occur, generally external, sometimes internal.

ANTHOTETHYA SARÀ & SARÀ, 2002

Synonymy

Anthotethya Sarà & Sarà, 2002.

Type species

Anthotethya fromontae Sarà & Sarà, 2002 (by original designation).

Diagnosis

Tethyidae with irregular conical shape and thin cortex. The megasclere skeleton is made by ascending tracts of styles (sometimes anisostrongyles or subtylostyles) and interstitial styles. Main tracts branch at different body levels and also may anastomose. Megasters are represented by anthasters, and micrasters by spiny strongylasters and oxyasters.

Description of type species

Anthotethya fromontae Sarà & Sarà, 2002 (Fig. 2A–F).

Synonymy. *Anthotethya fromontae* Sarà & Sarà, 2002.

Material examined. Holotype: WAM Z5793. Paratype: WAM Z5410 – Dampier Archipelago, Western Australia. Depth: intertidal to 14 m.

Description. The body is irregularly conical, 5–6 cm high and broad, with some little distinct rounded lobes 2 cm high. The surface is covered by small flattened tubercles 1–2 mm wide, often transformed in narrow irregular ridges with a winding pattern. The cortex is about 0.5 mm thick and distinct from the choanosome due to a dense concentration of anthasters and micrasters. Lacunae and canals are abundant throughout the body. Foreign particles occur on the surface and inside the sponge. Consistency elastic. Color (in ethanol) externally reddish-orange, internally ochre-brown. The skeleton shows ascending megasclere tracts that generally run in parallel and end at the surface in small fans. Megasclere tracts may often branch and anastomose at different body levels. Auxiliary megascleres placed in the interstices between the tracts are very abundant throughout the sponge.

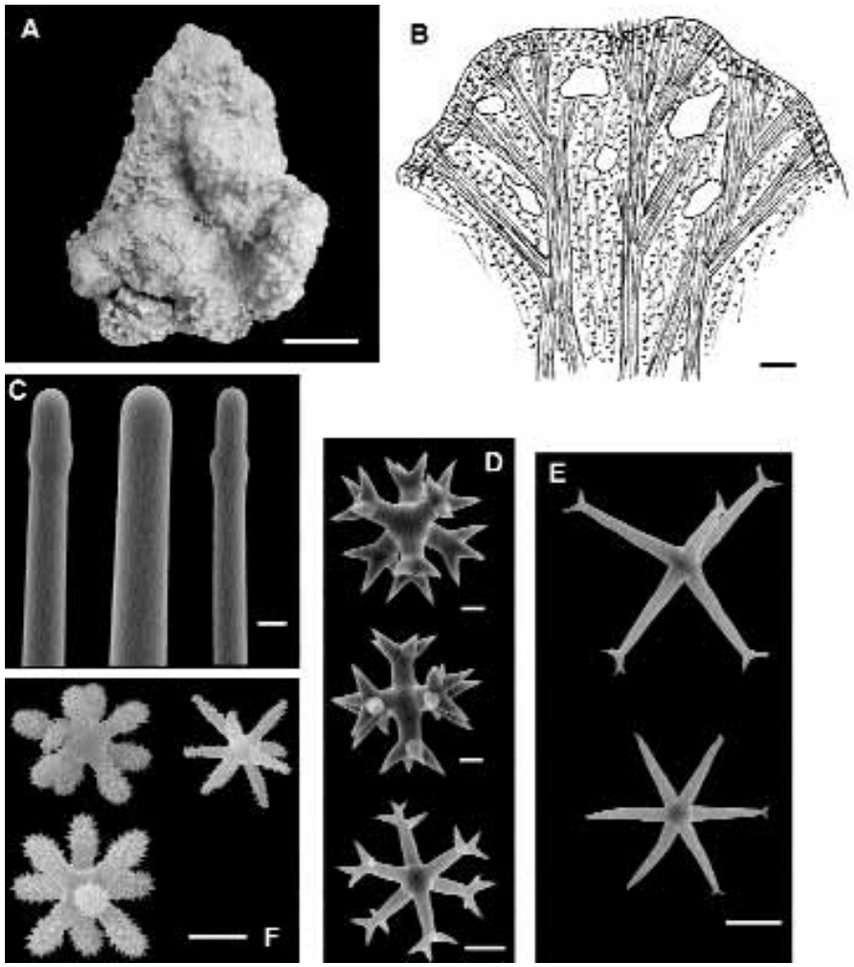

Fig. 2. *Anthotethya fromontae*. A, holotype. B, skeleton structure. C, stylote and subtylote bases of megascleres. D, anthasters. E, oxyasters. F, strongylasters (scales: A, 2 cm; B, 1 mm; C, F, 5 μm; D, E, 10 μm).

Megascleres are generally styles but also anisostrongyles and subtylostyles: 300–1750 × 5–35 μm. Megasters are anthasters with 4, or more frequently, 6 strong rays that fork in 3–5 (generally 4), slightly curved strong spines, 40–80 μm in diameter. Microsters are strongylasters, 10–20 μm with 8–10 microspined rays, and oxyasters, 10–50 μm with 3–8 smooth rays and bifid tips.

Remarks. This monotypic genus from Australia was erected primarily for its unique shape of megasters, resembling anthasters as in the Hemiasterellidae genus *Axos* (Hooper, 1986). Other features unique amongst Tethyidae are the cortex and the skeleton structure, and the microsters are also very peculiar. On the whole, the massive shape, the poorly developed cortex, the branching and anastomosing skeleton with little fusiform styles as megascleres, and the abundance of sediment particles in the body place this genus near the Australian *Laxotethya* and the Caribbean *Tectitethya*.

BURTONITETHYA SARÀ, 1994

Synonymy

Burtonitethya Sarà, 1994: 358.

Type species

Tethya gemmiformis Burton & Rao, 1957 (by original designation).

Diagnosis

Tethyidae with subspherical body and a basal stalk, approximately as long as the body diameter. Cortex rich in lacunae, poorly developed; with a large central spicular nucleus placed at the insertion of the stalk skeleton in the radiate body skeleton. The nucleus is formed by clumps of thin strongyles and styles around the bases of the radiating bundles of megascleres, represented by strongyloxeas. Surface with peculiar button-like tubercles, fringed by megascleres projecting nearly horizontally to, or at very acute angles with, the surface. Megasters represented by oxyasters filling the whole sponge, very heterogeneous in size, and reaching giant dimensions, up to 300 μm in diameter. Microsters represented by strongylasters.

Description of type species

Burtonitethya gemmiformis Sarà, 1994 (Fig. 3A–F).

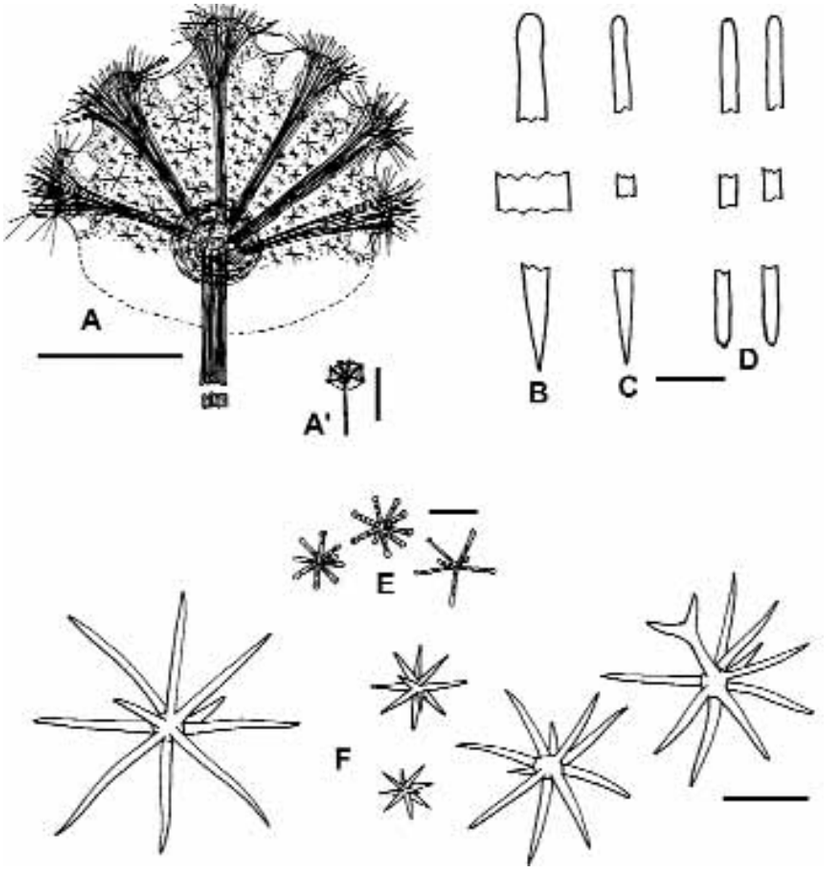

Fig. 3. *Burtonitethya gemmiformis*. A, reconstruction of the sponge structure. A', reconstruction of the whole body. B, main strongyloxea. C, accessory style. D, strongyles. E, micrasters. F, megasters (oxyasters) (scales: A, 4 mm; A', 10 mm; B–D, 20 μm; E, 10 μm; F, 100 μm).

Synonymy. *Burtonitethya gemmiformis* Sarà, 1994: 358.

Material examined. Holotype: BMNH 1957.7.15.1 (section slide) – Andaman Islands, NE. Indian Ocean, depth unknown. Other material. BMNH 1934.11.24.392 (section slide) – same locality.

Description. Body shape a depressed sphere 8 mm high and 10 mm broad. Overall height of body and stalk about 18 mm. Stalk 10 mm long formed by bundles of megascleres coated by a thin layer of micrasters. Cortex is less than 0.5 mm thick, with lacunae. Surface rough, with button-like tubercles, 0.5 mm high. Color pinkish-brown in ethanol. The body center is occupied by a large spicular nucleus formed by transverse and concentric rows of thin styles and strongyles, frequently slightly bent, around the bases of the strongyloxeas bundles. Main strongyloxeas of the radiating bundles very long, 2400 × 20 μm. Accessory strongyloxeas, styles and strongyles 200–600 × 3–10 μm. Auxiliary megascleres, besides the nucleus, are found along the main bundles and stop just below the surface. Megasters are oxyasters, 60–300 μm in diameter, with a small centrum about 10% of the ray length (R/C = 10). Rays 8–12, often irregularly bent in their apical and middle tract, sometimes forked or with rounded tips. Micrasters are slightly spined strongylasters, 10–12 μm in diameter, with the ray tips little enlarged, without centrum and with, on the average, 12 slender rays. The micrasters are uniform throughout the whole sponge and form a dense layer on the surface.

Remarks. This monotypic genus from the Indian Ocean was erected for a species mentioned in a manuscript of Burton and attributed to *Tethya*. But this species is sharply differentiated from the other *Tethya* species based on the distribution and shape of their megasters, represented by oxyasters (which fill the sponge with a heterogeneous set of sizes and include giant spicules), a reduced cortex, a stalk and a nucleus which surrounds the bases of megascleres and formed by peculiar spicules.

COLUMNITIS SCHMIDT, 1870

Synonymy

Columnitis Schmidt, 1870: 25; Sollas, 1888: 441; Lendenfeld, 1890a: 397; Sarà, 1994: 361; Sarà & Bavestrello, 1996: 374. *Donatia sensu* Burton, 1924: 1034. *Timea sensu* de Laubenfels, 1932: 47. *Tethya sensu* Wiedenmayer, 1977b: 171. Taxonomic decision for synonymy: Sarà, 1994: 361.

Type species

Columnitis squamata Schmidt (by monotypy).

Diagnosis

Tethyidae with a thickly encrusting or massive body, horizontally developed into winding branches and lobes. Surface with flattened, roughly hexagonal tubercles, contiguous above and separated below by grooves. Cortex indistinct but a thickening of asters under the surface is present (pseudocortex), with large

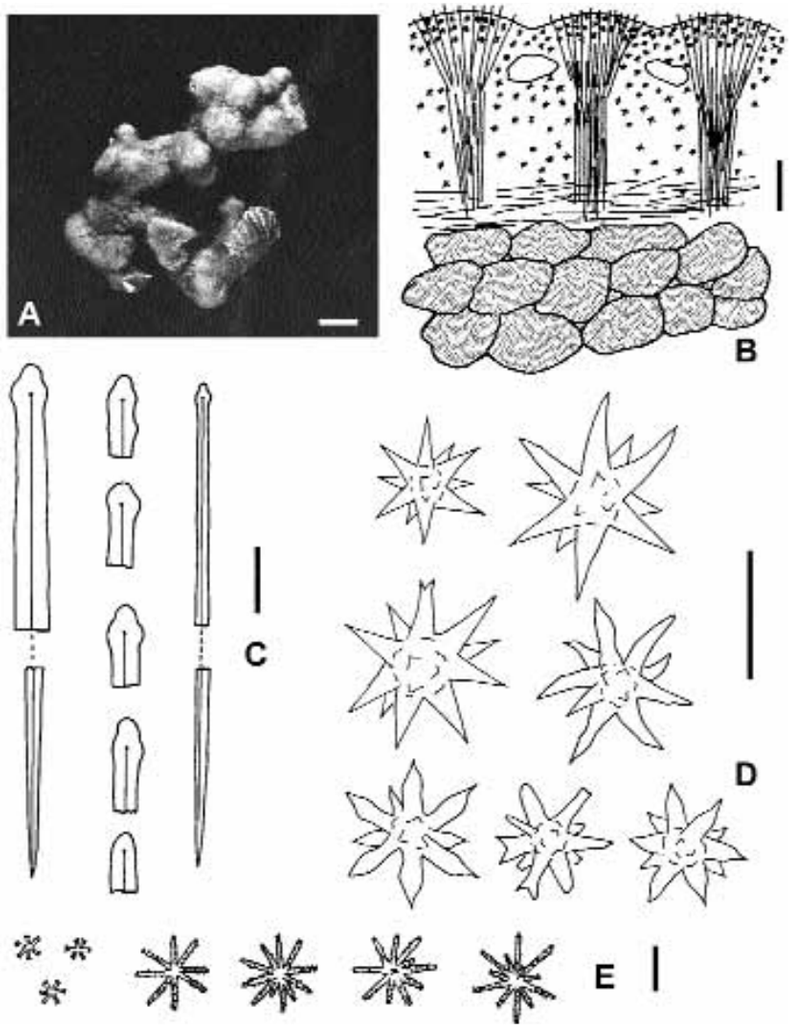

Fig. 4. *Columnitis squamata*. A, holotype. B, skeleton structure. C, subtylostyles. D, megasters. E, microsters (scales: A, 1 cm; B, 1 mm; C, 30 μm; D, 50 μm; E, 10 μm).

subdermal lacunes. Skeleton made by parallel bundles of megascleres ending in the tubercles and crossed in the inner part of the sponge by thinner megascleres isolated or in bundles. Megascleres are subtylostyles, sometimes styles. Megasters are oxyspherasters. Microsters are of two sizes: the larger represented by oxyasters and strongylasters, with rays almost completely covered by spines; the smaller particularly abundant on the sponge surface, and represented by tylasters. A large amount of sediment, forming a massive central core, is included inside the sponge.

Description of type species

Columnitis squamata Schmidt, 1870 (Fig. 4A–E).

Synonymy. *Columnitis squamata* Schmidt, 1870: 25; Sollas, 1888: 441; Sarà & Bavestrello, 1996: 374.

Material examined. Fragment of holotype: ZMB 6560 (slide) – from Schmidt type (lost) – "Antilles?". Other material. USNM 34537 – Florida, Gulf of Mexico (erroneously nominated as Neotype by Sarà & Bavestrello (1996)), USNM 34548, BA 831 – Florida, Gulf of Mexico.

Description. Irregular massive body horizontally developed with winding branches and rounded lobes. The erroneously nominated neotype measures 7.5 × 5 × 2.5 cm. Surface smooth, covered by flattened, roughly hexagonal tubercles. Parallel bundles of megascleres arise from the inner sediment core and end with fans in the tubercles. Thinner megascleres, generally in smaller transverse bundles or scattered, cross the main bundles in the inner part of the sponge, around the sediment core. Megascleres are subtylostyles, sometimes styles, 300–2000 × 3–30 μm. The vertically disposed main megascleres are generally 20–25 μm thick while the secondary transverse ones are only 5–10 μm thick. Megasters and microsters are densely distributed throughout the whole sponge but more heavily concentrated under the sponge surface in a pseudocortical layer. Megasters are oxyspherasters with rays often bent or swollen at their tips, 50–80 μm, R/C = 1–2. Microsters in two categories: strongylasters, sometimes oxyasters, with 12 spined rays, 15–25 μm and without center; and very small tylasters 3–5 μm diameter.

Remarks. This genus was erected by Schmidt for the species *C. squamata*, now represented only by a spicular slide from the type stored in the ZMB. After checking this slide

Sarà & Bavestrello (1996) identified three specimens from the Gulf of Mexico as belonging to *C. squamata*, and one of these specimens was erroneously chosen as neotype of the species. The existence of a surviving slide from the type in the ZMB, which is here recognised as the holotype (ICZN Art. 72.5.5), allowed Sarà & Bavestrello (1996: 374) to identify three subsequent specimens of this species (not from Schmidt's description but from the contents of the slide; ICZN Art. 75), negates the subsequent neotype designation. On the basis of a more precise characterization of *Columnitis* from this new material it was also possible to attribute to this genus the BMNH specimen 1938.b.30.38, labelled by Burton as "*Tethya anomala*" but not described. This specimen was described by Sarà & Bavestrello (1996) as a second species of *Columnitis, C. anomala*. Conversely, the BMNH specimen 1928.5.12.167 from the Crawshay collection (West Indies) labelled "*C. squamata*", does not belong to this species but to *Tectitethya crypta*.

Peculiar traits of *Columnitis* are the body shape, the inner core of sediment, and the occurrence of two categories of micrasters, well-differentiated in size and shape, also in the absence of a distinction between cortex and choanosome. The larger category of micrasters occurs only in *Columnitis*.

Two West Indies species: *C. squamata* is known from the Gulf of Mexico, off the south-western Florida coast, 30 m depth; *C. anomala* is known from the Caribbean, off the Nicaragua coast (Sarà & Bavestrello, 1996).

HALICOMETES TOPSENT, 1898

Synonymy

[*Cometella*], in part, Schmidt, 1870: 49 (*nomen oblitum*). *Tethya sensu* Schmidt, 1880b: 78; Sollas, 1888: 440. *Halicometes* Topsent, 1898a: 112; Topsent, 1920a: 32; de Laubenfels, 1936a: 145; Lévi, 1993: 27; Sarà, 1994: 361; Sarà & De Rosa Barbosa, 1995: 167; Sarà & Bavestrello, 1996: 255. *Tethycordyla* de Laubenfels, 1934: 8; Lévi, 1964a: 72. Taxonomic decision for synonymy: Sarà, 1994: 362.

Type species

Halicometes stellata (Schmidt, 1870: 49) (by original designation).

Diagnosis

Tethyidae with an ovoid body and a basal stalk 2–4 times longer than the body height. Cortex indistinct or poorly developed. Exotyles on the surface of the stalk, sometimes rare or even lacking. The megascleres occur in radiating bundles, bristling at the surface tubercles, and may be strongyloxeas, anisostrongyles or styles. The megasters, distributed throughout the sponge, are oxyasters or oxyspheraster of different sizes, including giant spicules (more than 150 μm in diameter). Micrasters may be strongylasters, chiasters, tylasters, sometimes oxyasters.

Description of type species

Halicometes stellata (Schmidt, 1870) (Fig. 5A–G).

Synonymy. [*Cometella*] *stellata* Schmidt, 1870: 49. *Tethya caudata* Dezso, 1879: 648. *Tethya cometes* Schmidt, 1879: 78. *Tethya stellata* Sollas, 1888: 440. *Halicometes stellata* Topsent, 1898a: 112; Topsent, 1920a: 32.

Material examined. Lectotype: MZS.PO 114 A. Syntypes: MZS.PO 114 A, B – two specimens labelled "*Tethya cometes* O. Schm. 24° 8N, 82° 51W (329–339 Fd) Golf v. Mexico. Agassiz 1876". This material comes from the locality (North of Cuba) and from the depth of the original description by Schmidt. It represents the two extremes of a range of variability from an hispid and a smooth variety of the species as described by Schmidt (1879: 78) in an enlargement of the species diagnosis. MZS.PO 114C – labelled "*Tethya cometes* O. Schm. Golf v. Mexico. Agassiz". BMNH 1939.2.10.38, BMNH 1870.5.3.98 (teased fragments).

Description. With an ovoid body, 7 mm high and a basal stalk 22 mm long. In the body, radiating megasclere bundles ending in hispid cylindrical tubercles (in the more frequent variety). Less frequently, in another variety, tubercles are smooth. Megascleres of the choanosomal bundles are strongyloxeas, slightly flexuous (not anisostrongyles as indicated by Topsent, 1920a): 1900–2250 × 30–35 μm (15–20 μm at the base). In the stalk they are styles up to 3000 × 30 μm. Auxiliary megascleres, bristling also in the tubercles, are thinner styles, slightly flexuous, 800–1000 × 10–12 μm. Megasters of the body and stalk are oxyspheraster, with 18–20 rays, very heterogeneous in size, 15–180 μm, with R/C = 1.2–1.8. The R/C is higher in the hispid variety. Micrasters are chiasters, with 12 microspined rays, covering a dense layer at the surface of the body and stalk and also scattered inside the sponge. They have a diameter of 10–15 μm, and a centrum, more marked in the smooth variety. The stalk is bristled by numerous exotyles, often flexuous, 45–325 × 5–7 μm. In the stalk there are also anomalous asters with a reduced number of rays and differing in the shape of tetractines, triactines or diactines, 50–70 μm in diameter.

Remarks. The synonymy of *Tethycordyla* (stalked Tethyidae without exotyles) with *Halicometes* (stalked Tethyidae with exotyles) was established by Sarà (1994) on consideration that, at the present state of knowledge, the lack of the stalk exotyles as a unique distinctive trait is not sufficient to differentiate these nominal genera. In addition to the fact that a single spicular trait, even if important, should be used more for discriminating species than genera, the exotyles if rare may be easily overlooked or lost in the preservation of the very tiny specimens of *Halicometes*.

[*Cometella*] Schmidt, 1870 originally included [*Cometella*] *gracilior* Schmidt, 1870 (=*Asbestopluma*) and [*Cometella*] *stellata* Schmidt, 1870. De Laubenfels, 1936: 151 designated the former as type species of [*Cometella*] and thus *Cometella* is a cladorhizid (proposed to be suppressed under ICZN Art. 29.3., see Hajdu & Vacelet, this volume).

Halicometes is sharply differentiated from *Tethya*, not only for the stalk and the deep-water habitat, but also for the indistinct or reduced cortex and the megaster shape, size and distribution. Based on megaster shape and size, and the occurrence of giant spicules, *Halicometes* slides in museum collections (such as the BMNH) are sometimes erroneously labelled as *Tethya repens* Schmidt (or *Donatia repens*). However, *Tethya repens* Schmidt 1870 from Florida is a *species inquirenda*, likely a *Stellitethya*, but this cannot be unequivocally identified at the species level because its description is insufficient and the type is represented only by a spicule slide. Presently *Halicometes* contains six species from deep waters (150–2100 m depth) of the Atlantic and Indo-Pacific regions *Halicometes stellata* (Schmidt 1870) has been found off Cuba (650 m depth) and the Gulf of Mexico (619 m depth); *H. thyris*

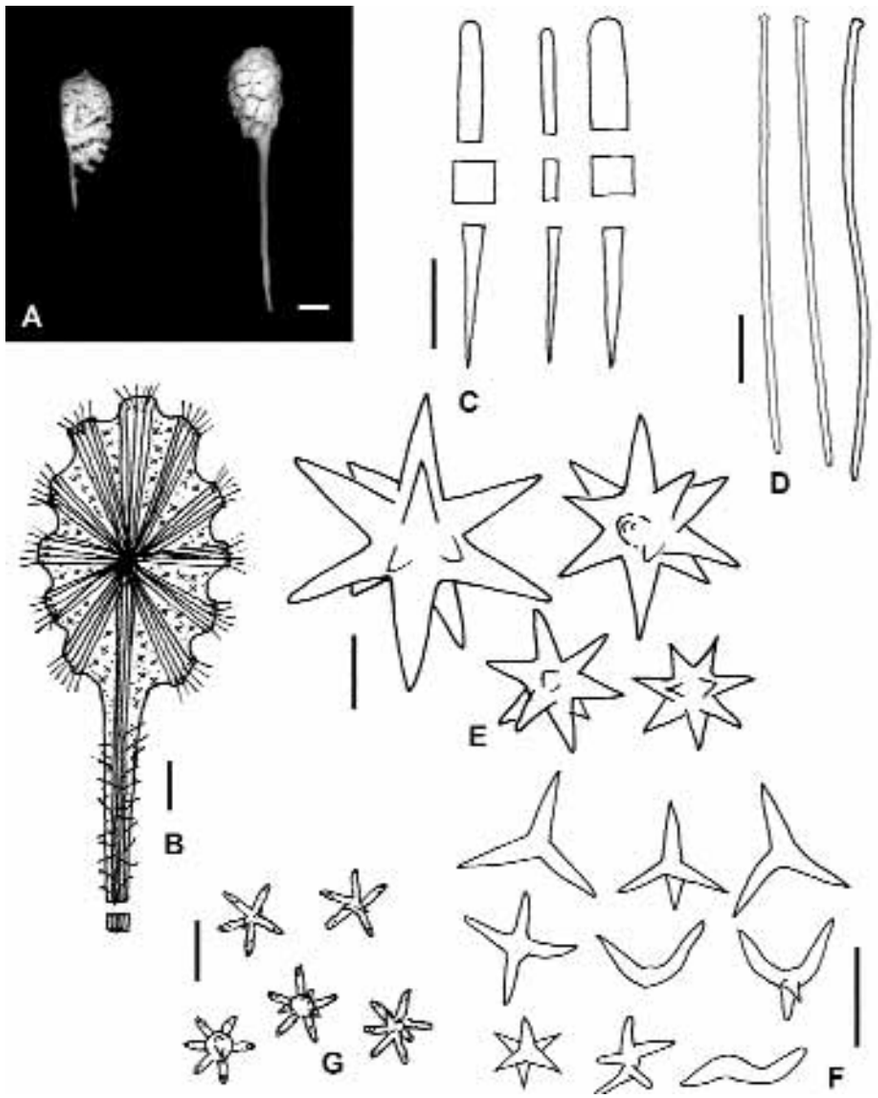

Fig. 5. *Halicometes stellata*. A, the two syntypes (on the left the hispid syntype chosen as lectotype, on the right the smooth syntype). B, sponge structure. C, megascleres (main strongyloxea, auxiliary style and stalk style). D, exotyles. E, megasters. F, anomalous stalk megasters. G, microsters (scales: A, 2 mm; B, 1 mm; C, 60 μm; D–F, 50 μm; G, 10 μm).

(de Laubenfels 1934) off Puerto Rico (350 m); *H. pediculata* (Lévi, 1964a) off Durban (South Africa, Indian Ocean, 495 m); *H. hooperi* Lévi, 1993, off New Caledonia (2100 m); *H. minuta* Sarà & De Rosa Barbosa, 1995 off the Brazilian coast (190 m); *H. stonei* Sarà & Bavestrello, 1996, west of Andaman Islands (732 m).

LAXOTETHYA SARÀ & SARÀ, 2002

Synonymy

Laxotethya Sarà & Sarà, 2002.

Type species

Laxotethya dampierensis Sarà & Sarà, 2002 (by original designation).

Diagnosis

Tethyidae with massive irregular body, ill-defined cortex and surface covered by irregular tubercles and sinuous ridges. Megasclere skeleton formed by subtylostyles packed in winding, more-or-less compact tracts and scattered in the interstices. The tracts branch and anastomose, and generally ascend towards the surface, ending in fans. Microscleres are only microsters, mainly tylasters, but also smaller oxyasters, filling the whole body. Sediment particles are abundant on the surface and inside the sponge.

Description of type species

Laxotethya dampierensis Sarà & Sarà, 2002 (Fig. 6A–G).

Synonymy. *Laxotethya dampierensis* Sarà & Sarà, 2002.

Material examined. Holotype: WAM Z3948 – Dampier Archipelago, Western Australia, depth 20 m.

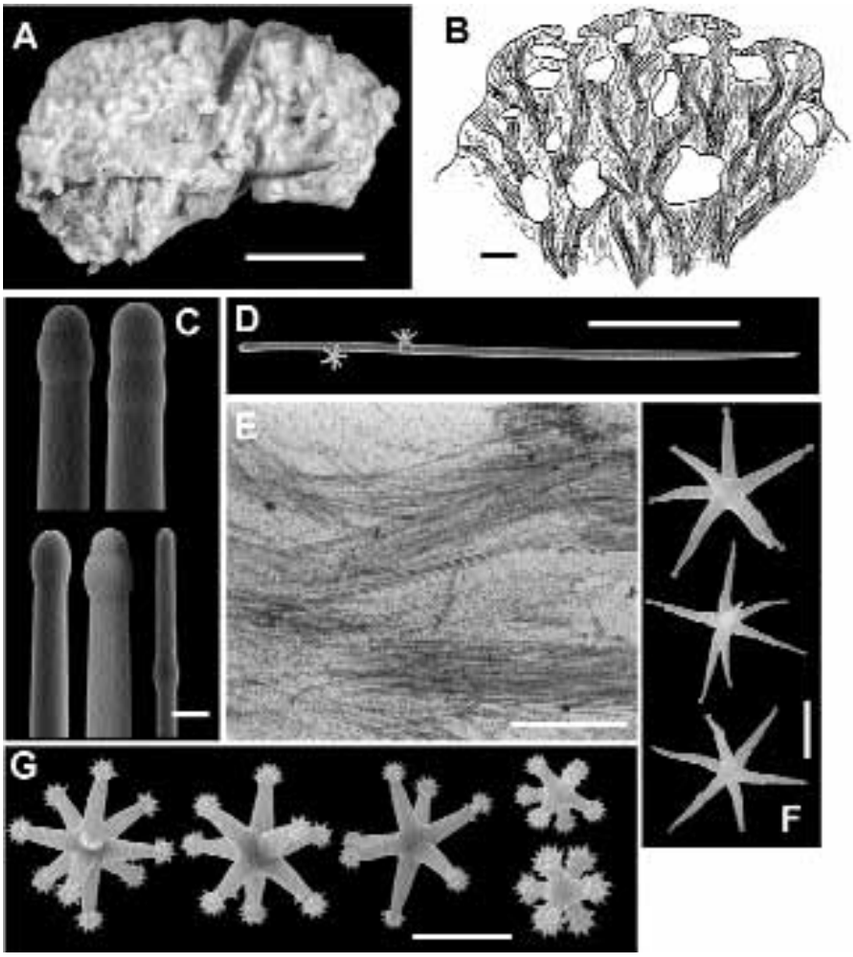

Fig. 6. *Laxotethya dampierensis*. A, holotype. B, skeleton structure. C, tylote and subtylote bases of megascleres. D, megasclere. E, convergence and forking of megasclere tracts. F, oxyasters. G, small and large tylasters (scales: A, 2 cm; B, 1 mm; C, G, 10 μm; D, 100 μm; E, 500 μm; F, 5 μm).

Description. Cushion-shaped compressed body of 5.5 × 3 × 3 cm. The scabrous and uneven surface is covered by irregular tubercles, 1–3 mm broad, 1–2 mm high, fused partly into winding ridges. The cortex is macroscopically indistinct and may be observed only as a 0.5 mm wide histologically peculiar zone. The aquiferous system shows some small oscules, grooves harboring cribriporal areas, and several lacunae throughout the body. Consistency firm and color (in ethanol) whitish-brown externally and internally. Megasclere tracts ascend towards the surface where they end in small fans, and may be compact or loosened, run in a winding pattern, branching and anastomosing. The interstices between tracts are filled by abundant scattered megascleres. Generally the skeleton pattern may be defined as dendritic reticulate. Megascleres are short subtylostyles, sometimes tylostyles and styles, 300–920 × 5–20 μm. Megasters are absent. Micrasters are generally tylasters, 10–20 μm, smaller in the micraster crust of the surface zone, with 4–12 rays bearing spiny knobs, or more rarely oxyasters, 5–15 μm in diameter, with 4–10 thin rays and often with a small apical knob.

Remarks. This monotypic genus from Australia was erected for a Tethyidae characterized by an extensive loosening, anastomosing and branching of the ascending megasclere tracts, producing a skeleton pattern that may be defined as dendritic-reticulate. Other peculiarities are the body shape, the subtylostyle, and sometimes tylostyle megascleres, the lack of megasters and the abundance of sediment. These traits put this genus near the Australian *Anthotethya* and the Caribbean *Tectitethya*.

NUCLEOTETHYA SARÀ & BAVESTRELLO, 1996

Synonymy

Nucleotethya Sarà & Bavestrello, 1996: 380.

Type species

Nucleotethya bifida Sarà & Bavestrello, 1996 (by original designation).

Diagnosis

Tethyidae with a conical or ovoid massive body. Surface with flattened, rounded or polygonal tubercles. Cortex indistinct, marked only by the density of asters. Skeleton composed of radiating bundles of megascleres ending in the tubercles, and in the inner part of

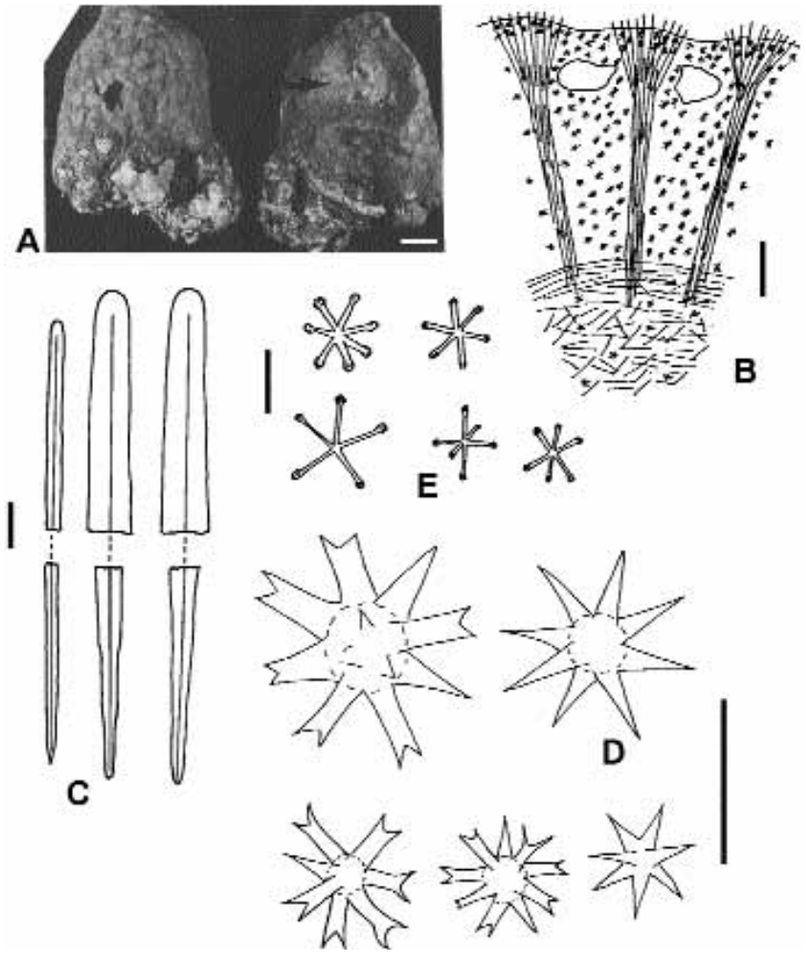

Fig. 7. *Nucleotethya bifida*. A, holotype. B, skeleton structure. C, styles. D, megasters. E, microasters (scales: A, 1 cm; B, 1 mm; C, 30 μm; D, 100 μm; E, 5 μm).

the sponge by transverse bundles of thinner megascleres crossing the radiating bundles and surrounding a large spicular nucleus (about 0.5–0.66 of the sponge diameter). The nucleus is made of a confused network of megascleres accompanied by megasters, microasters and sediment. Megascleres are styles and subtylostyles. Megasters are oxyspheraster and microasters tylasters. Surface covered by sediment, abundant also inside the sponge.

Description of type species

Nucleotethya bifida Sarà & Bavestrello, 1996 (Fig. 7A–E).

Synonymy. *Nucleotethya bifida* Sarà & Bavestrello, 1996: 380.

Material examined. Holotype: USNM 34558 – SW Florida coast, Gulf of Mexico, 85 m depth. Paratypes: USNM 34559, BA 477 – same locality.

Description. Body irregularly conical ($6 \times 3 \times 5$ cm for holotype and one paratype) or ovoid (the other paratype). The color (in ethanol) is brownish gray at the sandy surface and pink-brown in the interior. The consistency is hard, incompressible. One small oscule located on the top of the sponge. Large subdermal lacunes under the pseudocortex. The surface is finely hispid and covered by sediment. The tubercles are flattened, 2–4 cm in diameter, rounded or with a roughly polygonal outline. The skeleton is composed of radiating bundles of styles or subtylostyles, sometimes anisostrongyles, 800–2300 × 20–30 μm, ending in tubercles with fan-like expansions. The transverse rows are composed of thinner styles, 350–1600 × 5–10 μm. The styles in the nucleus measure 300–2000 × 5–20 μm. Megasters are oxyspheraster 40–160 μm in diameter (in the nucleus 30–80 μm) with R/C = 1–1.5, and rays generally truncated with forks and teeth. Microasters are tylasters with slender rays and swollen tips, in diameter 7–12, sometimes 15–18 μm.

Remarks. The genus *Nucleotethya* was established primarily for its nucleus, which strongly differs in its structure from other nuclei occasionally found in Tethyidae. Other distinctive characters differentiating it from *Tethya* are the indistinct cortex, the large size of the megasters, and the megascleres represented generally by styles or subtylostyles. *Nucleotethya* belongs to the same clade as *Columnitis* and *Tectitethya* based on its external appearance, the indistinct cortex, the megasclere shape and the abundance of sand. The only known species comes from SW Florida coast.

OXYTETHYA SARÀ & SARÀ, 2002

Synonymy

Oxytethya Sarà & Sarà, 2002.

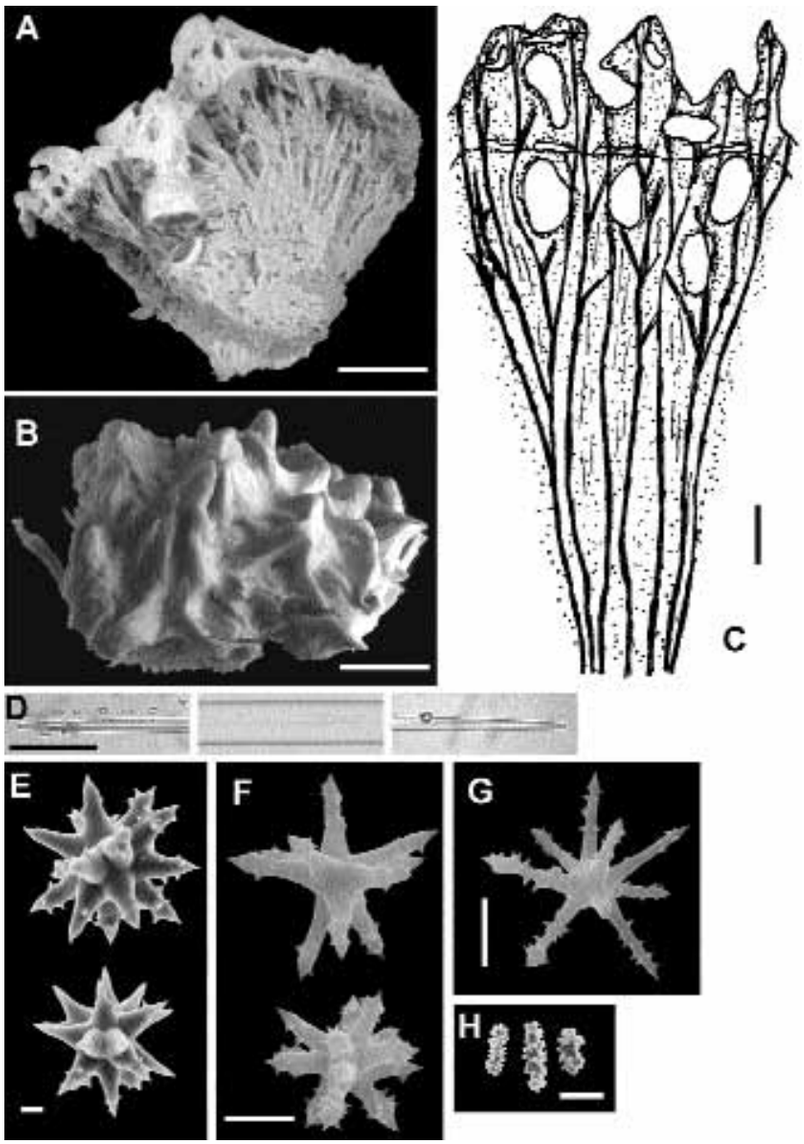

Fig. 8. *Oxytethya mirabilis*. A, holotype, lateral view. B, holotype, view of the surface. C, skeletal structure. D, oxea in three sections. E, oxyspherasters. F, oxyasters. G, oxyaster/strongylaster. H, polyrhabds (scales: A, B, 2 cm; C, 1 cm; D, 100 μm; E, 2 μm; F, G, 5 μm; H, 10 μm).

Type species

Oxytethya mirabilis Sarà & Sarà, 2002 (by original designation).

Diagnosis

Tethyidae with globose, subspherical or spherical body and radiate skeleton. Cortex well developed. Surface with high pinnacles and crests. Megascleres are oxeas with similar ends and widest at the middle of the spicule. Megasclere tracts branch and anastomose in the choanosome. Microscleres are represented only by microasters, which are oxyasters, oxyspherasters, and polyrhabds.

Description of type species

Oxytethya mirabilis Sarà & Sarà (Fig. 8A–H).

Synonymy. *Oxytethya mirabilis* Sarà & Sarà, 2002.

Material examined. Holotype: AM Z5684 – Long Reef, New South Wales, SE Australia, depth 37.5 m.

Description. The holotype, represented by a large fragment of a radial sector of the body, 9.5 × 8 cm, is reconstructed to probably be globose (subspherical or spherical), with a probable diameter of about 12–16 cm. The cortical surface is covered by pinnacles, 2.5 cm high, connected by crests irregularly spaced and sometimes fused. The surface texture is characterized by megasclere tracts, visible in transverse section, with the cortex under the pinnacles and crests having a thickness of 2–3 cm. The aquiferous system shows large lacunae in the cortex and choanosome. The consistency is elastic, the color in ethanol is pale brownish. Megascleres radiate in partially winding tracts and may branch, but also anastomose in the choanosome. They run tangential to the surface, ending without fan expansions in the pinnacles and crests. Main megascleres

are giant oxeas, 4000–4970 × 50–65 μm, straight or moderately bent in the middle, with similar tips sometimes sharp but more often a little blunt or tapered. Auxiliary megascleres are also oxeas, 180–210 × 3–5 μm. Megasters are absent. Microsters are represented by a varied set of oxyspherasters, oxyasters, oxyasters/strongylasters. Other microscleres are polyrhabds. Oxyspherasters and oxyasters with a more-or-less developed center, measuring 8–20 μm in diameter, with 12–16 short conical rays, with rays generally spiny. The rarer oxyasters/strongylasters measure 15–20 μm in diameter, with 8–12 cylindrical spiny rays, and sometimes a poorly developed center. The polyrhabds are varied in size and shape, 10–16 × 3–10 μm, with irregularly verticillated spines.

Remarks. *Oxytethya* is a very distinct genus of Tethyidae, so far known only from the Pacific coast of SE Australia characterized primarily by the extraordinary occurrence of oxeas as main and auxiliary megascleres but also by the surface structure and the lack of megasters. In some traits, such as the occurrence of polyrhabds, there is a similarity to some *Tethya*, and consequently its phylogenetic position is likely to be near the *Tethya* clade. An association of oxeas with euasters occurs also in *Asteropus* Sollas, 1888 and *Melophlus* Thiele, 1899. Both these genera were transferred to Ancorinidae (Hajdu & Van Soest, 1993), and *Oxytethya* differs sharply from them in its skeleton (formed by well-defined radiating megasclere tracts) and without their specialized tangential ectosomal skeleton. The microrhabds of *Melophlus* are different from the polyrhabds of *Oxytethya* and other Tethyidae.

STELLITETHYA SARÀ, 1994

Synonymy

Tethya sensu Schmidt, 1870: 51; Wiedenmayer, 1977b: 172. *Donatia sensu* Hentschel, 1909: 374. *Tethytimea sensu* Burton, 1937: 12; Thomas, 1968a (thesis unpublished); Thomas, 1980: 14. *Stellitethya* Sarà, 1994: 362; Sarà & Bavestrello, 1996: 257. Taxonomic decision for synonymy: Sarà, 1994: 362.

Type species

Stellitethya extensa (Hentschel, 1909) (by original designation).

Diagnosis

Tethyidae with a body of large size and irregularly massive shape, sometimes subspherical, frequently thick encrusting. Without a distinct cortex. Megascleres styles or strongyloxeas (fusiform styles), vertically crossing the sponge in parallel bundles and ending in large flattened tubercles at the surface. Megasters represented by oxyspherasters, filling the whole sponge, heterogeneous in size, and including giant spicules (more than 150 μm in diameter and reaching 500 μm in two species). Microsters usually represented by tylasters.

Description of type species

Stellitethya extensa (Hentschel, 1909) (Fig. 9A–F).

Synonymy. *Donatia fissurata* var. *extensa* Hentschel, 1909: 374. *Stellitethya extensa* Sarà, 1994: 362. *Tethya repens*; Hooper & Wiedenmayer, 1994: 425.

Material examined. Lectotype: BMNH 1925.11.1111 (slide from ZMH syntype). Hooper & Wiedenmayer (1994) report the following type data. Syntypes: ZMB 6589 (2 slides), slide BMNH 25.11.1111 (slide from type material), ZMB 4267 (fragment of type), BMNH (unregistered slide, ex ZMH 1530 2/54). Lectotype locality: NW of Middle Bluff Shark Bay, Western Australia, 7–8 m depth, rocky bottom with corals. The locality of the other syntype is not recorded.

Description. The two specimens described by Hentschel differ in shape and size but are apparently similar in their spicular traits. The lectotype is cushion shaped and thickly encrusting (9.5 × 6 × 1.5 cm). The skeleton shows parallel megasclere bundles that run from the sponge base to the tubercles, where they expand into large fans. The other dry syntype, represented in Fig. 9 (reproduced from the original illustration of Hentschel, 1909), is irregularly massive (19 × 11 × 6.5 cm). Cortex is indistinct. Surface with contiguous flattened tubercles, variable in breadth and height. In the lectotype they are 1–3 mm broad, often low and only in some places 3 mm high. In the syntype they are 3–10 mm broad and high. The surface is covered with sediment, which is also found inside the sponge, and by a thick layer of tylasters. External color (in ethanol) is reddish-yellow on the free surface. Main and auxiliary megascleres are styles, sometimes distally abbreviated. In the lectotype the largest megascleres are generally anisostrongyles. Their sizes (reported by Hentschel) for the main and auxiliary megascleres are respectively of 1056–2560 × 35–52 μm and 701–1353 × 12–21 μm (700–3250 × 5–60 μm from re-examination of the lectotype). Megasters are oxyspherasters with 20–24, sometimes dichotomous rays, 20–200 μm in diameter, R/C = 1–1.5, generally 1.25. Microsters are tylasters with 10–12 slender rays, 10–13 μm (10–19 μm according to Hentschel).

Remarks. The two specimens described by Hentschel (1909), and considered to be the syntypes differ in shape and size but are similar in spicular traits. The lectotype designation is made for ZMB 6589 on the basis that it has a known type locality and the skeleton structure is known and can be corroborated with Hentschel's description. The other syntype has not been designated as paralectotype because it has yet been personally examined by me.

The first record of a species pertaining to the genus *Stellitethya* may be *Tethya repens* Schmidt, 1870 from Florida. Unfortunately, Schmidt's description is incomplete and the only clue for this possible assignment is its thickly encrusting shape. Type material is represented only by the spicule slide BMNH 1870.5.3.91, which shows some resemblance in its megasters with those of *S. stellagrandis*, but this material is not sufficient to conclusively decide on the precise taxonomic status of *repens*. Consequently, Sarà (1994) chose *Donatia fissurata* var. *extensa* as type species (*Donatia fissurata* Lendenfeld, 1888: 48, should be assigned to *Tethya* according to the original description). However, *Tethya repens* has been also attributed to the genus *Tethytimea* de Laubenfels, 1936a because, erroneously, Burton (1924) considered *Donatia tylota* Hentschel, 1912, the type species of *Tethytimea*, as a synonym of *T. repens. Stellitethya* is, however, differentiated from *Tethytimea* by many important structural and skeletal characters. Stalked specimens from the Andaman Islands have also been assigned to *Donatia repens* by Dendy & Burton (1926), but these likely belong to *Halicometes*. Indeed, I have found that under the name '*Tethya repens*' or '*Donatia repens*' there are labelled slides or specimens in the BMNH which belong to other species of *Stellitethya*, such as *S. murrayi*, but also perhaps to the very different genus *Halicometes* (for the size and shape of the megasters).

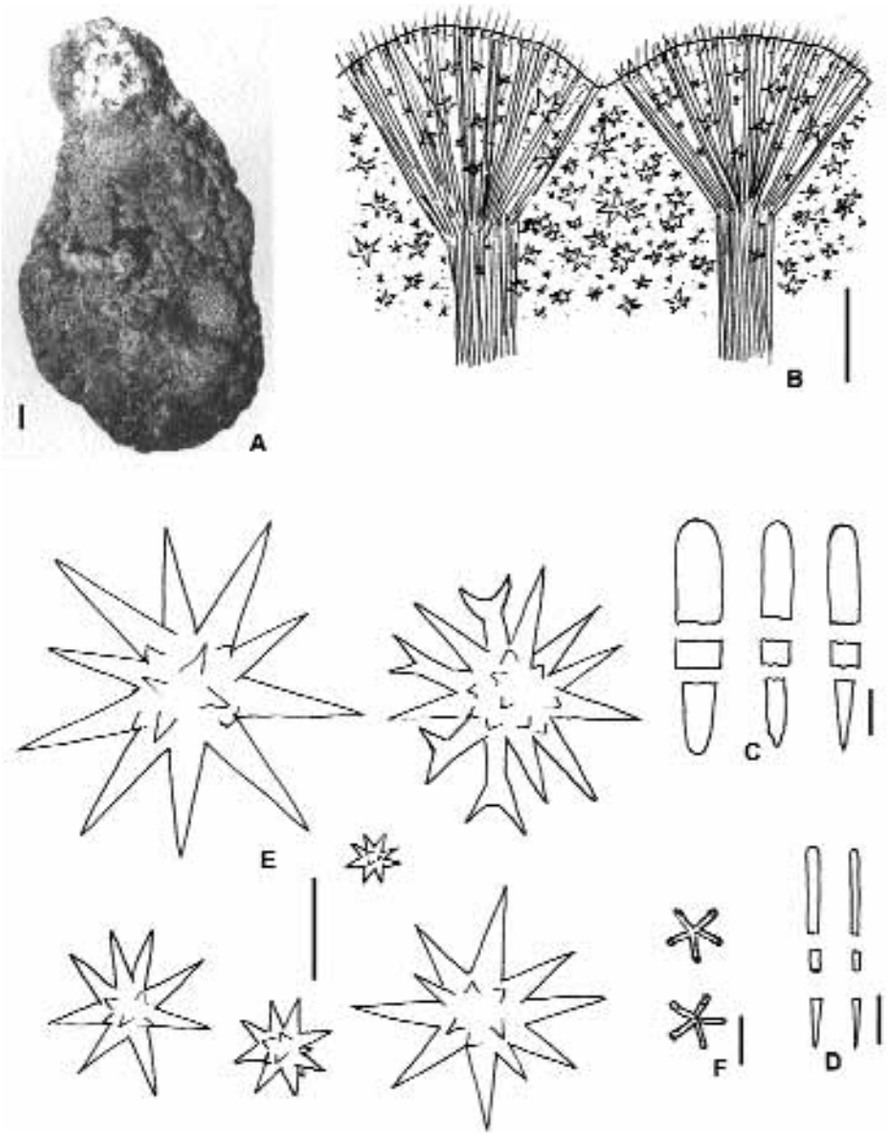

Fig. 9. *Stellitethya extensa*. A, the syntype figured by Hentschel. B, skeleton structure (lectotype). C, main styles and anisostrongyles. D, auxiliary styles. E, megasters. F, micrasters (scales: A, 1 cm; B, 1 mm; C–E, 50 μm; F, 10 μm).

The genus contains four species from the Indian Ocean, South Arabian coasts (Sarà & Bavestrello, 1996) and S Western Australia (Hentschel, 1909), with depth range 40–70 m. The possible extension of the geographic range of the genus to the West Indies depends on a more certain attribution of *Tethya repens* to *Stellitethya*.

TECTITETHYA SARÀ, 1994

Synonymy

Cryptotethya sensu de Laubenfels, 1949b: 20 (not: Dendy, 1905). *Tethya sensu* Reiswig, 1971: 569; Wiedenmayer, 1977b: 171. *Tectitethya* Sarà, 1994: 362; Sarà & Bavestrello, 1996: 381. Taxonomic decision for synonymy: Sarà, 1994: 362.

Type species

Tectitethya crypta (de Laubenfels, 1949b) (by original designation).

Diagnosis

Tethyidae with a massive, amorphous, irregularly conical, cylindrical or plurilobate body of large size. The cortex is ill defined, nearly indistinct. Tubercles flattened and irregularly rounded, of different size. The surface is covered by sediment or sea-weed, and sediment may also be found inside the sponge. Megascleres are anisostrongyles or strongyles, frequently with subtylote heads, forming stout bundles that end in fans at the tubercles and frequently branch and anastomose along their course.

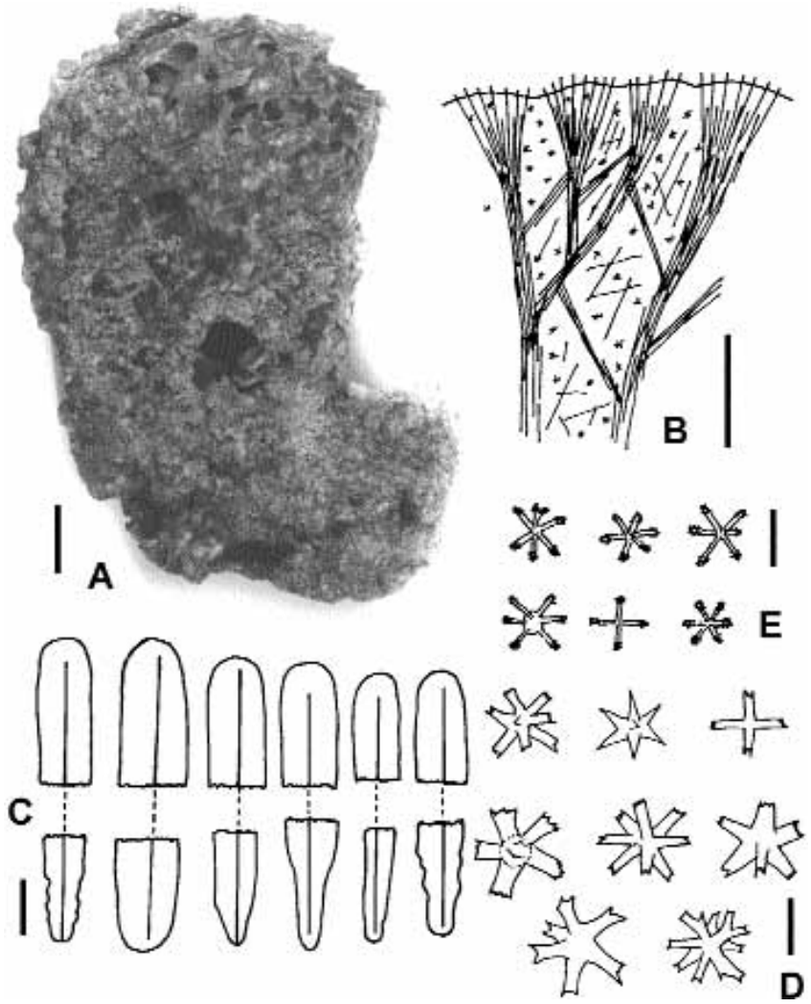

Fig. 10. *Tectitethya crypta*. A, paratype. B, skeleton structure. C, anisostrongyles. D, megasters. E, microasters (scales: A, B, 1 cm; C, D, 20 μm; E, 10 μm).

Scattered megascleres lie in the interstices among the bundles. Megasters, sometimes rare, are represented by oxyspheraster of small or medium size, with rays frequently reduced or anomalous. Microasters are represented by strongylasters or oxyasters.

Description of type species

Tectitethya crypta (de Laubenfels) (Fig. 10A–E).

Synonymy. *Cryptotethya crypta* de Laubenfels, 1949b: 20; *Tethya crypta* Reiswig, 1971: 569; Wiedenmayer, 1977b: 171; *Tectitethya crypta* Sarà, 1994: 362; Sarà & Bavestrello, 1996: 383.

Material examined. Holotype: AMNH 473, in two fragments – Bimini, Bahamas. Paratype: AMNH 500 – same locality. Other material. *Tethya crypta*: USNM 30278 – Bimini. Pulitzer-Finali coll. BW4 – Bimini. SDC 10 – San Domingo. Pansini coll. 2206 – San Salvador (Little Bahamas). *Columnitis squamata*: BMNH 1928.1.12.167 – Crawshay collection, West Indies.

Description. According to de Laubenfels (1948) the body is amorphous, often of fist size or in slabs, $4 \times 7 \times 12$ cm, but it may also be conical, hemispherical or stubby cylindrical (Wiedenmayer, 1977b), covered on much of its surface by low, irregularly rounded and flattened tubercles, 3–5 mm in diameter, and by abundant sediment. Color of the surface, devoid of sediment, gray-olive. Megascleres in radiating bundles frequently branched and fused, described by de Laubenfels as strongyloxeas, but are generally anisostrongyles to strongyles, 500–1400 × 10–40 μm. Megasters are represented by oxyspheraster occurring throughout the sponge, but generally in reduced number, with forked rays and other anomalies, 10–50 μm in diameter, R/C = 1–2. Ray tips frequently rounded with ray length twice their basal width. Microasters are strongylasters, sometimes oxyasters, 8–12 μm in diameter.

Remarks. The name *Tectitethya* refers to the species described as *Tectitethya crypta* by de Laubenfels (1949b) and subsequently included in *Tethya* by Reiswig (1971). This species has been carefully re-described by Wiedenmayer (1977b), but always attributed to *Tethya*. Conversely, Sarà (1994) and Sarà & Bavestrello (1996) showed clearly by the body shape and skeleton structure that *T. crypta* is not a *Tethya* but belongs to a separate genus. It cannot be called *Cryptotethya* because this name was previously used by Dendy (1905) for a species (*C. agglutinans*) which is not a Tethyidae and bears no affinities to *C. crypta*. Striking differences of *Tectitethya* from *Tethya* are seen in the branching and anastomosing megasclere bundles, the lack of a cortex, the megasclere type represented by strongyles or anisostrongyles, and the megaster and microaster shape. The genus contains four shallow-water species, all found in the Caribbean (Sarà & Bavestrello, 1996).

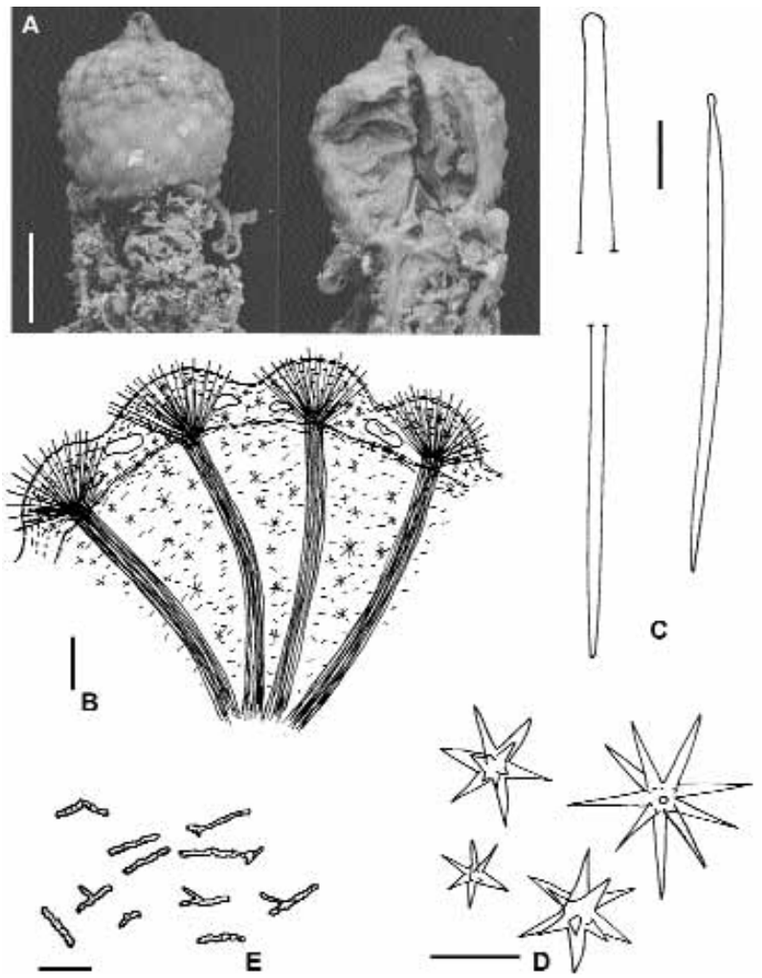

Fig. 11. *Tethyastra oxyaster*. A, holotype. B, skeleton structure. C, strongyloxeas. D, megasters. E, polyrhabds (scales: A, 1 cm; B, 1 mm; C, 50 μm; D, 100 μm; E, 10 μm).

TETHYASTRA GEN.NOV.

Synonymy

Tethyorrhaphis sensu Burton, 1934a: 568. *Tethya sensu* Bergquist & Kelly-Borges, 1991: 60.

Type species

Tethyorrhaphis oxyaster Burton, 1934a: 568 (here designated).

Diagnosis

Tethyidae with a subspherical body with rounded tubercles and distinct but thin cortex. Megascleres are strongyloxeas arranged in radiating bundles. Megasters are represented by oxyasters filling the whole sponge, very heterogeneous in size, and with giant spicules. Microasters are spiny microrhabds, sometimes with branches.

Description of type species

Tethyastra oxyaster (Burton, 1934a) (Fig. 11A–E).

Synonymy. *Tethyorrhaphis oxyaster* Burton, 1934a: 568; *Tethya oxyaster* Bergquist & Kelly-Borges, 1991: 60.

Material examined. Holotype: BMNH 1930.8.13.30 (section slide BMNH 1930.8.13.30a) – Great Barrier Reef, Australia, 65 m depth, mud bottom.

Description. Body subspherical, 2 cm in diameter, with rounded tubercles and an apical oscule. Cortex thin, about 0.5–1 mm thick, but distinct and with lacunes. Megascleres are strongyloxeas, 1120 × 24 μm, in distally bent bundles. Megasters are oxyasters, very heterogeneous in size. Choanosomal oxyasters 20–200 μm in diameter, cortical oxyasters, sometimes with a small centrum, 20–120 μm. Ray number: 8–12. Microasters are spiny polyrhabds sometimes with branches (according to the description of Burton, spirasters with lateral branches). They measure 5–20 × 1–3 μm (3–18 μm according to Burton).

Remarks. The genus *Tethyorrhaphis*, to which Burton (1934a) attributed *T. oxyaster*, was established by Lendenfeld (1988) for Tethyidae species, such as *T. laevis* (Lendenfeld) with polyrhabds in addition to microasters. Bergquist & Kelly-Borges (1991), on the basis of a new species with polyrhabds (*Tethya communis*), placed *Tethyorrhaphis* in synonymy with *Tethya*, and then also *Tethyorrhaphis oxyaster*. I agree with this synonymy except for

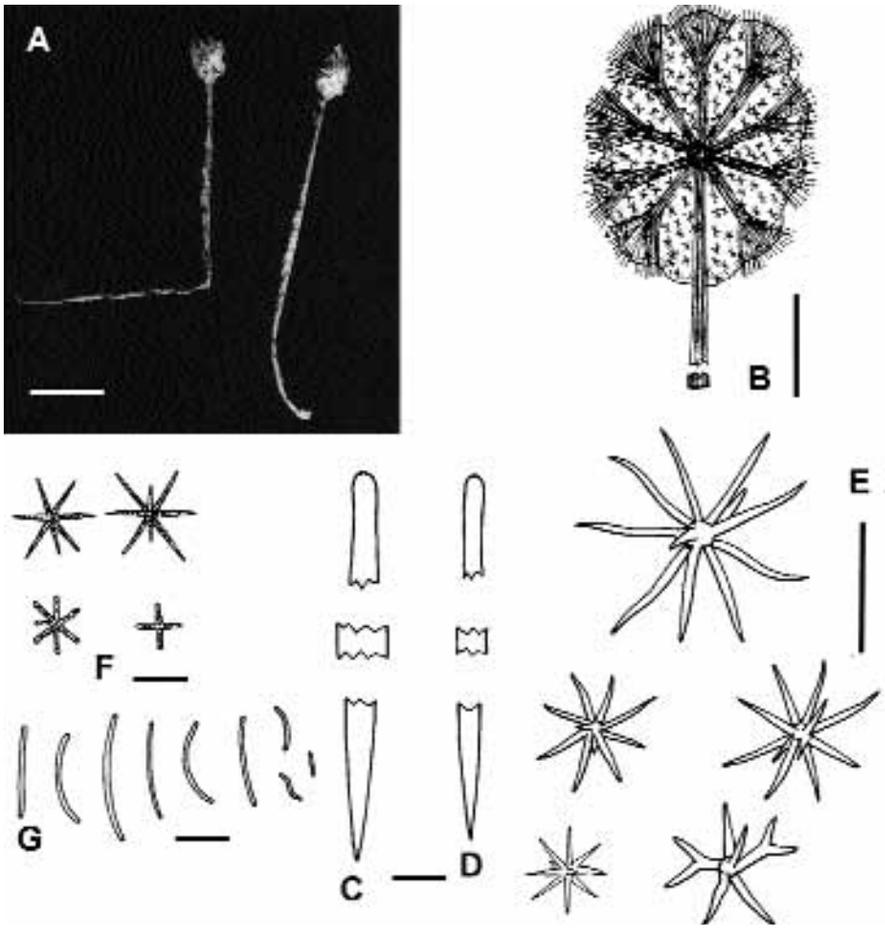

Fig. 12. *Tethycometes sibogae*. A, holotype (on the right) and paratype. B, sponge structure. C, basal strongyloxea. D, distal strongyloxea. E, megasters (oxyasters). F, micrasters. G, microstrongyles (scales: A, 5 mm; B, 1 mm; C, D, F, 10 μm; E, 100 μm; G, 50 μm).

the inclusion of *T. oxyaster*. Indeed, a single trait such as the occurrence of polyrhabds in addition to micrasters, may be considered as species descriptor but not for the establishment of a new genus. But this is not the case for *T. oxyaster*. This species differs from other species of *Tethya* not only for the polyrhabds, but more importantly, for the role of the megasters in the skeleton structure accompanied by a reduced cortex, and the megaster features (shape, size and distribution). The megasters are represented by oxyasters, with a wide range of sizes and reaching giant dimensions, and are distributed uniformly and densely throughout the whole sponge. The distribution pattern, as well as the shape and size of the oxyasters, is more similar to the genus *Stellitethya* than to other species of *Tethya*. But *T. oxyaster* cannot be attributed to *Stellitethya* given its globose regular shape, accompanied by a radiating megasclere skeleton and a distinct cortex. It is therefore a representative of a new genus, somewhat intermediate for its reduced cortex and megaster geometry, between *Tethya* and *Stellitethya*. The genus contains only one species from the Great Barrier Reef (Burton, 1934a).

TETHYCOMETES SARÀ, 1994

Synonymy

Tethycometes Sarà, 1994: 363.

Type species

Tethycometes sibogae Sarà, 1994 (by original designation).

Diagnosis

Tethyidae with an ovoid and very small body, and with a thin basal stalk about eight times the length of the body. Without a distinct cortex. Surface with rounded and hispid tubercles. Body skeleton formed by bundles of strongyloxeas, one-spicule long, which radiate from the body centrum. Fans of diverging thinner strongyloxeas, one spicule-long, originate from the bundles and bristle the tubercles. Megasters represented by oxyasters, heterogeneous in size, reaching large dimensions (more than 150 μm in diameter), and filling the whole sponge body. Two types of micrasters: oxyasters and strongylasters. In addition there are microstrongyles around the base of the main strongyloxeas.

Description of type species

Tethycometes sibogae Sarà, 1998 (Fig. 12A–G).

Synonymy. *Tethycometes sibogae* Sarà, 1998: 363.

Material examined. Holotype and one paratype: BMNH 1933.8.12.245 – 'Siboga' Exped. stat. 321, Java sea, Indonesia, 82 m depth.

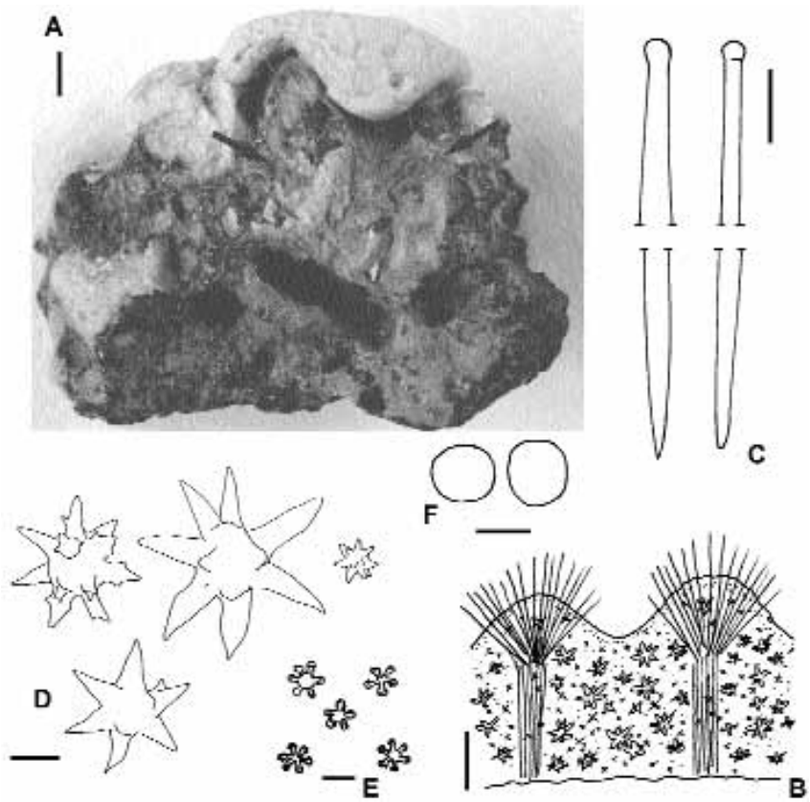

Fig. 13. *Tethytimea tylota*. A, holotype (indicated by arrows) on a stone with other sponges. B, skeleton structure. C, tylostyles. D, megasters. E, micrasters. F spheres (scales: A, 5 mm; B, 1 mm; C–D, F, 50 μm; E, 10 μm).

Description. The ovoid body measures 3 × 2 mm, the long and thin stalk 25 × 0.3 mm. Main strongyloxeas in bundles, 700 × 10 μm, thinner strongyloxeas in the distal fans, 600 × 5 μm. The thin microstrongyles, grouped around the base of the main strongyloxeas, range from 15 × 2 to 160 × 6 μm, and are straight or variously bent or twisted. Megasters are oxyasters with or without a small centrum (R/C = 10) and 60–200 μm in diameter. Micrasters are oxyasters without centrum with 8–12 slightly spined slender rays, 10–20 μm in diameter. On the surface layer are several strongylasters, slightly spined and sometimes slightly tylote, also cruciform, 10 μm in diameter. It was not possible to ascertain if there are exotyles in the stalk.

Remarks. *Tethycometes* is differentiated from other stalked Tethyidae (*Burtonitethya, Halicometes*) by the length of the stalk in proportion to the body size, the very small size of the body, its simple skeletal structure formed by only two series of non-overlapping strongyloxeas (a basal layer of bundles of larger strongyloxeas and a distal layer with fans of smaller strongyloxeas), the heterogeneity in shape of the micrasters, and the peculiar occurrence of microstrongyles. The genus contains only one species from Indonesia (Sarà, 1994).

TETHYTIMEA DE LAUBENFELS, 1936

Synonymy

Donatia sensu Hentschel, 1912: 41. *Tethytimea* de Laubenfels, 1936a: 164. Not *Tethytimea*; Thomas, 1968a; 1980: 14.

Type species

Donatia tylota Hentschel, 1912 (by original designation).

Diagnosis

Tethyidae with thinly encrusting body and indistinct cortex. Megasclere skeleton composed of parallel bundles of tylostyles ending in tubercles. Megasters are oxyspheraster, heterogeneous in size and with giant spicules. Micrasters are tylasters. Other microscleres, occasionally present, are spheres.

Description of type species

Tethytimea tylota (Hentschel, 1912) (Fig. 13A–F).

Synonymy. *Donatia tylota* Hentschel, 1912: 41; *Tethytimea tylota* de Laubenfels, 1936a: 164; *Donatia tylota* Sarà, 1994: 367. *Tethya repens*; Hooper & Wiedenmayer, 1994: 425.

Material examined. Holotype: SMF 992–996 (fragment MNHN DCL 2208) – Sungi Manumbai, near Dosi, Aru Islands, Arafura Sea, Indonesia collected 29.v.1908, 20 m depth. Paratype: SMF (not seen) – Sungi Manumbai (Kapala Sungi), Arafura sea, Indonesia, 5.v.1908, 20 m depth.

Description. Encrusting body of 3 cm diameter, 3 mm thick. Tubercles about 1–5 mm broad. Indistinct cortex (pseudocortex) 600–700 μm thick. Tylostyles, with a more-or-less developed head, of two sizes: 1192–1624 × 15–25 μm and 320–640 × 5–10 μm. Megasters are oxyspheraster 40–250 μm in diameter with about 14 rays, frequently bent, forked or trunked with spines

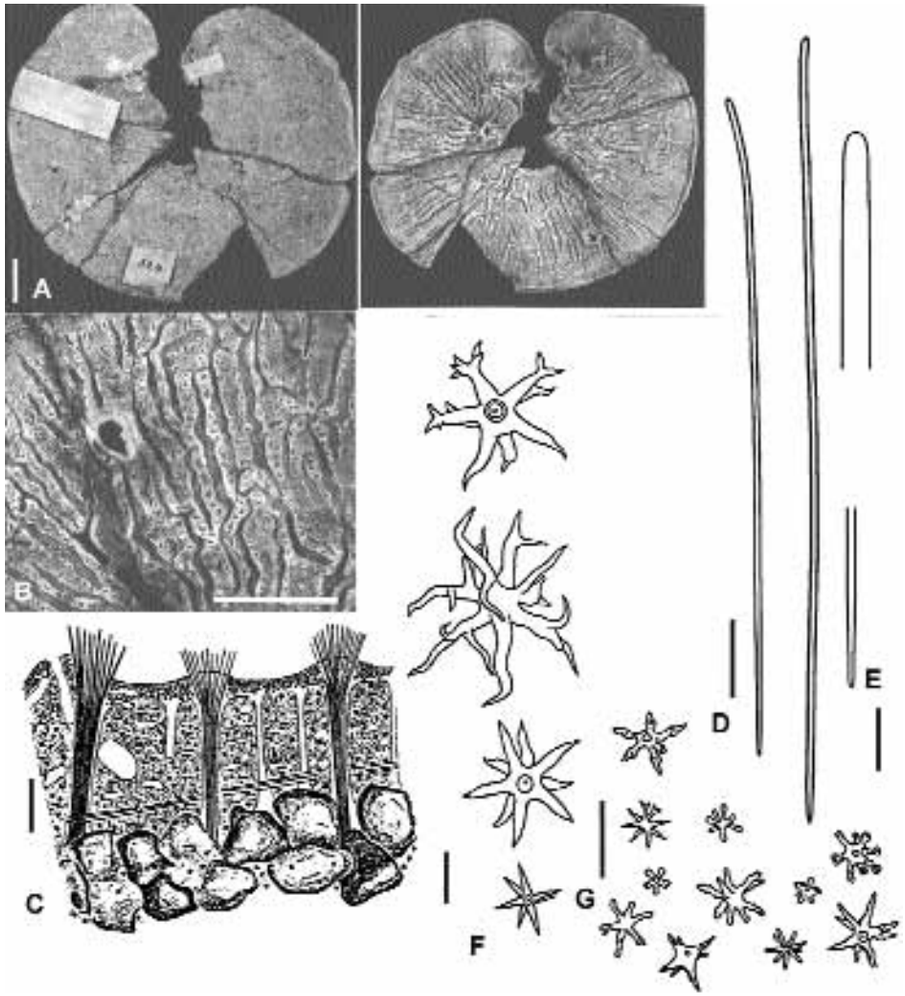

Fig. 14. *Xenospongia patelliformis*. A, holotype (upper face on the right). B, detail of the upper face. C, sponge structure. D, auxiliary styles. E, main style. F, megasters. G, micrasters (scales: A, B, 1 cm; C, 1 mm; D, 100 μm; E, F, 50 μm; G, 10 μm).

(R/C = 1–1.5). Micrasters are tylasters, 10–13 μm in diameter with 6–14 rays. According to Hentschel spheres are abundant in the holotype but not recorded in the paratype and measure 44–60 μm in diameter, but I observed only few of these in the holotype. One anomalous spicule formed by two joined spheres measures 70 × 40 μm.

Remarks. The holotype in the SMF is encrusting on a stone, associated with other sponges. From the original description of Hentschel (1912) it clearly refers to the specimen from Station 7, Sungi Manumbai. The other reported specimen is a fragment collected from Station 17 and should be considered a paratype. Hooper & Wiedenmayer (1994) proposed the type material of this species included only 'Syntypes (2 specimens) SMF 993 wet', and that Hentschel's species was a synonym of *Donatia repens* schmidt, but this is rejected here.

This genus, erected by de Laubenfels (1936a) for *Donatia tylota* Hentschel 1912, is well characterized by the thinly encrusting body and the megascleres represented by tylostyles in parallel bundles. Another peculiarity is the occurrence of spheres. These traits clearly distinguish *Tethytimea* from *Tethya repens* Schmidt, 1870. De Laubenfels (1936a) suggested to attribute *Tethya repens* to *Tethytimea*, and in this opinion he was followed by Thomas (1968a, 1980). However, the diagnostic traits of *T. tylota* do not occur in *T. repens*, which as noted above, is likely to be a *Stellitethya*. The genus contains only a single species from the Aru Islands, Indonesia (Hentschel, 1912).

XENOSPONGIA GRAY, 1858

Synonymy

Xenospongia Gray, 1858: 230; Dendy, 1905: 115.

Type species

Xenospongia patelliformis Gray, 1858 (by monotypy).

Diagnosis

Tethyidae with a discoid body. Cortex is thin, poorly developed. Surface with relatively small rounded tubercles and oscules

on slight prominences in the central part of the disk. Much sediment occurs in the deeper part of the choanosome. Megascleres are represented by styles in parallel bundles ending in the tubercles, crossed by thin bundles of styles in the lower part of the choanosome at the contact with the sand layer. Megasters are oxyasters, heterogeneous in size and shape, reaching large dimensions (also 180 μm in diameter): Microsters are spiny oxyasters, strongylasters, chiasters and tylasters.

Description of type species

Xenospongia patelliformis Gray, 1858 (Fig. 14A–G).

Synonymy. *Xenospongia patelliformis* Gray, 1858: 230; Dendy, 1905: 115.

Material examined. Holotype: BMNH 1883.1.25.9 – Torres Straits, N Australia.

Description. Body discoid, slightly concave above and convex below, 3–12 cm or more in diameter and 6 mm thick. The holotype is 12 cm in diameter. Surface minutely tuberculate or conulose. Oscules multilocular placed in the center of the disc, pores in two peripheral grooves. Texture firm, compact, leathery. Color (in ethanol) yellowish-gray with a pinkish fringe. Cortex thin and represented essentially by a dense layer of asters (pseudocortex) about 130 μm thick. Megascleres are flexuous styles 1700–3500 × 12 μm and more. Megasters are represented by oxyasters with small centrum and heterogeneous in size, with diameters between 50–180 μm with about 11 rays frequently irregularly curved and more-or-less branched. The larger and more branched spicules are characteristic of the sandy layer. Microsters are strongylasters (chiasters-tylasters), generally 8 μm in diameter with about 8 stout rays and sometimes a center, and oxyasters-tylasters with small center, 11 rays sometimes branched with oxeote or tylote tips. Sand grains in the lower two-thirds of the disk, surrounding the bases of styles and asters.

Remarks. This genus belongs to the shallow-water clade of Tethyidae with massive or encrusting shape (Sarà & Burlando, 1994). The main peculiarities are the flattened discoid shape and the inner layer of sediment that surrounds the megasclere bases. The genus contains only one species, found in the Indo-Pacific, from Torres Straits to Sri Lanka, depth 20–35 m (Dendy, 1905).