Systema Porifera: A Guide to the Classification of Sponges, Edited by John N.A. Hooper and Rob W.M. Van Soest

Family Spirasigmidae Hallmann, 1912

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Spirasigmidae Hallmann (Demospongiae, Spirophorida) contains two genera, both known only from single specimens from remote islands of the Pacific and Indian Oceans. They are thinly encrusting to small conical shapes, with radial skeletons that fan out and become plumose in the periphery where they become nearly tangential at the surface, composed of large strongyloxeas. One genus (*Spirasigma*) also has a secondary disorganised skeleton of roughened 'microxeas'. Both lack triaenes, and their allocation to Spirophorida is based on possession of true sigmaspires, although it is included in Spirophorida as a family *incertae sedis*.
Keywords: Porifera; Demospongiae; Spirophorida; Spirasigmidae; *Spirasigma*; *Tentorina*.

DEFINITION, DIAGNOSIS, SCOPE

Synonymy

Spirasigmidae Hallmann, 1912: 131; Hooper & Wiedenmayer, 1994: 440.

Definition

Spirophorida without long-shafted triaenes, with strongyloxeas forming a primary ascending skeleton that fans out towards the periphery and becomes nearly tangential at the surface.

Diagnosis

Thickly encrusting to conical sponges with main skeleton composed of large strongyloxeas forming radial bundles initially in the basal skeleton, plumose tracts towards the periphery of the skeleton, and nearly tangential tracts at the surface; microscleres are sigmaspires, and roughened microxeas in one genus (*Spirasigma*).

Scope

Two poorly known and monospecific genera, *Spirasigma* Hallmann and *Tentorina* Burton.

History

Spirasigmidae, as proposed by Hallmann (1912), initially included three genera, *Trachygellius* Topsent, *Spirasigma* Hallmann and *Trachycladus* Carter, and was supposedly characterized by the presence of sigmaspires and oxeas arranged radially (reminiscent of Tetillidae). Later, Hallmann (1916a) did not mention Sigmaspiridae when discussing *Trachycladus*, and we can only assume that he had changed his mind. De Laubenfels (1936a) referred both the former genera to his subfamily Rhaphidistiinae (in Epipolasida, roughly corresponding to Coppatiidae, now in Ancorinidae). Hooper & Wiedenmayer (1994) tentatively included *Trachygellius* and *Spirasigma* in the family Thrombidae (Astrophorida), as genera *incertae sedis*, but this allocation is now rejected (Uriz, Family Thrombidae, this volume) as Thrombidae are defined by their possession of amphiaster microscleres and acanthotriaene megascleres, lacking any oxeas, which clearly differ from these two former taxa.

Re-examination of the type species of *Trachygellius* (*Trachya globosa* Carter), showed that it was a clear synonym of *Tetilla* (Tetillidae), whereas allocation of *Spirasigma* is more problematic. No Tetillidae have an encrusting growth form, and the possession of a secondary skeleton of roughened 'microxeas' is also unique to the family. Similarly, although several tetillids lack triaenes (presumed secondary losses, such as in *Tetilla* and *Cinachyrella*), the same logic does not necessarily apply to *Spirasigma*. One clue which does confer possible affinities is the possession of true sigmaspires (roughened, c- and s-shaped or multiple twists, abrupt terminations differing substantially from sigmas), and on this basis Spirasigmidae is allocated to Spirophorida as a family *incertae sedis*. *Tentorina* Burton is also here assigned to this family, being very similar to *Spirasigma* but lacking the secondary skeleton of microxeas.

KEY TO GENERA

(1) With roughened microxeas forming a secondary skeleton ..... ***Spirasigma***
Lacking microxeas ..... ***Tentorina***

SPIRASIGMA HALLMANN, 1912

Synonymy

Spirasigma Hallmann, 1912: 131; de Laubenfels, 1936a: 159; Hooper & Wiedenmayer, 1994: 440.

Type species

Gellius aculeatus Whitelegge, 1897: 326 (by original designation).

Definition

Spirasigmidae which has a secondary skeleton of roughened microxeas overlaying the primary ascending, plumose skeleton of strongyloxeas.

Diagnosis

Thickly encrusting sponge with main skeleton composed of large strongyloxeas forming radial bundles initially in the basal skeleton, plumose tracts towards the centre of the skeleton, and halichondroid tracts that are nearly tangential at the surface; a dense secondary skeleton of roughened microxeas overlays the primary ascending skeleton, and microscleres also include sigmaspires concentrated mainly around choanocyte chambers.

Description of type species

Spirasigma aculeata (Whitelegge, 1897) (Fig. 1).

Synonymy. *Gellius aculeatus* Whitelegge, 1897: 326–327, pl. 13, fig. 3; Hallmann, 1912: 131–132.

Material examined. Holotype: AMS G1659 (slides AM G1659, Z5385) – West Funafuti (Tuvalu), central South Pacific, deep water in the lagoon, coll. C. Hedley.

Description. Thickly encrusting, 45 × 20 mm long, up to 12 mm thick. Surface shaggy, with small pointed conules up to 8 mm long, 1 mm wide. Texture soft, compressible, tough. Ectosome partially transparent, oscules and ostia not visible but reported as "occurring between the aculeate processes, subcircular … 1.2–1.5 mm in diameter". The choanosomal skeleton consists of thick multispicular tracts of larger strongyloxeas, arising from the basal skeleton, attached to a coral base. In the basal region these tracts form discrete bundles, without any bifurcation or anastomoses. Approximately mid-way through the choanosomal region tracts begin to bifurcate, and continue increasingly towards the surface where they become plumose, fanning out to touch neighboring tracts. In the peripheral skeleton these tracts become almost disorganised, with unispicular or paucispicular tracts protruding through the surface, and also similar sized tracts (often bispicular) nearly tangential to the surface, lying just below the surface. In the region of surface conules these tracts may form anastomoses with adjacent tracts and reform to produce multispicular bundles supporting the conules. The overall impression of the choanosomal structure is radial at the base and nearly halichondroid at the surface. Throughout the skeleton are dispersed numerous large 'microxeas', forming a dense secondary skeleton in between the more or less ascending larger oxeas. These microxeas are slightly less common (but equally disorganised) at the surface, and most dense (and disorganised) in the basal skeleton. There is no real basis to support Hallmann's (1912) contention that this secondary skeleton of microxeas is isotropic, allegedly resembling that of *Gellius*, but it is true that individual microxeas do cross in all directions, and depending on the plane of focus through thick sections they may be construed of having some sort of reticulate organisation. It is suggested that any interpretation of isotropic structure is an artefact. Collagen is abundant throughout, heavier in the basal skeleton than at the periphery. No fibres were observed surrounding tracts of megascleres. Sigmaspires appear to be concentrated several layers deep around oval-elongate choanocyte chambers (up to 100 μm diameter). Megascleres are strongyloxeas, or more accurately, large thick oxeas with long tapering rounded ends, with straight or slightly curved smooth shafts. Generally, the larger megascleres have rounded tips and the smaller, thinner ones are sharply pointed, with a range of terminations in between (740–1670 × 6–18 μm). 'Microxeas' were described as megascleres by Whitelegge (1897), but these are roughened and almost resemble very thick onychaetes (except they are consistently symmetrical and sharply pointed), and as such they are considered here to be microscleres. These microxeas are predominantly straight (112–184 × 2–6 μm). 'Sigmas' are actually sigmaspires, with c- and s-shapes, and sometimes with double twists, with their surfaces minutely roughened (11×24 μm chord length × 1.5–3 μm maximum width).

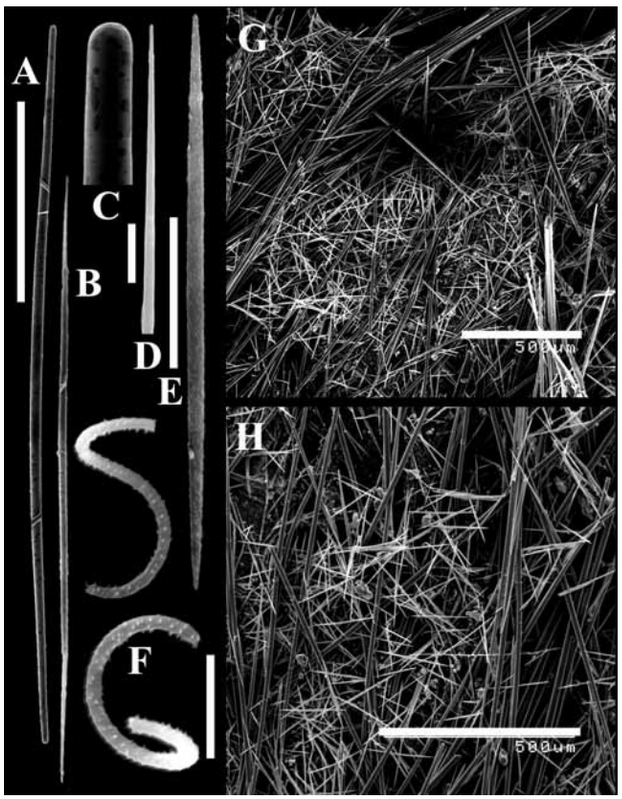

Fig. 1. *Spirasigma aculeata* (Whitelegge). Holotype AMS G1659. A–B, larger and smaller strongyloxeas (oxeas) (scale 250 μm). C–D, terminations of the same (scale 10 μm). E, roughened microxea (scale 20 μm). F, sigmaspires (scale 10 μm). G, plumose radial skeleton near periphery (scale 500 μm). H, secondary skeleton of microxeas (scale 500 μm).

Remarks. De Laubenfels (1936a: 159) suggested that *Spirasigma* was defined to contain two types of megascleres, smaller oxeas and larger strongyles, and that microscleres were 'spirals' something like those in *Trachygellius* and *Spiroxya* Topsent. This is not an accurate description, however, with the larger spicules being strongyloxeas and smaller oxeas are roughened and could legitimately be classed as microscleres (and for this reason they are described here as 'microxeas'). Similarly, the comparison with the other two genera is not entirely accurate either. In the case of *Trachygellius* (now assigned to Tetillidae), these 'spirals' are sigmaspires, c- and s-shaped, with roughened surfaces. This latter genus also has a completely radial arrangement of huge oxeas in bundles, and is clearly a species of *Tetilla*. In the case of *Spiroxya* (now assigned to Alectonidae) these 'spirals' consist of curled or curved rhabds, bearing no resemblance to sigmaspires whatsoever.

Hallmann (1912) also made a misleading comparison between *Spirasigma* and *Trachycladus*. He was correct in assuming that the sigmaspirae of *Spirasigma* were not "ordinary sigmata", but incorrect in stating that they were more similar to "sigmaspires of *Trachycladus*" (in the latter they are curled rhabds, not sigmaspirae).

The allocation of *Sigmaspira* to a higher taxon is not straightforward. Its larger megascleres are more-or-less radially arranged in bundles, vaguely reminiscent of Tetillidae as suggested by Hallmann (1912), but these bundles fan out near the surface and as such they are clearly plumose in the peripheral skeleton. Hallmann (1912) also suggested that if "the fibre-forming strongyla disappeared, the species would, without doubt, owing to the mode of distribution of its smaller oxea, be classed as a *Gellius*" (Chalinidae), but this comparison is purely superficial. Microxeas of *Sigmaspira* do not form a true isotropic or isodictyal reticulation but are dispersed in such heavy numbers that they appear at all angles to the main skeletal tracts, depending on the plane of view in thick sections. Similar microxeas with roughened surfaces also occur in several *Cinachyrella* (e.g., *C. australiensis, C. kuekenthali*; see also Rützler & Smith, 1992), so they are not unique to Spirasigmidae, although their distribution in a secondary skeleton in *Sigmaspira* is most unusual. It could also be argued that if not for the encrusting shape *Sigmaspira* could be assigned to *Cinachyrella*, as an atypical species or a very young or badly damaged specimen (the latter supposition supported by its shaggy surface, which is often a sign of a maltreated *Cinachyrella* half-ripped off the substrate). This may indeed be the situation, and the most parsimonious allocation of this taxon, but for the fact that the specimen is truly encrusting on a coralline base (i.e., it is not a fragment of a torn specimen), its main skeleton is plumose (and eventually halichondroid) in the peripheral region, unlike typical radial structures seen in *Cinachyrella*, and its possession of a secondary skeleton of microxeas. The genus remains *incertae sedis* within Spirophorida, with true sigmaspires the only definite apomorphy.

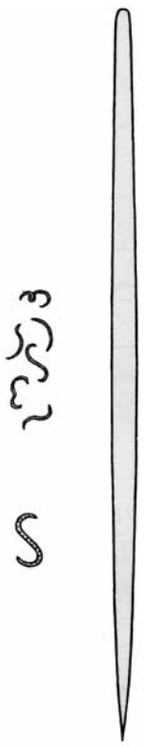

Fig. 2. *Tentorina sigmatophora* Burton. Strongyloxea and sigmaspires (for sizes see text) (from Burton, 1959a).

TENTORINA BURTON, 1959

Synonymy

Tentorina Burton, 1959a: 205.

Type species

Tentorina sigmatophora Burton, 1959a: 205 (by monotypy).

Definition

Spirasigmidae lacking microscleres other than sigmaspires.

Diagnosis

Conical sponge with radiating tracts of strongyloxeas, which level off at the surface to form a tangential layer. Microscleres sigmaspires. Maldives. Monotypical.

Description of type species

Tentorina sigmatophora Burton, 1959a (Fig. 2).

Synonymy. *Tentorina sigmatophora* Burton, 1959a: 205, fig. 7.

Material examined. Holotype: BMNH 1936.3.4.516 (slide) – Maldives, John Murray Expedition, Stn 157, 04°44′N, 72°55′E, 229 m depth, coral rock.

Description (after Burton, 1959a). Small, conical sponge with smooth, even surface. Apparently there are one or more apical oscules. The consistency is described as soft and delicate. Colour pale yellow (in alcohol). The skeleton consists of radiating curving tracts of megascleres, thickness 50–220 μm, consisting of 12–25 spicules in cross section, spaced apart 100–300 μm, fanning out and levelling off at the surface to form apparently a more-or-less tangential layer at the surface. Between the tracts there is a dense homogeneous presence of sigmaspires. Megascleres are perfectly formed fusiform strongyloxeas with a tapering but rounded-off end and a sharply pointed end. Size variable, 400–900 × 10–24 μm, no distinct size categories are apparent and the various sizes are mixed in the tracts without localization.

Remarks. This is a monotypical genus with rather perplexing skeletal and spicular characters. With *Spirasigma aculeata* it shares the strongyloxeas in a relatively small size, the sigmaspires, the soft consistency, and the irregular non-globular shape. It differs from that species in lacking the spined microxeas and in having a smooth rather than a shaggy surface and lacking conules. It remains to be determined whether these differences are sufficiently different to keep the two as separate genera.