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# Family Acanthochaetetidae Fischer, 1970

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Acanthochaetetidae Fischer (Demospongiae, Hadromerida), is a largely extinct family of 'sclerosponges' represented by two extant species, *Acanthochaetetes wellsi* and *Willardia caicosensis*, our knowledge of which indicates its relationship to the Porifera rather than Cnidaria. The siliceous spicules of these sponges indicate close ties to the genera *Spirastrella* and *Diplastrella* but morphological peculiarities of spicules and the presence of an elaborately structured calcareous basal skeleton justifies the distinction of Acanthochaetetidae from Spirastrellidae.
**Keywords:** Porifera; Demospongiae; Hadromerida; Acanthochaetetidae; Spirastrellidae; *Acanthochaetetes*; *Willardia*.

## DEFINITION, DIAGNOSIS, SCOPE

### Synonymy

Acanthochaetetidae Fischer, 1970: 199. Tabulospongiidae Mori, 1976: 8.

### Definition

Encrusting Hadromerida with calcareous basal skeleton and siliceous spicules (tylostyles, streptasters) reinforcing the soft-tissue.

### Diagnosis

'Sclerosponges' with a massive calcareous skeleton by which the animals are attached to the substratum. Living tissue coating the outermost layer of the basal skeleton and containing siliceous spiculation of tylostyles as megascleres, points outward, and common, relatively large streptasters.

### Scope

Only two extant genera, *Acanthochaetetes* and *Willardia*.

### History and biology

The first live specimens of Recent Acanthochaetetidae were discovered by divers in submarine caves (1–30 m depth) on reefs of Guam in 1968, belonging to *Acanthochaetetes wellsi*. Soon thereafter it was shown that the species is common in similar habitats throughout the western Pacific Ocean (Hartman & Goreau, 1975). The second genus, represented by *Willardia caicosensis*, was found by research submersible on vertical rock walls (100–119 m) near the Turks and Caicos Islands (tropical western Atlantic Ocean) (Willenz & Pomponi, 1996). The calcareous base in both species is covered by a thin layer of soft tissue that is attached by a basopinacoderm and includes small, rounded choanocyte chambers, choanocytes with periflagellar sleeves, collagen strands, and cells with various inclusions (Hartman & Goreau, 1975; Vacelet, 1981, 1990; Boury-Esnault *et al.*, 1990; Reitner, 1991; Willenz & Pomponi, 1996). *Acanthochaetetes wellsi* has two important features of the living tissue that are absent in *W. caicosensis*: (1) fascicles of collagen fibrils that extend through canaliculi in the limestone base skeleton (Fig. 1) and anchor the soft tissue, including masses of pseudogemmules; and (2) presence of these pseudogemmules, apparently dormant bodies consisting of clusters of thesocyte-like cells, enclosed in the basal part of some pseudocalices (crypt tissue) (Vacelet, 1990).

### Taxonomic remarks

The genus *Acanthochaetetes* Fischer, based on the fossil species *A. seunesi* Fischer, is represented by the 'living fossil' species *A. wellsi* Hartman & Goreau which shows strong affinities to the Spirastrellidae (Van Soest, 1984a; Wood, 1990; Chombard, 1997). It has been proposed to assign *A. wellsi* to this family, even as a subgenus to the genus *Spirastrella* (Reitner, 1991: 195), but scrutiny of morphological differences supports the validity of Acanthochaetetidae. The genus *Willardia*, with its only species *W. caicosensis* Willenz & Pomponi, was placed by its original authors in the family Timeidae (Willenz & Pomponi, 1996). However, comparing spicule shape and the parallel morphology evident in *Spirastrella* and *Diplastrella* we decided to place both genera in the Acanthochaetetidae (see also discussion in the chapter Spirastrellidae).

## KEY TO GENERA

(1) Basal skeleton composed of calcite, with vertical tabulate pseudocalicles; siliceous microscleres include spirasters ..... ***Acanthochaetetes***
Basal skeleton composed of aragonite, with perpendicular pillar-shaped processes; siliceous microscleres are exclusively diplasters ..... ***Willardia***

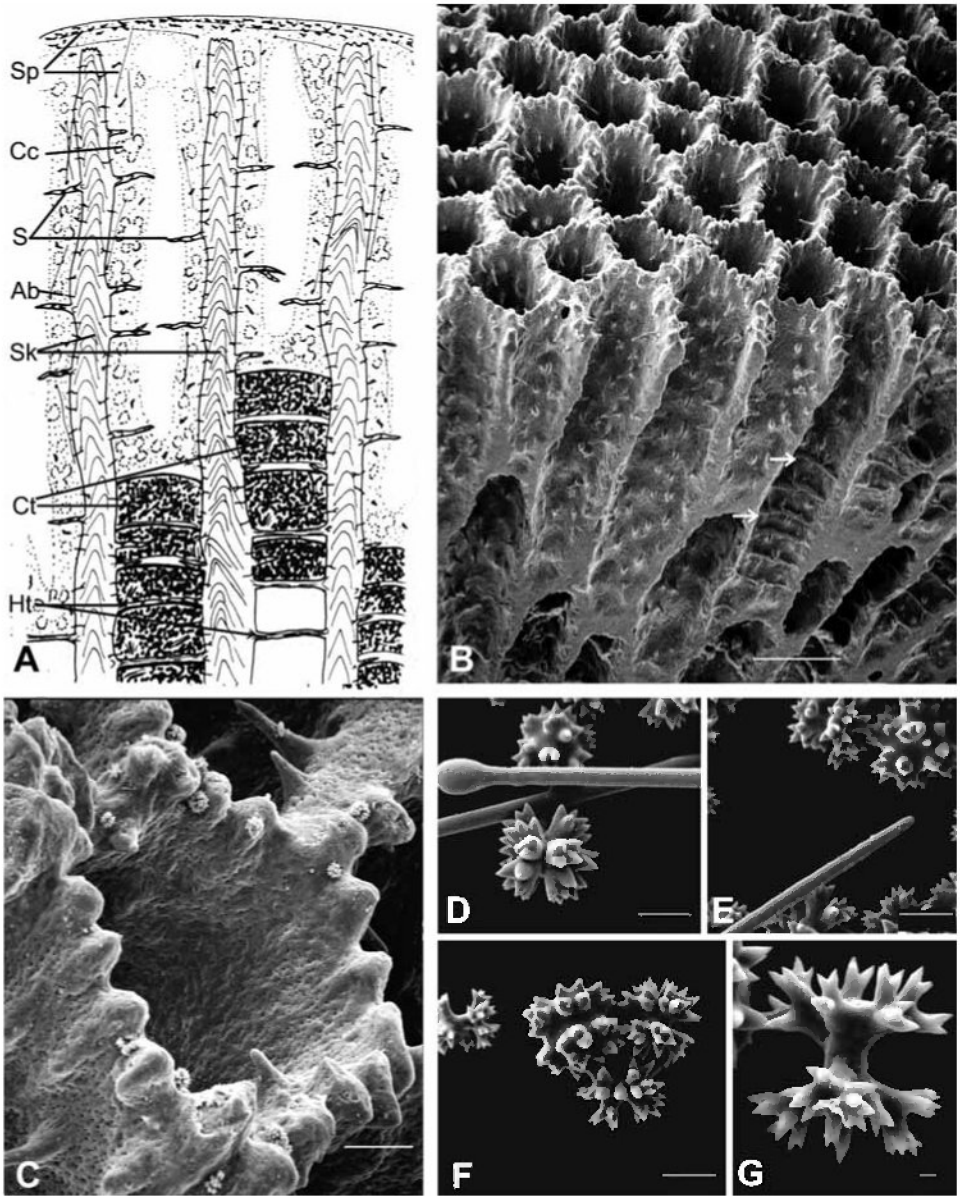


**Fig. 1.** *Acanthochaetetes wellsi* Hartman & Goreau, 1975. A, schematic vertical section of skeleton and living tissue, with a superficial layer of diplasters, and pseudogemmulae in crypts under horizontal tabulae (from Vacelet, 1990) (abbreviations: Ab, anchoring collagen bundles; Cc, choanocyte chambers; Ct, crypt tissue; Ht, horizontal tabulae; S, spines; Sk, calcareous skeleton; Sp, spicules). B, SEM photo of the surface and fracture of the skeleton, with tabulae (arrows) (scale 0.5 mm). C, SEM photo of calicle, showing diplasters adhering to the skeleton, spines and micropores corresponding to anchoring collagen bundles (scale 75 μm). D–F, siliceous spicules (scale 10 μm). G, diplaster (scale 1 μm). (B, C, specimen from Philippines; D–G, specimen USNM 51487, from Palau).

## *ACANTHOCHAETETES* FISCHER, 1970

### Synonymy

*Acanthochaetetes* Fischer, 1970: 199. *Tabulospongia* Mori, 1976: 2 (type species *T. horiguchii* Mori 1976: 2).

### Type species

*Acanthochaetetes seunesi*† Fischer, 1970: 199 (by original designation).

***Only extant representative.*** *Acanthochaetetes wellsi* Hartman & Goreau, 1975.

### Definition

Spirastrellid-like 'sclerosponge' with basal calcite skeleton of lamellar microstructure. Calicles (vertical tubes) have shared walls and are beset by vertical rows of spines. Basal part of the calicles closed by horizontal tabulae.

### Diagnosis (combining information from fossil and Recent material)

Sponge has a basal calcite skeleton composed of contiguous vertical, tabulate calicles with lamellar microstructure and covered at the lower surface by an epitheca with concentric growth lines.

The inner walls of the calicles are ornamented by vertical rows or clumps of spines. Growth occurs by intramural budding. Living tissue is restricted to a thin surface layer and to the lumen of the outermost tabulae and contains a siliceous spiculation of megascleres in the choanosome and common, relatively large microscleres condensed in the ectosome. Exhalant canals converging upon the slightly elevated oscula create a star-like pattern that is also impressed into the surface of the calcitic calicles and is termed astrorhizae. Spicules consist of tylostylote megascleres, points directed outward, and spiraster-like microscleres.

### Previous reviews

Hartman & Goreau (1975); Vacelet (1981, 1990); Hartman (1982); Reitner & Engeser (1987); Hooper & Wiedenmayer (1994).

### Description of type species

*Acanthochaetetes seunesi*† Fischer, 1970 (Fig. 1). This description is based on the Jurassic type species and supplemented by description of the closely related 'living fossil' *Acanthochaetetes wellsi* Hartman & Goreau, 1975.

***Synonymy.*** *Acanthochaetetes seunesi*† Fischer, 1970: 199, 201–202, fig. 32, pl. F3–5. Only extant representative: *Acanthochaetetes wellsi* Hartman & Goreau, 1975: 2–12, figs 1–9, 11–14.

***Material examined.*** Holotype (not seen): MNHN Institut de Paleontologie R05599 – type material consists of 1 specimen, 2 fragments, 4 sections; description is partly based on Fischer's (1970) photographs (pl. F, figs 3–5). Holotype of *Acanthochaetetes ramulosus*† Fischer: USNM 32196. Paratype of *A. wellsi* Hartman & Goreau: USNM 24410 – Puntan Madag, Saipan, Marianas Islands, coll. T. F. Goreau, 27 July 1969. Other material. USNM 51487 – South Point Cave (wall), Ngermeuangel, Koror, Palau, coll. D. Williams & J. Bozanic, 18 April 1985. Numerous specimens from New Caledonia and Philippine from the authors' collection.

***Description.*** The Mesozoic material consists of a fragmented but seemingly spheroid colony composed of radiating tubes, oval or circular in cross-section, ranging from 0.8 × 0.8 mm to 1.1 × 0.7 mm in maximum perpendicular diameters. Recent material of *Acanthochaetetes wellsi*: Massive sclerosponge with calcitic skeleton made up of adjoining vertical tubes (calicles) with common walls. Basal parts of the calicles partitioned by vertical tabulae. Walls ornamented by spines that are arranged in vertical lines or clumped irregularly. Both walls and spines have a microstructure of stacked lamellae. The surface of the skeleton shows starlike impressions (astrorhizae) from meandering exhalant canals converging upon single oscula. Epitheca with concentric growth lines covering lower surface of sponge. Size ranging from under 1 cm to over 18 cm (diameter of live tissue area). Living tissue (as seen on only extant species, *A. wellsi*) cream-colored, restricted to a coating of the calcareous skeleton, including the spaces in the calicles above the outermost tabulae. Siliceous spicules (observed in *A. wellsi*) occur in the living tissue and include erect tylostyles (points toward the surface, 286 × 3.4 μm, 7.4 μm head diameter) and spiraster-like and amphiaster-like microscleres (5 × 6–20 × 28 μm) localized in a layer in the outer tissue. Microsclere spines are often branched and closely spaced thus obscuring the axis. Some microscleres can be seen adhering to the calcareous skeleton (Fig. 1) and may thus become incorporated during fossilization, as described for *A. seunesi* (Reitner & Engeser, 1983). Growth rate of *A. wellsi* is very slow; estimated from carbon isotope records it ranges from 50–450 μm/yr (Böhm *et al.*, 1996; Reitner & Gautret, 1996).

***Remarks.*** Based on *Acanthochaetetes wellsi*, the only known living representative of the genus, Hartman & Goreau (1975) and Hartman (1982) suggested to place the 'sclerosponge' family Acantho-chaetetidae in a separate order, Tabulospongida. We disagree with this suggestion as it overemphasises the presence of a calcareous skeleton and prefer to position *Acanthochaetetes* in the Hadromerida.

## *WILLARDIA* WILLENZ & POMPONI, 1996

### Synonymy

*Willardia* Willenz & Pomponi, 1996.

### Type species

*Willardia caicosensis* Willenz & Pomponi, 1996 (by original designation).

### Definition

Spirastrellid sclerosponge with basal aragonite skeleton of peniciliate spherulitic microstructure, ornamented by pillar-shaped processes at the surface.

### Diagnosis

Encrusting sponges secreting a basal calcareous skeleton of aragonite that is attached to the substratum but may have free edges curling downward. The surface of the calcareous base, where it is covered by cellular tissue, is densely ornamented by finger-like processes (Willenz & Pomponi, 1996: fig. 5), ca. 1 mm tall. Oscula are slightly elevated and in the center of converging, vein-like surface canals. Siliceous megascleres (tylostyles) are arranged in brushes at the sponge surface. Microscleres (diplasters) are concentrated near the surface and along major aquiferous canals. In places, spicules may become embedded in aragonite.

### Previous review

Willenz & Pomponi, 1996.

### Description of type species

*Willardia caicosensis* Willenz & Pomponi, 1996 (Fig. 2).

***Synonymy.*** *Willardia caicosensis* Willenz & Pomponi, 1996: 208, figs 1–22.

***Material examined.*** Holotype (not examined): RIB-POR 49 – Grand Turk Island, Turks and Caicos Islands, 21°31′59″N, 71°07′97″W, 114 m, collected 1994. Paratypes: BMNH, HBOI, YPM – same locality.

***Description (from Willenz & Pomponi, 1996).*** The sponge forms 5 mm thick, plate-like crusts, up to 20 cm in diameter, and is attached to the substratum by its aragonite basal skeleton; the plate margin is free and curled downward, toward the substratum. The live tissue is yellow to tan orange and has a velvety appearance from perpendicular spicule brushes embedded in the surface.

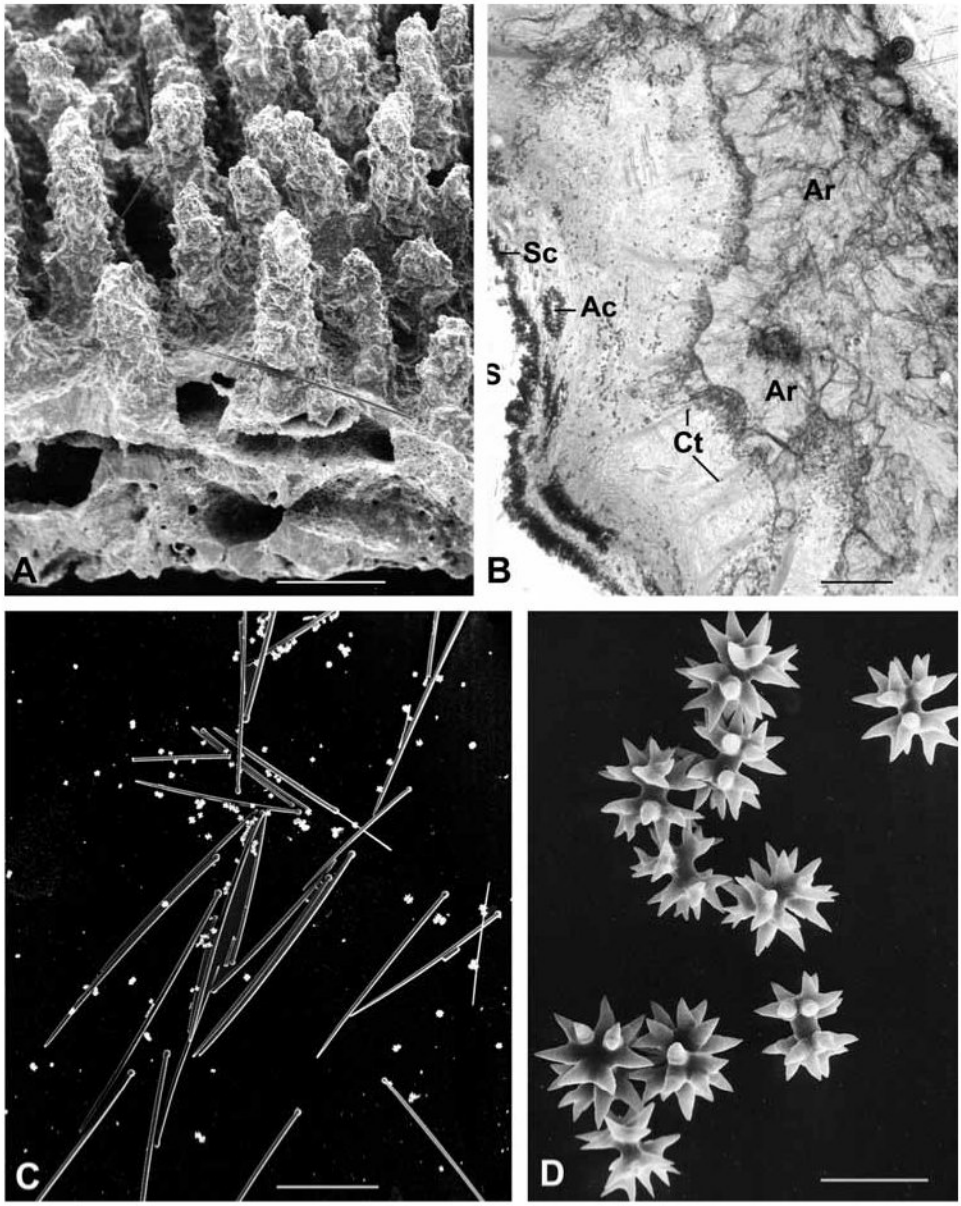


**Fig. 2.** *Willardia caicosensis* Willenz & Pomponi, 1996. A, SEM photo of the surface of calcareous skeleton with pillar shaped processes (scale 500 μm). B, section perpendicular to the surface (abbreviations: Ac, aquiferous canal; Ar, aragonite skeleton; Ct, collagen tracts; S, surface; Sc, spherulous cells accumulated at the surface (scale 200 μm). C, tylostyles and amphiasters (scale 200 μm). D, diplasters (scale 20 μm). (From Willenz & Pomponi, 1996.)

Oscula are slightly raised, 3–4 mm in diameter, supplied by converging, anastomosed canals that form a star-like pattern. Siliceous spicules consist of tylostyles arranged in bouquet fashion at the surface, points protruding out beyond the ectosome, and diplasters, also in the surface and lining the canals. A few spicules are embedded in the calcareous base. Tylostyles have small rounded heads and mostly dull points; they measure 577 × 9.8 μm in mean dimensions. Diplasters (amphiasters) have short, blunt spines and average 17.6 × 15.8 μm. The basal skeleton plate is aragonite with finger-shaped processes 1 mm tall, 0.25 mm spaced protruding into the soft tissue and a microstructure of radiating needle like crystalline units. The soft-tissue sheet is 0.1–5 mm thick. Choanocyte chambers are small (16.8 μm in diameter, ca. 20 cells per chamber), spherical, and eurypylous. The choanocytes have a periflagellar sleeve surrounding the base of the long flagellum, typical of hadromerids. There is also a central cell controlling flow through the apopyle. The mesohyl is rich in collagen fibrils which anchor the cellular tissue to the aragonitic base and includes spherulous cells and glycocytes. There are a few intercellular bacteria.

***Remarks.*** The following important characteristics separate *Willardia* from *Acanthochaetetes*. *Willardia* has a base skeleton of aragonite mineralogy and finger-like ornamentation instead of calcitic pseudocalicles and tabulae; tylostyles are forming surface brushes instead of strands in the choanosome; and microscleres are only diplasters without spiraster-like variants.