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# Family Aulocystidae Sollas, 1887

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Aulocystidae Sollas (Hexactinellida, Lychniscosida) consists of two genera, the well known *Neoaulocystis* (previously *Aulocystis*) with three species, and a new genus, *Lychnocystis* gen. nov., erected here to receive *Cystispongia superstes* Schmidt as type and only species. The genera are differentiated by both framework organization and spiculation. *Neoaulocystis* is constructed of thin-walled tubules which branch and anastomose. *Lychnocystis* is constructed of pillars and plates which branch and anastomose, but do not form tubules. *Neoaulocystis* has discohexasters and graphiocomes as microscleres while *Lychnocystis* has large onychexasters and discohexasters, but apparently lacks graphiocomes. A sturdy external siliceous crust may be formed as a terminal growth stage of some members of both genera. The family is restricted to tropical-temperate waters on western ocean basin margins: the West Indies, the Philippine-Indonesian region and the Red Sea, at depths of 82–1383 m.
**Keywords:** Porifera; Hexactinellida; Lychniscosida; Aulocystidae; *Lychnocystis*; *Neoaulocystis*.

## DEFINITION, DIAGNOSIS & SCOPE

### Restricted synonymy

Aulocystidae Sollas, 1887a; Schulze, 1904: 180; Ijima, 1927: 301. Maeandrospongidae (in part); Schulze, 1886: 84.

### Definition

Recent Lychniscosida with dictyonal framework composed of unchannelized pillars, plates or tubules, the components of which (pillars, tubule walls) are several lychniscs in thickness; primary meshes are square or rectangular with tendency for arrangement of nodes in ranks parallel to growth margin.

### Diagnosis

Body form calicular, massive, or unknown; dermalia and atrialia pentactins with straight or sinuous tangential rays; prostalia as dermalia with immensely elongated proximal ray; choanosomal hexactins may occur; microscleres always include regular spherical discohexasters, with or without large onychexasters or graphiocomes; an external siliceous cover may be deposited first as a flexible, dense mat of loose spicules which may then be thoroughly silicified to a 1 mm-thick rigid crust; uncinates and sceptrules are absent.

### Remarks

Schulze (1885) first used the name Aulocystidae in his preliminary report on the 'Challenger' hexactinellids, but as he failed to tie the name to any described species, the name is a *nomen nudum*. He retreated from use of that name throughout the more formal descriptions of the collection, and chose to assign Bowerbank's *Myliusia grayi*, the only species in his new genus, *Aulocystis*, to Maeandrospongidae Zittel (Schulze, 1886). While Schulze backed away from using Aulocystidae, Sollas (1887a) was the first to use that family name after the connection had been firmly made between *Aulocystis* and a described species, *M. grayi*, by Schulze (1886). Sollas (1887a) is thus the valid, if unintentional, author of the family name. Following abandonment of Maeandrospongidae for Recent hexactinellids, Schulze (1904) re-established Aulocystidae into mainstream hexactinellid taxonomy, and most subsequent authors to the present have followed his decision. Credit and authority have never properly been accorded Sollas, but instead to Schulze, 1886, where the name was never used, or to Schulze, 1904, where the name was used, but long after Sollas.

### Scope

The family includes two genera, the long known (as *Aulocystis*) *Neoaulocystis* Zhuravleva, presently with three species, and the new genus, *Lychnocystis* gen. nov., erected here for the historically troublesome and poorly known species *Cystispongia superstes* of Schmidt. The family is distributed in three regions, all on the western margins of ocean basins: the West Indies, the Philippine-Indonesian area, and the Red Sea, over a depth range of 82 to 1383 m.

## KEY TO RECENT GENERA

(1) Frame of pillars and plates; with long-spined onychexasters ..... ***Lychnocystis***
Frame of thin-wall tubules; without long-spined onychexasters ..... ***Neoaulocystis***

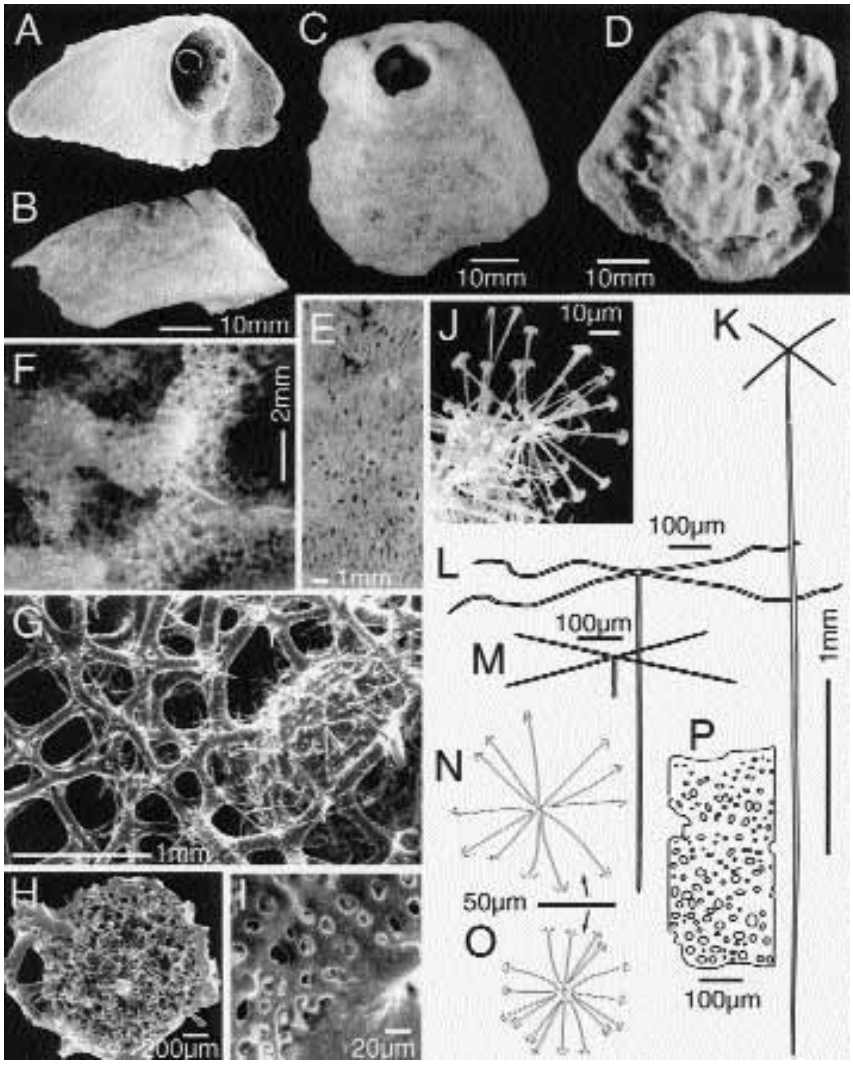


**Fig. 1.** *Lychnocystis superstes*. A, original figure of *Cystispongia superstes* holotype (from Schmidt, 1880b, pl. VII, fig. 6A – without scale). B–D, holotype (BMNH 1939.2.10.17) in side, outer, and inner views, photographed Dec. 1989. E, porous outer crust surface. F, dictyonal pillars of main framework with three enclosed siliceous balls evident. G, meshwork of dictyonal frame (left) and surface of a siliceous sphere (right) ornamented by small hexactins and ray tips (SEM). H, section of siliceous sphere filled with close-meshed network of fused, small, simple hexactins and main frame beam (center) enclosed in a complete siliceous shell (SEM). I, inner surface of body crust at point of fusion of porous siliceous plate to crustal matrix (SEM). J, hexaster microscleres on edge of framework (SEM). K, prostal pentactin. L, sinuous-rayed pentactin from frame surface. M, regular pentactin, proximal ray length unknown. N, onychexaster. O, discohexaster. P, portion of porous siliceous plate.

## *LYCHNOCYSTIS* GEN. NOV.

### Restricted synonymy

*Cystispongia*; Schmidt, 1880b: 51 (not Roemer, 1864: 7).

### Type species

*Cystispongia superstes* Schmidt, 1880b: 51 (by monotypy).

### Definition

Aulocystidae constructed of branching system of pillars and plates, 3–8 lychniscs in thickness; with rigid, silicified crust as cover layer; loose spicules include pentactine megascleres and spherical discohexasters and large onychexasters as microscleres.

### Diagnosis

Monospecific. Refer to type species description.

### Description of type species

*Lychnocystis superstes* (Schmidt) (Fig. 1).

***Synonymy.*** *Cystispongia superstes* Schmidt, 1880b: 51, pl. VII, fig. 6A (not any other figures).

***Material examined.*** Holotype: BMNH 1939.2.10.17 (dry) – West Indies, precise locality unknown.

***Description.*** Body a curved surface fragment 52.4 mm long by 50.6 mm wide by 24 mm thick from a specimen of probably hemispherical form; internal structure of branching cylindrical pillars 0.86–*1.47*–2.6 mm width, often flattened to plates of similar edge dimensions, arranged radially toward fragment margins;

pillar branches form bridges over confluent passages, but never form tubules; internal surfaces of pillars-plates smooth, without channelization but lightly roughened by projecting silica rods, the proximal rays of broken pentactine prostalia; external body surface covered by 1 mm thick, rigid, siliceous crust constructed of pentactin spicules fused by extensive hyper-silicification; porous siliceous plates as synapticular lattices without axial canals, 4–*9*–18 μm thick with circular to ovoid pores 2–*12*–30 μm diameter conspicuous on inner crust surface and incorporated in cavities within crust; single large 10 mm wide aperture (osculum?) uncovered but silicification extends onto internal walls of atrial cavity; atrium projects tangentially, separated from medial interior passage system by completely silicified plate arrayed nearly parallel to outer surface; atrium connected to internal passages by lateral openings; main framework of pillars-plates 3–8 lychnisc dictyonalia in thickness; dictyonal meshes mainly rectangular but triangular and polygonal meshes common; mesh diameters (open apertures) 146–*379*–616 μm; slight tendency for local parallel ranking of nodes obscured by irregular superficial dictyonalia placement and pillar-plate curvature; nodes 190–*220*–264 μm in oblique diameter; node spacing center-to-center 162–*478*–702 μm; beams 11–*101*–238 μm thick ornamented with low sharp spines in short transverse groups (2–6 spines); yellow-tinted siliceous spheres, 1–2 mm diameter, common conspicuous elements (27 counted by eye on internal surface view) in middle layer of pillars-plates, constructed on existing framework, enclosed entirely by a siliceous crust 20–50 μm thick and filled with a fine reticulum of fused, very spiny, non-lychnisc hexactins; holotype nearly completely macerated but patches of spicules obtained by filtration of acid-boiled fragments: all megascleres as finely rough pentactins probably as dermalia, atrialia, but certainly as prostalia with straight or sinuous tangential rays 105–*270*–527 × 2.8–*5.7*–8.7 μm; proximal rays 143 μm to 5 mm long by 4–34 μm thick; long silica rods to 8.9 mm long × 84 μm thick probably proximal rays of pentactine prostalia with distal ends broken; spherical discohexasters 48–*77*–99 μm diameter with short primary rays 3.3–*4.9*–7.7 μm long; onychexasters 93–*109*–148 μm diameter with primary rays 2.5–*4.3*–5.3 μm long; porous synapticular plate fragments common in spicule preparations; holotype from West Indies but exact location and depth unknown.

***Remarks.*** Schmidt's *Cystispongia superstes* has been considered indeterminate (Schulze, 1887; Ijima, 1927), or occasionally placed in synonymy with *Neoaulocystis grayi* (Schulze, 1899: 3; Mehl, 1992) without review of original specimens. All known specimens labelled *C. superstes* from Agassiz's 1870–1880's collections and those figured by Schmidt have been reviewed for the present work. As feared, the specimens do not all represent a single species. Most proved identical in spiculation and framework to *Neoaulocystis grayi* Bowerbank, and have been reassigned there. One specimen proved to be a unique lychniscid, related to, but distinct from *Neoaulocystis*. To obviate necessity of erecting a new species, that specimen, figured by Schmidt (1880b, pl. VII, fig. 6A) has been here designated the lectotype of *C. superstes* (all other original specimens having been reassigned), and a new genus erected to contain only this specimen. The species differs from its local relative, *N. grayi*, in not being constructed of tubules, in having much larger lychnisc nodes, a coarser meshwork (beam width, node spacing and mesh openings all 2–3× that in *N. grayi*), having distinctive onychexasters as microscleres, and having conspicuous porous plates appended to the inner surface of the external crust. Other differences might be significant, but with a single mostly-macerated specimen of *L. superstes* available, these are problematic as taxonomic characters: *L. superstes* has siliceous spheres embedded in the framework (absent in *N. grayi*, but sporadically present in many other hexactinellid genera), lacks graphiocomes and free hexactins (absence might relate to absence of soft tissues). In agreement with Mehl (1992), it is here considered inadvisable to assign Recent hexactinellid species to fossil genera, when free spicules required for diagnosis of Recent genera and species, cannot be determined for fossil forms. Unfortunately original collection data of the specimen was lost in the exchange from MCZ to BMNH. It is reasonable to assume that the specimen derives from one of the locations reported by Schmidt (1880b: 51); none of those locations (Yucatan, Cuba, Martinique) can be excluded by labels of the reassigned original specimens.

## *NEOAULOCYSTIS* ZHURAVLEVA, 1962

### Restricted synonymy

*Cystispongia* (in part) Roemer, 1864: 7. *Iphiteon* (in part) Bowerbank, 1869b: 76. *Myliusia*; Bowerbank, 1869c: 335 (not Gray, 1859: 439); Schmidt, 1880b: 51. [*Aulocystis*] Schulze, 1885: 451 (*nomen nudum*). *Aulocystis* Schulze, 1886: 87; Schulze, 1887: 356; Ijima, 1927: 302. *Neoaulocystis* Zhuravleva in Rezvoy *et al*., 1962: 44.

### Type species

*Myliusia grayi* Bowerbank, 1869c: 335 (by subsequent designation; Mehl, 1992: 107).

### Definition

Aulocystidae constructed of thin-wall branching and anastomosing tubules 2–15 mm diameter, circumscribing a system of similar-sized intercanals; primary dictyonalia arrayed in ranks parallel to growing tube margins; with graphiocomes and lophohexasters and/or only spherical discohexasters with normally serrated discs bearing 5–25 short marginal teeth.

### Diagnosis

Overall body form massive without detectable axial vestibule, or calicular with a central vestibule; upper surface may be enclosed in a cover as either an incomplete, dense, mat of interdigitating but unfused dermalia with elongate tangential rays or a solid crust of spicules embedded in a thick silica matrix; dermalia and atrialia are pentactins either entirely rough or ornamented only at ray tips; axial atrium if present may be lined by hexactins; dermalia with elongated proximal rays occur as prostalia (often as straight rods without centrum and tangential rays); besides microscleres, choanosomals include small rough hexactins.

### Remarks

Schulze (1885: 451) first used the genus name, *Aulocystis*, in his preliminary arrangement of the 'Challenger' Hexactinellida, but he provided no possible linkage to any known species, hence the usage is a *nomen nudum*. In his 1886 descriptions, Schulze provided an incomplete, but adequate, tie of his *Aulocystis*

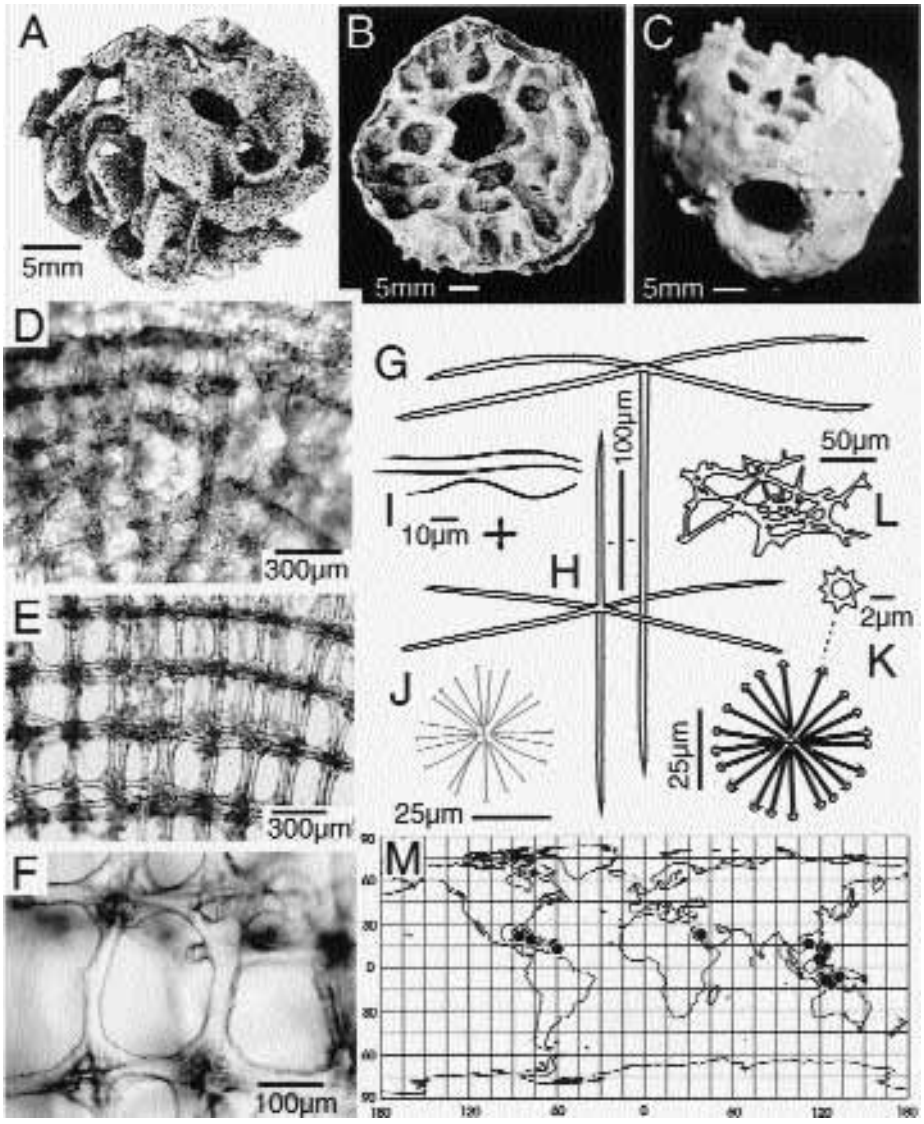


**Fig. 2.** *Neoaulocystis grayi* and distribution of *Neoaulocystis*. A, holotype BMNH 1840.10.23.11 as figured by Carter, 1877c, pl. IX, fig. 8. B, Schmidt's specimen B (MCZ 8161A) of *Cystispongia superstes* = *N. grayi* (1880b, pl. VII, fig. 6B). C, the same photographed (1987) from oblique superior view showing osculum and internal tubules where crust has been torn away. D–E, lateral view of tubule wall showing arrangement of lychnisc nodes in transverse ranks (growth margin above in both) from non-optimal unselected fragment of holotype (D) and selected area of straight wall (E – MCZ 6363). F, typical lychnisc nodes and mesh openings of holotype. G, dermal pentactin. H, choanosomal hexactin. I, graphiocome centrum and raphidal terminal rays. J, thin spherical discohexaster. K, stout spherical discohexaster with enlargement of terminal disc. L, network of synapticular lace. M, distribution of *Neoaulocystis*.

to Bowerbank's (1869c) *Myliusia grayi* and Marshall & Meyer's (1877) *Myliusia zittelii*, thus authority of the genus is accorded him as of that publication. Unlike most hexactinellid genera, Schulze's *Aulocystis* remained stable for 75 years, with one shift in family allocation, from Maeandrospongidae to Aulocystidae by Schulze (1904). Eventually it was recognized to be preoccupied by *Aulocystis* Schlüter, 1885 (fossil Anthozoa), and Zhuravleva, 1962 (in Rezvoy *et al*., 1962) replaced it with *Neoaulocystis*. Reid's proposed transfers of the genus to junior synonyms of *Cyclostigma* Schrammen (Reid, 1967b) and *Callicylix* Schrammen (Reid, 1968a) are rejected since membership in those fossil genera cannot be verified by loose spiculation. The genus presently contains three species, *N. grayi* (Bowerbank, 1869c), *N. polae* (Ijima, 1927) (as proposed by Van Soest & Stentoft, 1988: 8, and accepted here), and *N. zitteli* (Marshall & Meyer, 1877), the latter consisting of two subspecies, *N. zitteli zitteli* (Marshall & Meyer, 1877) and *N. zitteli sibogae* (Ijima, 1927). Distribution of the genus is entirely tropical to subtropical, restricted to western margins of Atlantic, Indian and Pacific Ocean basins, with vertical range of 82–1383 m.

## Description of type species

*Neoaulocystis grayi* (Bowerbank) (Fig. 2).

***Restricted synonymy.*** *Myliusia grayi* Bowerbank, 1869c: 335, pl. XXIII, fig. 8, pl. XXV, fig. 1; Carter, 1873c: 358; Carter, 1877c: 126, pl. IX, figs 8–17. *Myliusia hassleri* Schmidt, 1879: pl. III, figs 11–12. *Myliusia zitteli*; Schmidt, 1880b: 51, pl. IV, fig. 5, pl. VI, fig. 4 (not Marshall & Meyer, 1877). *Tremabolites superstes* Schmidt, 1879: pl. III, fig. 10, pl. IV, fig. 4. *Cystispongia superstes* (in part); Schmidt, 1880b: 51, pl. VII,

fig. 6B (not fig. 6A), pl. VI, fig. 2. *Aulocystis grayi* Schulze, 1886: 87; Schulze, 1887: 359, pl. CIV, fig. 9; Schulze, 1901 (in part): 311, pl. I, figs 10–11 (not figs 1–9, 12).

***Material examined.*** Holotype: BMNH 1840.10.23.11 (dry) – St. Vincent. Other material. Labeled *Neoaulocystis grayi*: RMM I-2542. I-3456, I-3758 – all Barbados; UWIJ EST 352B – Jamaica. Labeled *Aulocystis grayi*: BMNH 1910.10.18.3 – Haiti; ZMA Por 5146 – Barbados. Labeled *Aulocystis zittelii*: BMNH 1939.2.10.34 – Cuba; MCZ 8066 Montserrat. Labeled *Aulveyelis zitteli*: USNM 23434 – Gulf of Mexico. Labeled *Cystispongia superstes*: MCZ 8161A (cotype, Schmidt 1880b specimen B) – Barbados; MCZ 8162 (cotype, Schmidt 1879, pl. IV, fig. 4) – SE Cuba; USNM 00978 (part) – SE Cuba, USNM 23296 – source MCZ, location unknown; UWIJ GSN 1094A – Jamaica. Labeled *Farrea facunda*: MCZ 6209, 6225 (part), 6429s – all St. Vincent; MCZ 6721 (part) – Guadeloupe. Labeled *Myliaria callocyathes*: MCZ 6429nii – St. Vincent. Labeled *Myliusia callocyathes*: MCZ 6354 – location unknown. Labeled *Myliusia zittelii*: MCZ 6362 – Yucatan; MCZ 6363, 6368, 6369 (part) – all Barbados; MCZ 6369 (part), 6371 – Cuba; MCZ 6370, 6372 – Montserrat; MCZ 6361, 6366 – location unknown. Labeled *Myliusia* sp.: MCZ 6731 – Gulf of Mexico.

***Description (measurements from holotype unless otherwise indicated).*** Network of thin-wall branching and anastomosing tubules 3–6 mm diameter circumscribing a system of similar-size intercanals; total body hemispherical from 2.2 (holotype) to 12 cm diameter; tubule walls unchannelized 0.6–0.8 mm or 2–5 lychnisc dictyonalia in thickness, narrow axial vestibule similar in size to lateral tubules hence difficult to distinguish; tubule texture brittle; color pale brown; outer surface of usually open tubules and intercanal apertures often covered in larger specimens by solid silica crust (holotype not crusted) incorporating dermal spicules but not covering axial vestibule opening (osculum) ca. 1 cm diameter; 1–4 additional small lateral apertures 3–7 mm diameter and presumably lower body margins may remain uncovered; inner surface of crust joined to lychnisc tube framework by irregular network of hexactins with small, unperforated nodes and firmly fused by ray-to-ray silica deposits; inner crust surface ornamented by hollow hemispherical blisters of silica 1.1–1.5 mm diameter; main tubule framework of lychniscs organized in ranks parallel to growing margin; meshes basically quadrangular but oval in shape due to lychnisc buttresses at mesh corners; mesh diameter 65–*141*–276 μm; center-center nodal spacing 122–*198*–287 μm; node diameters measured obliquely from outer buttress margins 68–*100*–147 μm; beams and buttresses ornamented with sharp conical spines arranged in short transverse ridges; beam thickness 17–*34*–52 μm; spurs of peripheral dictyonalia sharply conical and moderately ornamented with short spines; dermalia and atrialia as rough pentactins with tangential rays 72–*206*–608 by 2.3–*5.6*–8.7 μm, proximal rays 87–*227*–686 by 3.1–*5.7*–8.7 μm; tangential rays may be sinuous and extended >1 mm in forms assumed nearing crust formation; prostalia may occur as modified dermalia with proximal rays, deeply embedded in tubule walls, lengthened to 10 mm and thickened to over 25 μm; rough choanosomal hexactins with rays 50–*104*–292 by 2.2–*4.5*–6.6 μm; stout and thin short-primaried spherical discohexasters with 3–6 terminal rays in 2 broadly overlapping size classes (t-test of diameter, $p > 0.001$): stout forms 40–*56*–69 μm diameter; thin forms 35–*44*–53 μm; graphiocomes, known only broken, with simple centra 8.8–*10.5*–12.1 μm diameter bearing sinuous terminals (measured as loose raphides) 26–*49*–65 μm long, calculated total spicule diameter 60–*108*–142 μm; small fragments of synapticular lace with poorly resolvable ghosts of axial canals occur commonly in spicule preparations but source location in specimen unknown; known from throughout the West Indies from depths of 106 to 1383 m.

***Remarks.*** History of the species is well documented by Schulze (1887). Two glaring errors complicated its early treatment – Bowerbank's (1869c) ill-advised replacement of type species of *Myliusia* (he transferred the original type species *M. callocyathes* Gray to *Iphiteon*, then replaced it with his own *M. grayi* as type) – and Schmidt's (1880b) inexplicable selection of the Philippine *M. zittelii* Marshall & Meyer as an appropriate name for the most common lychniscosan in Agassiz's West Indies collections when he cannot have been unaware of Bowerbank's *M. grayi* from St. Vincent. Schulze (1901) ultimately corrected the second problem by reassigning Schmidt's *M. zitteli* to *M. grayi*. Many of Agassiz's hexactinellids were misidentified and misgrouped by Schmidt in his determinations – results are obvious in the assortment of labelled specimens resolved in the examined list above. The case of Schmidt's *Cystispongia superstes* is typical of his careless determinations, but has been resolved here by selection of Schmidt's specimen A (1880b, pl. VII, fig. 6A) as lectotype of *C. superstes* and reassignment of that species to a newly formed genus, *Lychnocystis* (above). All remaining specimens to which Schmidt assigned the name, *C. superstes*, including remaining cotypes, are *Neoaulocystis grayi* by spiculation and framework arrangement. This resolution clearly negates the synonymy of *C. superstes* with *N. grayi* rashly proposed by Mehl (1992) on the basis of my incomplete inspection and analysis of the concerned specimens. The siliceous spheres (Weltner's balls) described and figured by Mehl (1992) thus do not belong to *Neoaulocystis*, as stated there, but to *Lychnocystis*.