

The hexactinellid *Leiobolidium* Schmidt (Porifera) is a *Hyalonema* Gray

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ABSTRACT

The hexactinellid sponge genus *Leiobolidium* was proposed by Schmidt (1880) for a specimen dredged by Agassiz on the USCSS *Blake* off Bequia, Lesser Antilles in 1879. The description accompanying the uninominal proposal was adequate to give the genus name zoological availability, but inadequate for determination of its relationship to other hexactinellids. It has remained an irritant requiring resolution. The specimen upon which the genus was based has been discovered, examined and found to be a species of *Hyalonema*. Its possession of macramphidiscs with serrated teeth and uncinates allows it to be placed in either of two modern subgenera with these respective distinctive characters, *Prionema* or *Onconema*. The first of these is chosen, along with Schmidt's species label name, in formation of the taxon, *H. (Prionema) repletum* n. sp.

KEY WORDS

Porifera,
Leiobolidium,
Hexactinellida,
Hyalonema,
Prionema,
Onconema,
new species.

RÉSUMÉ

L'hexactinellide Leiobolidium Schmidt (Porifera) est une Hyalonema Gray.

Le genre d'éponge hexactinellide *Leiobolidium* a été proposé par Schmidt (1880) pour un spécimen dragué par Agassiz sur le USCSS *Blake* devant Bequia, Petites Antilles, en 1879. La description accompagnant cette proposition uninominale convenait pour donner un statut zoologique au nom de genre, mais était inadéquate pour déterminer ses relations avec les autres hexactinellides. Cela est resté un problème irritant qui doit être résolu. Le spécimen sur lequel le nom a été basé a été redécouvert et correspond en fait, après examen, à une espèce de *Hyalonema*. La possession de macramphidiscs à dents dentelées et d'uncinates amène à placer cette espèce dans l'un des deux sous-genres ayant ces caractères distinctifs, *Prionema* ou *Onconema*. Le premier a été choisi, avec le nom d'espèce indiqué sur l'étiquette de Schmidt, pour former le taxon *H. (Prionema) repletum* n. sp.

MOTS CLÉS

Porifera,
Leiobolidium,
Hexactinellida,
Hyalonema,
Prionema,
Onconema,
nouvelle espèce.

INTRODUCTION

The West Indian hexactinellid sponge fauna was the very first of this taxon (class Hexactinellida) to receive a regional taxonomic treatment (Schmidt 1880) by virtue of the extensive U. S. Fish Commission collections made in this area under A. Agassiz's direction during the period 1868-1879. Paradoxically, many hexactinellid specimens collected today from this region cannot be identified to species with any certainty, and consequently, their inclusion in faunal surveys is restricted. This problem stems from Schmidt's hesitancy to examine spiculation of every specimen and his reliance on similarity of body form to assemble specimens as individual species, resulting in species mixtures. He then produced trivial species descriptions from the mixed species assemblages. Although Schulze (1899) tried to clarify a few of the problems resulting from Schmidt's actions, his lack of access to the entire Agassiz collection of hexactinellids held in the Museum of Comparative Zoology, Harvard University (MCZ), and the historical lack of a North American taxonomic specialist on this group has left many of Schmidt's original ambiguities unresolved. Through review of the Agassiz collections and comparison with Schmidt's original figures, the type specimens of his original species are slowly being located and their characters clarified. Here I continue the process of unravelling Schmidt's hexactinellid puzzles by redescribing and resolving the status of one of his proposed generic names, *Leiobolidium*.

Schmidt (1880: 65) described *Leiobolidium* as: "Zu einem Schwamme von total anderer Consistenz, nämlich vom Habitus und der Weichheit einer zarten Reniere ist das Material der microscopischen Formbestandtheile vom Pheronema in einer neuen Gattung vereinigt: *Leiobolidium*. Sie liegt vor als eine Kugel von 15 Mmtr. Durchmesser, weich und glatt anzufühlen. An dem einen Pol findet sich ein umrandetes Osculum, ihm gegenüber eine unregelmässige kleine Vertiefung, aus welcher ein Wurzelschopf ausgerissen zu sein scheint. Fundort: Bequia, 1507 Faden". He provided neither a

figure nor a species name for his new genus, but his brief description of *Leiobolidium* meets the ICZN (1999, Article 12.1a) requirements for availability. The brief description has proven inadequate to assign the genus to any higher taxon of the Hexactinellida: it has been treated as a questionable synonym of another taxon (Schulze 1904), listed as *incertae sedis* among hexactinellids (Laubenfels 1936), or ignored (Ijima 1927). The specimen has been located at the MCZ, bearing Schmidt's original label with his unpublished complete name, *Leiobolidium repletum*. As suspected from Schmidt's short description, it is a member of the genus *Hyalonema* Gray, 1835, and it is here allocated to the subgenus *Prionema* Lendenfeld, 1915. Schmidt's label name, *repletum*, is retained as the preferred species name.

ABBREVIATIONS USED

- MCZ Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts;
 ICZN International Commission on Zoological Nomenclature;
 SEM Scanning electron microscopy.

MATERIAL AND METHODS

The single specimen was examined in August, 1987 and re-examined and photographed in May, 1997. Small fragments were removed from margins of the polar apertures (osculum and presumed root tuft socket located on opposite points of the ovoid body, Fig. 1A) and lateral dermal surface, cleared in xylene, mounted on slides in balsam and examined for spicules. A 10° pole-to-pole wedge was removed from the specimen for preparation of thick sections and spicule preparations. The superior half of the wedge was embedded in paraffin and cut by hand into 1/2 to 1 mm thick sections with a razor blade. These were cleared in xylene and mounted on slides in balsam. The inferior half of the wedge was digested in hot nitric acid to release and clean the spicules. Large spicules were removed by forceps, rinsed in water, spread on microscope slides and mounted in balsam. Smaller spicules were dispersed on

0.2 µm nitrocellulose filters by filtration: the filters were rinsed, dried and mounted on slides in balsam. Spicules were measured by computer via a light microscope-coupled digitizer. Data are reported as: mean ± standard deviation number of measurements (range). Amphidisc length data were resolved into size classes by computer-generated histogram. Spicule drawings were prepared from video-captured microscope images imported into a computer drawing program and traced on-screen.

Samples for SEM were nitric-acid-cleaned and either filtered onto 0.2 µm membrane filters or deposited directly onto cover-glasses after rinsing in distilled water. Following gold-palladium coating, specimens were viewed and photographed with a JEOL JSM-840A SEM.

SYSTEMATICS

The specimen, MCZ #8023 m, agrees in all particulars to Schmidt's original description of *Leiobolidium* and bears on its label the name « *Leiobolidium repletum* neu » in Schmidt's handwriting. The new species, to be more extensively described below, is clearly the basis of Schmidt's taxon. No species name has ever been assigned to this genus, thus *L. repletum* is here established as the holotype of *Leiobolidium* by monotypy. The species, in thorough examination of its spicules, is clearly a member of the older genus *Hyalonema* Gray, and assignable to the subgenus *Prionema*. Schmidt's *Leiobolidium* becomes a junior synonym of *Hyalonema*.

Family HYALONEMATIDAE Gray, 1857

TYPE GENUS. — *Hyalonema* Gray, 1835 by monotypy.

DIAGNOSIS. — From Ijima 1927. Amphidiscophora as a rule without uncinata; choanosomal supporting spicules all or in a large proportion rhabdodiactins, in the latter case occurring in association with macrohexactins or macropentactins; marginalia pinular rhabdodiactins; basal fibres with anchor, consisting of an inverted-conical swelling, furnished with a circle of several short teeth, forming a single basal tuft of which the parts within sponge body form a compact axial columnella.

Genus *Hyalonema* Gray, 1835

TYPE SPECIES. — *Hyalonema sieboldi* Gray, 1835 by monotypy.

DIAGNOSIS. — From Ijima 1927. Hyalonematid with variously shaped body; dermal surface entirely exposed on the exterior, without conical projections and pleural prostals; gastral surface flatly exposed, depressed or outbulged; basal tuft compact, twisted after full growth.

Subgenus *Prionema* Lendenfeld, 1915

TYPE SPECIES. — *Hyalonema agujanum* Lendenfeld, 1915 by subsequent designation (Ijima 1927: 52).

DIAGNOSIS. — (from Ijima 1927). Dermal pinular ray varying in general shape from swollen and spindle-like to slender with tapering rachis. The largest or the second largest kind of amphidisc with umbel teeth which are finely serrated or fimbriated on their lateral edges.

Hyalonema (Prionema) repletum n. sp. (Figs 1A-F, 2: Table I)

MATERIAL EXAMINED. — Holotype (MCZ # 8023m, old # 297), dry.

ETYMOLOGY. — From Latin *replere*, to fill up.

TYPE LOCALITY. — Lesser Antilles. 16 km, W-SW of the island of Bequia, USCSS *Blake*, stn 235, 12°57'10"N, 61°25'25"W, 2757 m, 21. II.1879, A. Agassiz.

DIAGNOSIS. — Hyalonematid with macramphidiscs bearing teeth with finely serrated edge: with uncinates; rhabdodiactins and macrohexactins as principalia; three distinct classes of amphidiscs and one class of microhexactins; body shape ovoid.

DESCRIPTION

Body

The single specimen, the holotype (Fig. 1A, B), is a nearly spherical ovoid in body form, slightly expanded in the middle, 11.2 mm tall by 12.7 mm wide. A small rounded apical cone projects slightly from a surrounding ring-like oscular aperture. The margins of the aperture are rounded and bear a palisade of pinular diactine marginalia. Lateral surfaces are covered by a dense felt of pinular pentactins, supported by a rectangular lattice of hypodermal pentactins, 0.4 mm mesh size, easily visible to the naked eye (Fig. 1A)

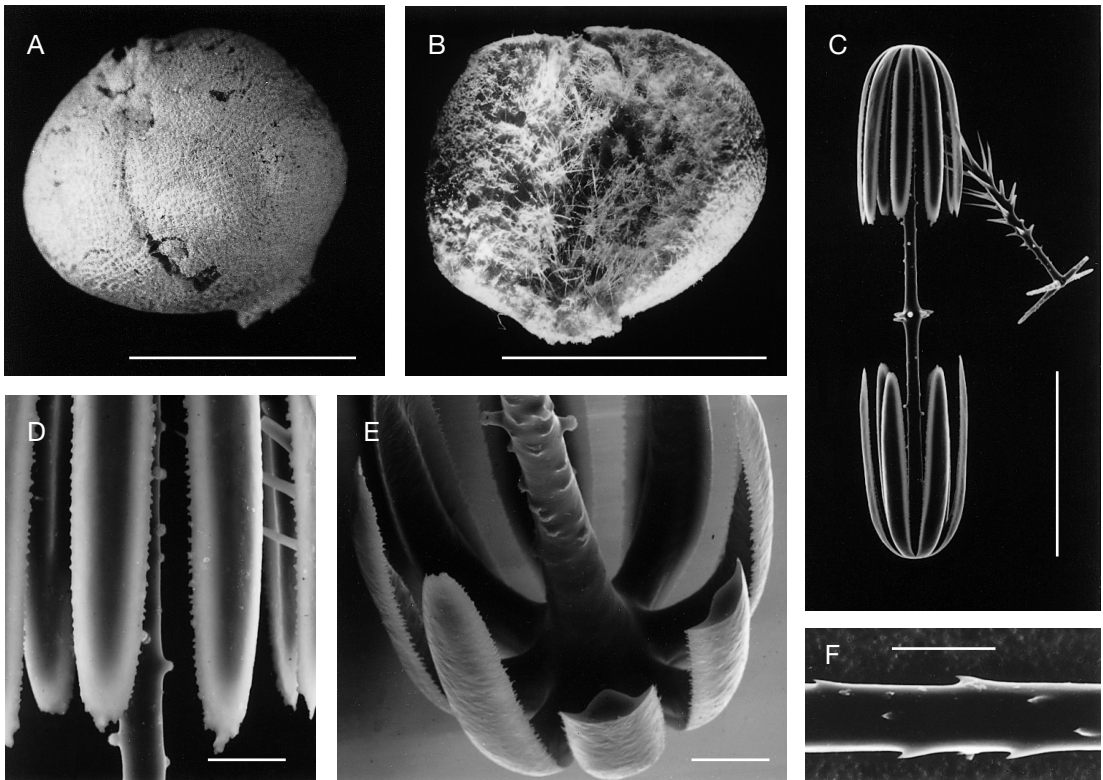


FIG. 1. — *Hyalonema (Prionema) repletum* n. sp.; **A**, external view of body; **B**, internal structure; **C**, macramphidisc and dermal pinule (SEM); **D**, serrated macramphidisc teeth (SEM); **E**, view of macramphidisc umbel with broken teeth in section (SEM); **F**, part of an uncinata (SEM). Scale bars: A, B, 1 cm; C-F, 10 μ m.

where the pinular feltwork has been partially abraded. Dermal pinules have no regular arrangement, are spaced at about 25 μ m distances, with tangential rays profusely overlapping in all directions. An aperture with a peripheral expansion is present at the inferior pole (Fig. 1A, B). This is presumed to be the point of emergence of the root tuft, which is lacking and is inferred to have been torn out during collection. No acanthophores were found in an extensive search of this entire region. The ectosome, 0.6 mm in thickness, consists of a dense dermal surface supported by radial pillars outlining an extensive series of confluent subdermal spaces. The choanosome consists of a structureless pulp of spicules, with neither large cavities nor organized skeletal structures evident to the naked eye or at any level of magnification (Fig. 1B).

Spicules

Ten classes of spicules have been found in this species: their dimensions are presented in Table I.

Rhabdodiactin. (Fig. 2A) Parenchymal principalia (with macrohexactins); thin, evenly tapering to sharp tips; entirely smooth with central inflation; most occur singly but occasionally in poorly defined tracts two to six spicules wide.

Macropentactin. (Fig. 2B) Hypodermalia providing support for dermal pinules: tangential rays smooth, acute-tipped, slightly bent downwards, angle between proximal and tangential rays $79.8 \pm 5.5^\circ_{50}$ (68.9-91.4); smaller pentactins common in mesh spaces of main hypodermal lattice.

Macrohexactin. (Fig. 2C) Parenchymal principalia (with rhabdodiactins); entirely smooth, acute-tipped, slightly unequal-rayed; occur

TABLE I. — Spicule dimensions of *Hyalonema (Prionema) repletum*, holotype.

Spicule Type	Length \pm SD _n (range) μm	Width \pm SD _n (range) μm
Rhabdodiactin	1069 \pm 227 ₅₀ (538-1695)	5.7 \pm 1.3 ₅₀ (3.5-9.6)
Macropentactin		
Tangential ray	516 \pm 124 ₅₀ (247-761)	18.7 \pm 4.1 ₅₀ (8.0-26.6)
Proximal ray	810 \pm 195 ₅₀ (456-1207)	19.5 \pm 4.3 ₅₀ (10.4-27.6)
Macrohexactin ray	331 \pm 119 ₅₀ (153-670)	7.5 \pm 2.8 ₅₀ (3.5-15.5)
Pinular Diactin		
Pinular ray	277 \pm 90 ₃ (208-379)	n.a.
Proximal ray	488 \pm 159 ₂₁ (122-678)	5.8 \pm 1.5 ₂₇ (2.8-9.2)
Pinular Pentactin		
Pinular ray	172 \pm 57 ₅₀ (111-493)	39.3 \pm 7.0 ₅₀ (25.9-52.8)*
Tangential ray	40.0 \pm 4.4 ₅₀ (31.6-55.6)	3.7 \pm 0.5 ₅₀ (2.5-4.9)**
Uncinate	426 \pm 54 ₅₀ (322-550)	3.3 \pm 0.5 ₅₀ (2.4-4.3)
Macramphidisc	292 \pm 23 ₅₀ (237-341)	6.3 \pm 0.7 ₅₀ (4.2-7.9)
Umbel	108 \pm 9 ₅₀ (87-131)	58.6 \pm 5.0 ₅₀ (48.1-63.4)
Shaft	n.a.	same
Mesamphidisc	70.0 \pm 12.0 ₅₀ (35-93)	7.5 \pm 1.0 ₅₀ (5.1-9.8)
Micramphidisc	18.8 \pm 3.3 ₁₄₄ (9.9-27.7)	17.2 \pm 2.1 ₅₀ (10.6-25.4)
Microhexactin	50.3 \pm 8.9 ₅₀ (33.7-79.3)	6.8 \pm 0.9 ₅₀ (4.9-8.2)
		1.3 \pm 0.4 ₅₀ (0.6-2.3)

* total width including spines; ** rachis width.

randomly throughout choanosome with slight suggestion of rectangular organization in peripheral areas.

Pinular diactin. (Fig. 2D) Marginalia; occur only as a palisade around margin of oscular rim; pinular ray usually broken, so few available for measurement.

Pinular pentactin. (Figs 1C; 2E) Dermalia (the only spicules present in dermal surface); spines of pinular ray long and sparse, inserted at fairly large angle to rachis, giving a ragged, bushy aspect; spines of lower quarter distinctly curved outwards: tangential rays straight, tapered, spined distally or throughout, always crossing perpendicularly.

Uncinate. (Figs 1F; 2I) Parenchymalia and comitalia to hypodermal pentactins; with low, sharp barbs all oriented in the same direction; very clear axial cross present centrally and occasionally associated with a slight central inflation.

Macramphidisc. (Figs 1C-E; 2F) Occur only ectosomal in linings of subdermal cavities: never dermal or choanosomal; long and narrow in form: usually eight teeth (four to eight) with fine-

ly serrated margins, ragged-toothed tips, and smooth rib support on inner side (Fig. 1E); shaft with a central whorl of long, cylindrical knobs with rounded tips; elsewhere sparsely ornamented with scattered small, low, round-tipped knobs.

Mesamphidisc. (Fig. 2G) Occur sparsely in ectosome but mainly in choanosome with micramphidiscs in lines interpreted as residual membranes of major water channels, not randomly strewn; shape like macramphidisc; eight teeth, smooth-margined (not serrate); tips parabolic, rounded; shaft bearing eccentric-placed whorl of elongate knobs and dense covering of short rounded knobs.

Micramphidisc. (Fig. 2H) Distribution as mesamphidisc: 16 teeth; shaft bears only a few sharp spines.

Microhexactin. (Fig. 2J) Distributed randomly throughout choanosome; rays slightly curved, occasionally straight; finely rough.

REMARKS

Although the specimen lacks a root tuft and acanthophores, both presumed lost during collec-

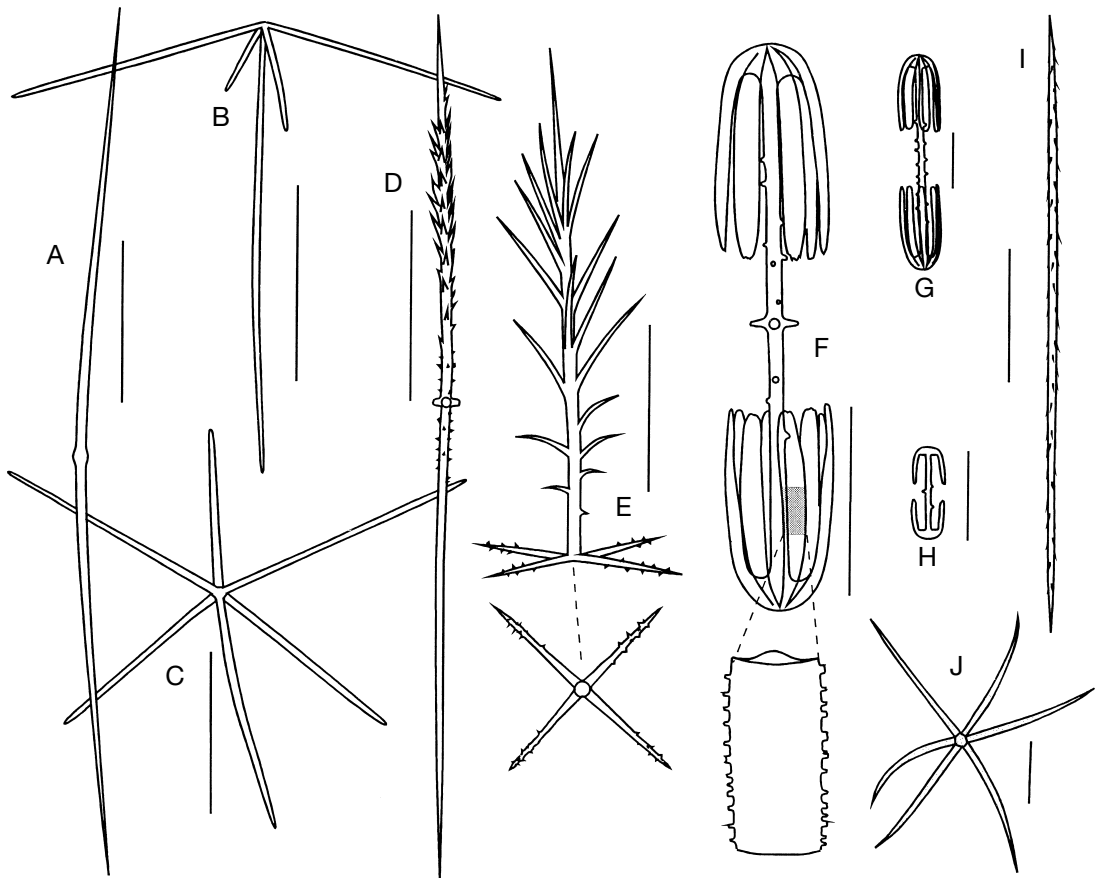


FIG. 2. — Spicules of *Hyalonema (Prionema) repletum* n. sp.; **A**, rhabdodiactin; **B**, macropentactin; **C**, macrohexactin; **D**, pinular diactin; **E**, pinular pentactin; **F**, macramphidisc; **G**, mesamphidisc; **H**, micramphidisc; **I**, uncinata; **J**, microxyhexactin. Scale bars: A-D, 200 μ m; E, F, I, 100 μ m; G, H, J, 20 μ m.

tion, there is no doubt that it is a member of the genus *Hyalonema*; taxonomic literature contains many similar situations and conclusions. Lévi's (1964) suggestion that nine of the recognized subgenera of *Hyalonema* be raised to generic status, and five others be considered doubtful, has not been followed by authors of subsequent publications, but it may yet form the basis of a needed revision of the genus. Because the 12 subgenera of *Hyalonema* accepted by Ijima (1927) are not diagnosed with mutually exclusive characters, *L. repletum* could be assigned to either of two subgenera on the basis of Ijima's diagnoses, *Prionema* Lendenfeld, 1915, with serrated amphidisc teeth, or *Onconema* Ijima, 1927, with

uncinates. The former assignment has been selected on practical grounds, that is, macramphidiscs are easier to inspect and evaluate as autochthonous structures than are uncinates. This choice agrees with Lévi's (1964) opinion that *Prionema* be considered an acceptable distinct taxon but that *Onconema* be considered a doubtful taxon. With its distinctive combination of serrated amphidisc teeth and uncinates, this species is not a close relative of any *Hyalonema* species so far described. Among the species presently assigned to the two pertinent subgenera, this species is most similar to *H. (Prionema) spinosum* Lendenfeld, 1915, a form also with serration of macramphidisc teeth. The two differ

in presence/absence of uncinates and shape of the dermal pinules, microhexactins, and body form. Ultimate resolution of the relationships between these groups of *Hyalonema* will depend upon more exclusive diagnosis of its subgenera and the importance accorded the uncommon occurrence of uncinates in this genus. For the present, *H. repletum* is comfortably contained within the subgenus *Prionema*, and Schmidt's generic name, *Leiobolidium*, can be put to rest.

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