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REVISION OF *NEOFIBULARIA* (PORIFERA,
DEMOSPONGIAE), A GENUS OF TOXIC SPONGES
FROM THE WEST INDIES AND AUSTRALIA

WILLARD D. HARTMAN

DEPARTMENT OF BIOLOGY AND PEABODY MUSEUM OF NATURAL
HISTORY, YALE UNIVERSITY

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ABSTRACT

A revision of the sponge genus *Neofibularia*, known for its dermatitis-producing qualities, is presented on the basis of a re-study of holotypic specimens. Carter's species *Fibularia massa* is regarded as a synonym of *N. nolitangere* (Duch. & Mich.), the only species known from western tropical Atlantic waters. A new subspecies of *N. nolitangere*, with oxate megascleres, is described as well as a new species, *N. mordens*, from South Australia. The relationship of *Neofibularia* to *Biemna* is discussed.

INTRODUCTION

In 1864 Duchassaing and Michelotti described a sponge, *Amphimedon nolitangere*, which, they said, produces on the skin of the imprudent handler a smarting sensation and a numbness which can last several hours. Two related forms, one from the Caribbean coast of Colombia and the other from South Australia, are described here. The latter is also toxic; Dr. R. V. Southcott, who referred the sponge to me for identification, states that "seven people handled it and all were affected with a contact dermatitis from which in one or two instances it took weeks to recover."

The sponge of Duchassaing and Michelotti has been described by a number of workers subsequently and has had a varied taxonomic history. The original authors made no mention of microscopic characters and it is, therefore, not surprising that subsequent authors failed to recognize the species.

Carter (1882) called the sponge "*Fibularia massa*", assigning it to a new genus for which, however, he gave no diagnosis. Carter was aware of the paper by Duchassaing and Michelotti but said, "I have hardly ever referred to it without vexation." Carter failed to note the similarity of *Amphimedon nolitangere* to his sponge, in part, no doubt, because the Rev. H. H. Higgins, who collected Carter's specimen at Long Cay Is., New Providence, Bahamas, apparently made no mention in his field notes of the toxicity of the sponge.

Vosmaer (1887) pointed out that the generic name *Fibularia* had been applied to a clypeastroid echinoid by Lamarck in 1815 and that it cannot stand for the sponges assigned to the genus by Carter.

Arndt (1927) reported a sponge from Curaçao that is comparable to Carter's specimen and named it *Gellius massa* (Carter) but made no mention of the dermatitis-producing quality of the sponge.

De Laubenfels (1936) found several specimens of a toxic sponge at the Dry Tortugas and recognized their identity with *Amphimedon nolitangere* Duchassaing and Michelotti. His treatment of the nomenclature of the species is unfortunate, however. Following the establishment of *Fibularia* by Carter in 1882, this same author used the similar name *Fibulia* in 1886 for a branched sponge from South Australia, *F. carnosa*, with oxeas and sigmas

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as spicules. De Laubenfels assumed that *Fibulia* was a name substituted by Carter for *Fibularia*, perhaps in recognition of the prior use of the latter name for an echinoderm. Burton (1929), on the other hand, interpreted *Fibulia* as a misprint for the earlier *Fibularia* and substituted the name *Plumocolumella* for the species *carnosa*. Later Burton (1936, p. 142) dropped the name *Plumocolumella* and reverted to *Fibulia* for the species *carnosa*, pointing out that "there is no substantial evidence for believing" that *Fibulia* was a misprint for *Fibularia*. Burton is certainly correct, since Carter had the habit of failing to qualify his new generic names with diagnoses or even with an indication that the names were new. Carter's species *carnosa* departs sufficiently from the species described under the earlier name, *Fibularia*, so that it is reasonable to accept the fact that *Fibulia* was intended as a new and distinct genus.

The genus *Fibulia*, with *carnosa* Carter as the type species, must be used as diagnosed by Burton (1929, p. 424). Duchassaing and Michelotti's genus *Amphinedon* was a heterogeneous assortment of species. Vosmaer (1887, p. 358; confirmed by de Laubenfels, 1936, p. 45) established the species *compressa* D. and M. (1864, p. 78), a lamellate halicionid with diactinal megascleres only, as the type species of the genus. The species *nolitangere* is unrelated to *compressa* and Hechtel (1965) proposed the name *Neofibularia* for it, designating *Fibularia massa* Carter as the type species of the genus. Evidence is presented here demonstrating that Carter's *massa* is a synonym of the species *nolitangere*.

Neofibularia Hechtel, 1965

TYPE SPECIES: *Amphinedon nolitangere* Duchassaing and Michelotti, 1864, p. 82, Pl. XV, fig. 3.

Massive sponges with an irregular reticulation of mostly flattened spongin fibers that enclose the megascleres. The megascleres are strongyles, oxeas, or styles. Included among the microscleres are always two categories of oxeate microscleres, forming trichodragmas or not, and one to three categories of sigmas. Minute tylostyles, curved or straight, known as commas, are usually present in specimens of *N. nolitangere*. The oscules open into a large cloaca or open individually on the surface of the sponge or are grouped in clusters at the surface of the sponge. Sponges belong-

ing to this genus may produce a painful dermatitis when they come in contact with human skin.

The spicule complement of species of the genus *Neofibularia* is similar to that of the genus *Biemna* Gray (1867, p. 538.) Bowerbank's figures of the spicules of *B. peachii* (1874, Pl. LXIII, p. 163; *B. peachii* is a synonym of the type species, *variantia* Bowerbank, 1858, p. 286) reveal the presence of two size categories of sigmas, short microxeas and longer raphides as microscleres; the megasclere is a subtylostyle. The sponge figured is notable for its plumose skeletal architecture. Subsequent descriptions of *B. peachii*, especially those by Lundbeck (1902, p. 90) and by Topsent (1913, p. 50), have confirmed Bowerbank's notes on the microsclere content, adding the occurrence of small commas in some specimens. The megascleres are styles and these are arranged in polyspicular tracts usually cemented together by a small amount of spongin.

Burton's (1930, p. 522) diagnoses of the species of *Biemna* reveal that the skeleton usually consists of multispicular tracts running more or less vertically to the surface, but it may be halichondroid, subsodictyal, or reticulate. The surface of the sponge is often shaggy and is sometimes conulose. The megascleres are usually styles; in *B. macrosigma* they are amphitylotes (there is some doubt about whether this species should be included in *Biemna*.) The microsclere complement may include one to three size categories of sigmas and one to three size categories of oxate microscleres; to these, commas are added in some species.

The megascleres of *Neofibularia nolitangere* are diactinal, unlike those of *Biemna* species except for *macrosigma*, a species of uncertain affinities to the genus in question; in the Australian species of *Neofibularia* described below, the megascleres are styles as is usual in *Biemna*. The significance of the presence of diactinal vs. monactinal megascleres has sometimes been overestimated in diagnosing sponge genera (Hartman, 1958, p. 45.) *N. nolitangere*, with predominantly diactinal megascleres, has a small percentage of styles as well; on the other hand, the Australian species of *Neofibularia*, with stylote megascleres, also has a small number of diactines.

In view of the similarity in spicules, it may be argued that *Neofibularia* is a synonym of *Biemna*. When other characteristics

are considered, however, differences are apparent. *Neofibularia* has well-defined spongin fibers that are characteristically flattened in form and consistently reticulate in pattern. The amount of spongin present in the Australian species described below is comparable to that found among keratose sponges. In a series of species of *Biemna* studied at the British Museum (Natural History) [*chilensis* Thiele, *fortis* (Topsent), *megalosigma* Hentschel, *trirhaphis* (Topsent)] I have found that only small quantities of spongin typically join the spicules together in tracts. Only in the type species, *B. variantia*, of the forms examined, is there a moderate quantity of spongin helping to make up the fibrospicular tracts; but even in this case the amount of spongin present is not as great as that found in *Neofibularia*. Interstitial megascleres are rare or absent in *Neofibularia*, whereas they are common in some species of *Biemna* (e.g., *megalosigma* Hentschel, 1912, p. 351.) The external surface of specimens of *Neofibularia* is smooth or minutely hispid whereas there is a marked tendency for most *Biemna* species to have a shaggy or rough surface.

Table I gives a comparison of *Biemna* and *Neofibularia*. The latter genus is characterized by the reticulate skeleton of flattened spongin fibers enclosing the megascleres, by the variation in megasclere form from species to species, by the smooth to minutely hispid surface, by the arrangement of the oscules, and by the dermatitis-producing qualities of its species.

The great difficulties experienced by sponge taxonomists in grouping species and genera in higher categories is strikingly illustrated by a consideration of *Biemna* and *Neofibularia*. *Biemna* has most frequently been related more or less closely to the genus *Mycale* from which it differs in the absence of chelas and toxons (the latter are not always present in species of *Mycale*, however.) Dendy (1922) and Burton (1930) placed *Biemna* and *Mycale* in the section Mycaleae, subfamily Esperellinae, family Desmacidonidae. Wilson (1925) and Topsent (1928), however, favored placing *Biemna* at a greater distance from *Mycale* and assigned the genus to the subfamily Desmacellinae of the family Desmacidonidae while placing *Mycale* in another subfamily, the Mycalinae, of the same family. Hentschel (1923-25) set up a separate family, the Biemnidae, for *Biemna* and its relatives, and placed it along with the Mycalidae and Esperiosidae in a separate suborder of

TABLE 1. COMPARISON OF BIEMNA AND NEOFIBULARIA

Character	<i>Biemna</i>	<i>Neofibularia</i>
Skeletal architecture and occurrence of spongin.	Main spicule tracts ascending to surface; halichondroid; reticulate with stouter primary tracts; or spicules scattered irregularly. Small to moderate quantities of spongin present.	Irregular reticulation of flattened spongin fibers in which megascleres are embedded. Spongin abundant.
Megascleres	Styles; amphitylotes in one species (?)	Styles, oxeas, or strongyles.
Microscleres:		
Sigmas	One to three size categories; may be roughened distally	One to three size categories; distally roughened.
Microxeas	Present; may be roughened distally.	Present; distally roughened.
Raphides	Present.	Present.
Commas	Present in some species.	Present in one species.
Surface	Often shaggy or rough; sometimes smooth.	Smooth to minutely hispid.
Oscules	Small and isolated; up to 6 mm in diameter and localized on crest in <i>B. fortis</i> (Topsent).	Small and clustered; or larger and opening into common cloacas.
Dermatitis-producing qualities.	Not recorded for any species.	Recorded for the two known species.

the order Cornacuspongida. Hallmann (1916) saw a relationship between *Biemna* and *Allantophora* on the basis of the similarity in spicule types and placed these genera in the family Axinellidae, far removed from *Mycale*. De Laubenfels (1936) set up a new family Amphilectidae to receive *Biemna*, *Allantophora* and other genera and postulated their origin from microcioniform sponges by loss of echinating spinose megascleres. *Mycale* was placed in a related family, the Ophlitaspongiidae, by the same author. De Lau-

benfels placed his concept of the genus *Fibulia* (= *Neofibularia*) in a different order, the Haplosclerida, on the basis of the simplicity of the megascleres. He assigned it to the family Desmacidonidae which he interpreted in a quite different manner from previous authors, however. Arndt (1927) placed the species that is here called *Neofibularia nolitangere* in the genus *Gellius*, thus including it among the Haplosclerida in agreement with de Laubenfels.

By emphasizing different sets of skeletal characters, therefore, sponge systematists have arrived at divergent interpretations of the relationships of *Biemna* and *Neofibularia* to other Demospongiae. It is postulated here that *Biemna* and *Neofibularia* are closely related, the latter genus having a greater amount of spongin in its fibrospicular tracts, having a different arrangement of the oscules, and possessing chemical substances that irritate human skin. An affinity between these genera and *Mycale* seems likely in view of the general similarity in skeletal architecture and microsclere types, but an objective appraisal of the phylogenetic position of all these genera is difficult at the present time. More characters are needed for consideration. Information from the techniques of molecular systematics and cytology, including studies of the fine structure of cells and spicules, are promising possibilities.

Two species may be included in the genus *Neofibularia* at the present time; the first of these, the type species of the genus, comprises two subspecies.

Neofibularia nolitangere (Duchassaing and Michelotti)

SYNONYMY:

Amphimedon nolitangere Duchassaing and Michelotti, 1864, p. 82

Fibularia massa Carter, 1882, p. 282.

Gellius massa, Arndt, 1927, p. 151.

Fibulia nolitangere, de Laubenfels, 1936, p. 51; 1953a, p. 19.

Fibulia massa, de Laubenfels, 1953, p. 522.

Neofibularia massa, Hechtel, 1965, p. 23

A re-examination of the specimens on which de Laubenfels (1950, p. 53; 1953, p. 522) based his conclusion that *nolitangere* and *massa* are distinct species has revealed that they are, indeed, synonymous as de Laubenfels had assumed in 1936 (p. 51). The source of his confusion was the oversight of sigmas in his specimens from the Dry Tortugas (see Table II.) Sigmas are present

in the holotype (Pl. I, fig. 1, and text-fig. 1) of *Amphimedon nolitangere*, preserved in the collections of the Museo di Zoologia, Università di Torino, and in a fragment of this specimen deposited in the British Museum (Natural History) by de Laubenfels in 1928.

A re-examination of the holotype (Pl. I, fig. 2) of *Fibularia massa* Carter has revealed that its spicule complement (text-fig. 2)

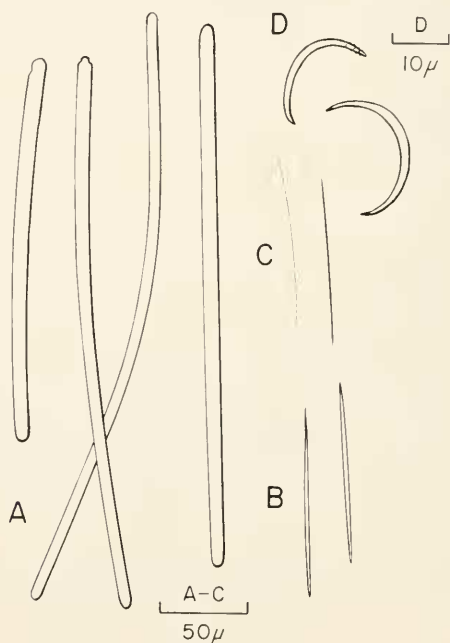


FIGURE 1. Spicules of *Amphimedon* [= *Neofibularia*] *nolitangere* D. & M. A. Strongyles. B. Microxeas. C. Raphides. D. Sigmæ. MZT. Holotype.

is identical to that of Duchassaing and Michelotti's specimen except for the somewhat larger size of the spicules. Carter's specimen agrees in other characters as well with that of the earlier authors. Spicule dimensions for a series of specimens of *Neofibularia nolitangere*, including the holotype of *F. massa*, are given in Table II.

In *Neofibularia nolitangere* the skeleton consists of an irregular reticulation of flattened spongin fibers packed with strongyles (Pl.

VI, fig. 1.) Although most of the strongyles are arranged in rows parallel to the fibers, some are placed diagonally and these may protrude from the fibers at all angles. At the surface of the sponge the skeleton presents one of two arrangements. Vertical spongin fibers filled with spicules may penetrate the epidermis at quite regular intervals. A few spicules usually protrude from these fibers and give the surface a hispid appearance. In some instances a

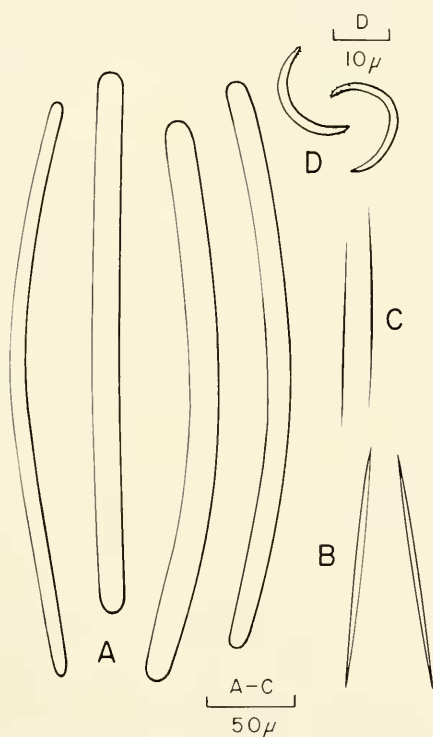


FIGURE 2. Spicules of *Fibularia massa* Carter [= *Neofibularia nolitangere*.]
A. Strongyles. B. Microxeas. C. Raphides. D. Sigmas. CLM No. 108.
Holotype.

regular reticulate pattern of flattened spongin fibers occurs at the surface. At points where vertical fibers join the reticulation from below a few spicules may protrude through the epidermis, but the surface in these cases is quite smooth in general aspect. Both types of surface pattern may be present in the same sponge. It is

possible that cross-connections between the vertically oriented fibers are formed simultaneously over a large area of the sponge surface and that areas with a reticulate surface pattern represent places where cross-connections have just been formed. On the other hand, regions of active outgrowth may present numerous vertical fibers, the distal ends of which protrude from the surface. At a later time such regions may assume a reticulate pattern as cross-connections are added.

In the holotype most of the megascleres are gently curved, some are straight, and a few are sinuous with two gentle curves. The microxeas occur infrequently while the raphides are abundant and the sigmas moderately common.

The microscleres occur throughout the sponge. The microxeas occur individually or in dense trichodragmas in the flesh. The raphides occur individually or in loose, irregular aggregations in the flesh. Commas and sigmas occur individually in the flesh, although the latter may occur in loosely arranged groups. All types of microscleres may be found at the surface, but sigmas are somewhat more abundant there than are the others. Regularly aligned groups of microxeas do not occur near the surface. All types of microscleres may be found associated with the surface of the spongin fibers.

Oscules may open individually at the surface, at times at the summit of an upright lobe of the sponge, or they may open into wide cloacas Pl. II, fig. 1); (also see Arndt, 1927, Pl. II, fig. 5; Hechtel, 1965).

The species may be divided into two subspecies as follows:

Neofibularia nolitangere nolitangere subsp. nov.

HOLOTYPE: Specimen of Duchassaing and Michelotti (Pl. I, fig. 1), preserved at the Museo di Zoologia, Università di Torino. A fragment of the specimen is deposited at the British Museum (Natural History) [BM (NH) Reg. No. 28.11.12.34.] The specimen was collected at St. Thomas, Virgin Is., prior to 1864.

SUPPLEMENTARY TYPE MATERIAL: The following plesiotypes, specimens upon which the descriptions of Hechtel (1965) and the present writer are based, are designated: YPM Nos. 5177,

5178, 5179. All were collected at Maiden Cay, Jamaica, in shallow water (< 3 meters.)

DIAGNOSIS: With strongyles as megascleres (text-fig. 1); shape varies from thickly encrusting to vasiform (Pl. II, fig. 1); up to 24 cm high and 28 cm in greatest width. Other details as in description above and that of Hechtel (1965).

RANGE: Dry Tortugas, Florida, and north in the Gulf of Mexico to Cape Romano, Florida; Bahamas; St. Thomas, Virgin Is.; Jamaica; Curaçao.

Neofibularia nolitangere oxeata subsp. nov.

HOLOTYPE: YPM No. 7604 (Pl. II, fig. 2). Collected at a depth of four meters at Bocachica, at the entrance to the Bahía de Cartagena, Colombia, in May, 1960, by Dr. Reynaldo Pfaff. Specimen dried after collection.

PARATYPE: YPM No. 1186. A fragment dredged off Cape Lookout, North Carolina (34°32.5' N. Lat., 75°55' W. Long.) at a depth of 46-74 meters. Jan. 21, 1950.

DIAGNOSIS: With oxeas or strongyloxeas as megascleres; microscleres as in the nominate subspecies; vasiform with a cloacal cavity.

DESCRIPTION: Shape: vasiform; 30 cm high; basal diameter, ca. 18 cm; apical diameter, 16 cm; wall 3-5 cm thick; cloacal diameter, 7.5 cm; depth of cloacal cavity, 22 cm. The wall of the sponge is marked by low moundlike lobules, 1-2 cm high (Pl. II, fig. 2.) The sponge was attached on one side of the base to dead corals.

COLOR: Unknown in the living condition. The dried specimen is beige.

CONSISTENCY: Firm but friable.

OSCULES: Opening into the cloacal cavity; 4-15 mm in diameter; in some instances several excurrent channels have fused near the surface to form openings up to 1.5 × 3.0 cm.

SKELETON: As in the nominate subspecies, the skeleton consists basically of a reticulation of somewhat flattened spongin fibers in which the megascleres are embedded. The fibrospicular tracts vary from $85\text{-}235\mu$ in diameter, the larger diameter being about twice that of the diameter at a right angle to it. Mesh sizes vary from $300 \times 425\mu$ to $600 \times 1475\mu$. Not infrequently thin sheets of spongin span the distance between adjacent longitudinal fibers; in these sheets are embedded megascleres oriented at right angles to the spicules in the main fibers.

The surface of the sponge varies from minutely hispid to smooth depending upon whether erect fiber ends project from the surface or whether the surface pattern of the fibers is reticulate.

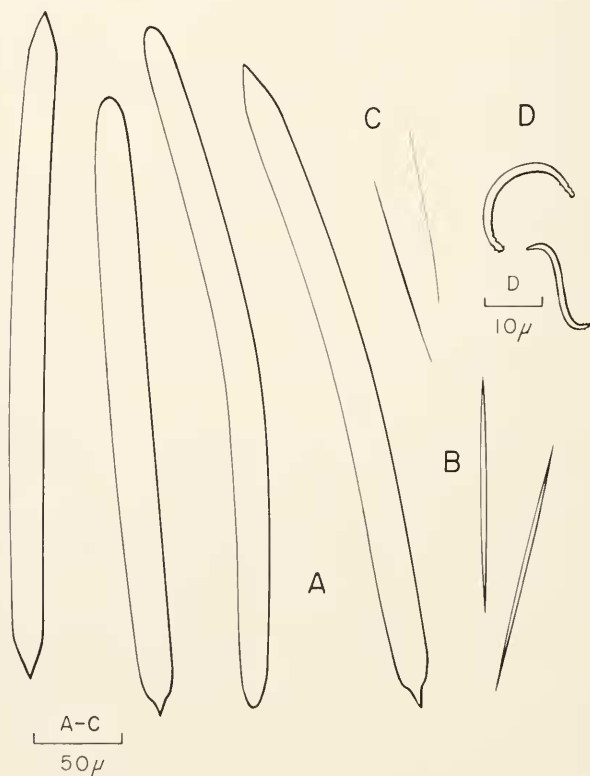


FIGURE 3. Spicules of *Neofibularia nolitangere oxcata* subsp. nov. A. Oxeas, style, strongyle. B. Microxeas. C. Raphides. D. Sigmas. YPM No. 7604. Holotype.

The megascleres are mostly oxeas of quite uniform diameter and with hastate ends; some have mucronate ends, while in still others the diameter at the ends decreases in a steplike fashion. Strongyloxeate modifications are common. True strongyles and styles occur occasionally. Most of the megascleres are gently curved; some are straight. The microscleres are microxeas, raphides and sigmas (text-fig. 3.) The microxeas taper gradually to a point at one end and abruptly so at the other end; the gradually pointed end is minutely roughened. Both the microxeas and raphides may occur in bundles or scattered individually in the flesh. The sigmas are minutely roughened at both ends. In the paratype some of the sigmas have a central swelling. Commas are of infrequent occurrence. Spicule dimensions are given in Table II.

DISCUSSION: The subspecies *oxeata* differs from the nominate form in its generally larger size, in the oxeate structure of the megascleres and in the larger size of all spicule types except the sigmas.

At present it is known only from two localities beyond the periphery of the range of the nominate subspecies. If further collecting reveals that the two forms overlap in range, consideration should be given to the possibility that *oxeata* represents a distinct species.

No information is available to indicate whether or not this form causes a dermatitis.

RANGE: Known only from the holotypic specimen from Colombia and from a fragment (YPM No. 1186) collected off Cape Lookout, North Carolina (34° 32.5' N. Lat., 75° 55' W. Long.) at a depth of 46-74 meters.

Neofibularia mordens sp. nov.

HOLOTYPE: YPM No. 5092. A portion of a specimen collected at a depth of 9.2 meters at Willunga (Aldinga) Reef, south of Adelaide, South Australia, on Feb. 7, 1960, by Mr. S. A. Shepherd. Another portion of the same specimen has been deposited at the South Australian Museum as a schizoholotype (No. A552.)

OTHER TYPE MATERIAL: Paratypes: YPM No. 7688, a portion of a specimen collected at a depth of 12.3 meters at the same

locality on March 6, 1966, by Messrs. H. W. Rumball and S. A. Shepherd. Another portion of the same specimen has been deposited at the South Australian Museum as a schizoparatype (No. A925). YPM No. 7689, three fragments of two specimens collected on the beach near Troubridge Lighthouse, Yorke Peninsula, South Australia, in 1890 by Messrs. H. W. Cristie and G. A. Payne. Portions of these specimens have been deposited at the South Australian Museum as schizoparatypes (Nos. A920, A921, A922.)

DIAGNOSIS: A massive sponge with oscules opening at the surface in clusters. The skeleton consists of a reticulation of spongin fibers enclosing styles. Microscleres include two size categories of microxeas and three size categories of sigmas. Dermatitis-producing properties pronounced.

DESCRIPTION: Shape and size: The collector of the holotype, Mr. S. A. Shepherd, described it as being massive and shaped like a hemispherical dome on a short cylindrical stalk (Pl. III, fig. 1.) It was 37 to 45 cm high and 30×25 cm in diameter. Large cavities penetrate the middle and lower regions of the sponge.

The paratype from Willunga Reef (YPM No. 7688) is massive, 32 cm high and 31×22 cm in width (Pl. IV, figs. 1, 2.) A marked ridge runs up the sides of the sponge and across the top at its greatest diameter.

COLOR IN LIFE: Mr. S. A. Shepherd has stated that the holotype was a "rich royal blue tending to purplish" as viewed at a depth of nine meters. When brought to the surface it was dark chocolate brown with a bluish tint. In a series of Kodachrome transparencies taken by Mr. Shepherd the upper surface of the sponge appears to be a deep taupe brown. This color changes gradually to a grayish-tan on the surface of the cavities described above. The cut surfaces reveal that the surficial color extends but a short distance into the endosome where a narrow region of medium gray color gives way to the biege-tan color of most of the interior mass of the sponge.

The paratype is also a deep taupe color grading to dark gray in the furrows in places, according to Kodachrome transparencies provided by Dr. R. V. Southcott.

CONSISTENCY: Moderately compressible but firm; tough; not friable.

SURFACE: The upper surface of the sponge is raised into ridges and lobules which rise to heights of 5 to 10 mm above the intervening furrows. The lobules on the holotypic fragments vary from 7 to 10 mm in diameter; ridges run for a distance of 3 cm and measure about 7 mm across. Plate III, fig. 1 shows one ridge running for a length of 18 to 20 cm; this ridge varies in width from 1.0—1.5 cm and bears a series of clustered oscules. The surface of the cavities is smooth and is not raised into ridges or lobules.

In the paratype upwardly directed ridges mark the sides of the sponge, and these terminate in free processes, 5-10 mm high and 3-4 mm in diameter.

The collector reports that the entire surface of the holotype exuded mucus when the sponge was collected. The cut base of the sponge was not slimy, however, indicating that the mucus is secreted by cells localized in the ectosome.

OSCULES: These occur in clusters distributed over the surface of the sponge on raised lobules or ridges. Each cluster includes from 6 to 25 or more oscules. The oscules are circular or elliptical in outline and vary in diameter from 2 mm to 3.5×3.0 mm. The oscules are the openings of long excurrent channels, 4 to 5 mm in diameter, which can be followed to depths of at least 5 cm into the interior of the sponge in the fragments available for study (Pl. V, fig. 1) These channels run parallel to one another for considerable distances into the endosome and presumably radiate out to receive smaller excurrent channels deep in the endosome.

In the case of the long ridge on the holotype mentioned above, the oscular clusters are spaced quite regularly along its length with 2 cm intervals between them. The clusters themselves are elongate; the one complete cluster present on the preserved fragments measures 2.0×1.4 cm.

Oscular clusters also open out into the cavities of the holotypic specimen. One such cluster shown in Pl. V, fig. 2, is composed of about 25 oscules. The cluster measures about 2.4×1.6 cm.

PORES: Not visible in the specimen available.

HISTOLOGY: The cells of the specimen have largely disappeared from the skeletal framework owing most probably to the fact that the sponge was preserved in sea-water formalin to which no supplementary neutralizing agent was added. In the few places in the interior of the sponge where cells are preserved, sections reveal the presence of a ground substance in which numerous amoebocytes lie. These cells lack cytoplasmic granules, are nucleolate, and bear two, three or more pseudopodia. Nucleolate cells with small cytoplasmic granules are common. A third cell type is probably anucleolate and bears large cytoplasmic granules which may represent food reserves. These cells are uncommon and vary in shape from spherular to amoeboid. These three cell types are comparable to the amoebocytes and granular cells described by Tuzet (1932) in *Haliclona elegans* (Bowerbank). Flagellated chambers and choanocytes were not seen in the sections examined.

Aggregations of sperm cells were found in one region about 1.5 cm below the surface. The sperm cells are enclosed by a protective layer of endopinacocytes. The cross-sectional diameters of one such aggregation measure $48 \times 40\mu$. Free sperm cells are distributed widely in the ground substance of the sponge. Fibers of spongin A (Gross et al., 1956) cannot be seen in the ground substance in Mallory-stained sections.

SKELETON: A rather irregular reticulation of spongin fibers in which the megascleres are embedded (Pl. V, fig. 1; Pl. VI, fig. 2.) The fibers are flattened; they twist occasionally so that now one is viewing the flattened side, again one is viewing the fiber on edge. The lesser diameter of the fibers is from about $3/5$ to $1/3$ the greater diameter. Fibers which measure 88μ and 151μ in lesser diameter, measure 265μ and 252μ respectively, in greater diameter. The dimensions of the fibers vary greatly throughout the sponge, measurements of the greater diameters ranging from 50μ to at least 365μ . The sizes of the openings between the anastomosing fibers are also highly variable, measurements ranging from $63 \times 150\mu$ to $820 \times 1070\mu$. Spongin reinforced with megascleres often occurs in perforated sheets which bound small cavities in which the cellular elements are undoubtedly enclosed in life. In some parts of the interior of the sponge, rows of such cavities run parallel to the surface, separated by dense, sparsely perforated layers of spongin packed with spicules and lying from 2 to 4 mm

apart. In other parts of the sponge these dense layers of spongin are not apparent.

The reticulation of fibrospicular tracts continues to a level very near the surface; in this region the fibers are narrower, measuring from 75 to 100μ just beneath the general upper surface of the sponge and from 60 to 140μ beneath the surface of cavities. The lacunae between the fibers show somewhat less variation in dimensions near the surface. Measured extremes of lacunar size are $88 \times 100\mu$ to $565 \times 630\mu$. At closely spaced intervals short, mostly flattened spongin fibers arise from the subsurface reticulation, and each terminates at the surface in a tuft of megascleres.

MEGASCLERES: Mostly styles; small numbers of oxeas and strongyles are also present. The styles are straight or, more often, gently curved. The curvature usually occurs in a region about $1/4$ to $1/3$ the distance from the rounded to the pointed end but may occur in a region $1/2$ to $2/3$ that distance. The diameter of the styles is usually uniform for about $4/5$ of the length and tapers gradually to a point at one end. Not infrequently the decrease in diameter at the pointed end is stepwise (e.g., style on right, text-fig. 4A.) The oxeas curve gently about $1/3$ the distance between the two points.

Most of the megascleres lie embedded in spongin fibers, with 6 to 25 rows occurring in a fiber cross-section. Occasionally a megasclere is enclosed in spongin only at one or the other tip, and the main body of the spicule protrudes into the space between fibers. Few if any megascleres lie completely free of the spongin fibers. The megascleres usually lie parallel to the fiber length but, especially at fiber intersections, some lie in diagonal positions.

MICROSCLERES: Two categories of microxeas are present. The larger ones (I) are roughened at one end only in most instances, but occasional ones are roughened at both ends. The middle third of these spicules has a uniform diameter; the distal thirds taper gradually to a sharp point. However, there is a tendency for the roughened end to taper more gradually and the smooth end more abruptly. The smaller microxeas (II) are roughened at both ends. It is this difference in structure together with the lack of overlap in length which suggests that the two categories of microxeas are

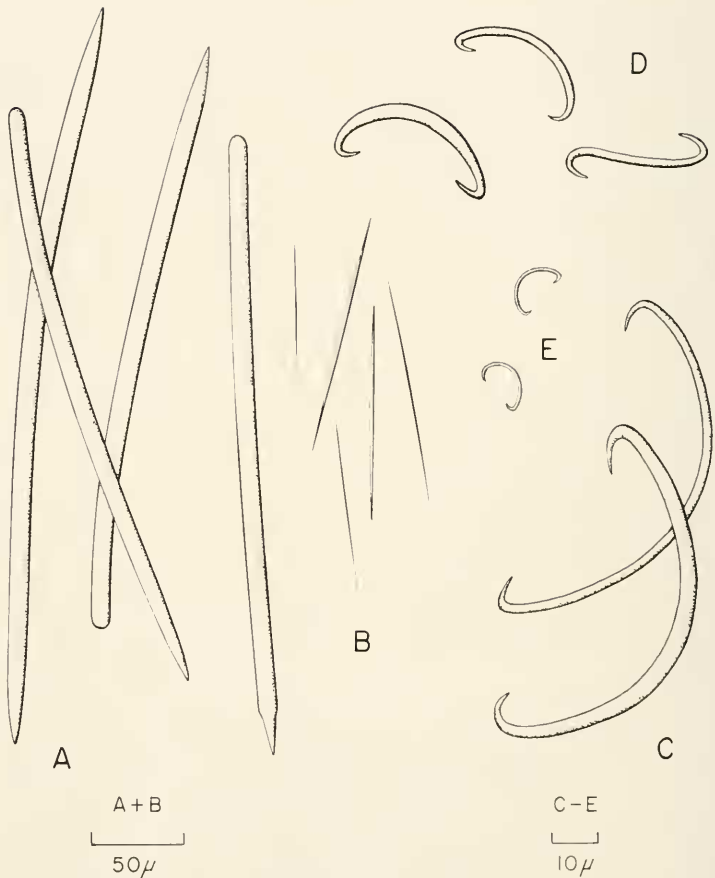


FIGURE 4. Spicules of *Neofibularia mordens* sp. nov. A. Styles, oxea. B. Microxeas of two sizes. C, D, E. Three size categories of sigmas. YPM No. 5092. Holotype.

distinct rather than that the smaller ones are developmental forms of the larger.

Three size categories of sigmas are present. In each category one prong of the spicule lies in the same plane as the main body of the spicule; the opposite prong is turned at an angle of 45° or more from the main axis. In the case of the largest and middle size categories, both distal prongs are roughened. It is impossible to

determine under the light microscope ($\times 1440$) whether or not the same is true for the smallest category.

Relatively few of the microscleres are enclosed in the spongin fibers; they do occur in abundance on the surface of the fibers, however. Microscleres of all categories also occur in abundance in the space between the reticulations of fibers. There is no localization of the several microsclere categories in the sponge. The microxeas do not form trichodragmas but occur individually with their axes arranged at random. In some instances the larger category of microxeas occurs in irregular star-shaped configurations, the midpoints of all axes in such an assemblage approaching one another at a central point and the distal ends radiating out in all directions.

Spicule dimensions are given in Table II.

DISCUSSION: This species agrees in spiculation in a general way with *Biemna variantia* (Bowerbank), the type species of *Biemna*. Minor differences occur, however. *B. variantia* has only two size categories of sigmas and the oxate microscleres include short, rather stout microxeas and long, thin raphides. No trace of roughened ends can be seen on the sigmas or microxeas in specimens of *B. variantia* that I have examined. This modification does occur in some species of *Biemna*, however.

In other characters, such as the abundance of spongin in the fibrospicular tracts, the roughened ends of the sigmas and microxeas, and the dermatitis-producing properties of the sponge, *N. mordens* approaches the West Indian sponge *nolitangere*. The Australian species differs from the latter, however, in the form of the megascleres, in the even greater quantity of spongin found in the fibrospicular tracts, in the arrangement of the oscules, and in another character that is difficult to understand. This is the fact that *nolitangere* is friable while *mordens* is more difficult to break apart. A similar difference can be observed between the genera *Adocia* and *Haliclona* (Hartman, 1958.) These crude observations no doubt have their basis in the structure of the fibrous proteins making up the fibers.

RANGE: Known only from the vicinity of Adelaide, South Australia, in the Gulf St. Vincent, where the toxic nature of the

sponge has been known at least since 1890 according to correspondence in the South Australian Museum. Depth: 9-12.3 meters.

OTHER SPECIES CONCERNED

Four additional species have been related to *Neofibularia nolitangere* at one time or another. Carter (1882) included two species in addition to *massa* in his genus *Fibularia*. These have since been placed in other genera as follows:

Fibularia ramosa Carter, 1882, p. 283 = *Gelliodes ramosa* (Carter) de Laubenfels, 1936, p. 53. A re-examination of the holotype of this species (Pl. VII, fig. 2) has shown that it is identical to *Pachychalina areolata* Wilson (1902, p. 392) which was redescribed by Hechtel (1965, p. 25) as *Gelliodes areolata*. Wilson's name falls in synonymy to *ramosa*. The megascleres of the holotype are oxeas, mostly straight or gently curved, but sometimes with a pronounced curve. About ten percent of the spicules are styles. The megascleres are densely packed in the reticulate spongin fibers; some occur interstitially. The microscleres are few in number and comprise sigmas only (text-fig. 5.) Spicule dimensions of the holotype are given in Table II.

Fibularia anchorata Carter, 1882, p. 283 = *Desmapsamma anchorata* (Carter) Burton, 1934, p. 547. (See Pl. VII, fig. 1.) This sponge was redescribed by Hechtel (1965, p. 21.) The megascleres of the holotype (text-fig. 6) are hastately pointed oxeas, straight or gently curved. A very few styles occur. The microscleres are arcuate isochelas and sigmas, possibly of two size categories; all are infrequent in occurrence. The megascleres occur in tracts forming an irregular reticulation and held together by small to moderate amounts of spongin; interstitial megascleres occur as well. Moderate amounts of debris, including broken spicules of other sponges, coat the surface of the sponge and are dispersed through the interior. Spicule dimensions of the holotype are given in Table II.

The only other species that has been assigned to *Fibularia* is *raphidifera* Topsent, 1889, p. 45. The same author later placed this species in the genus *Desmacidon* [= *D. raphidifer* (Topsent) Topsent 1894, p. 34]. De Laubenfels (1936, p. 52) included it in a new genus *Burtonispongia*, but later (1950, p. 78) transferred

it to *Fibulia*. Its spiculation does not agree with that of the type species of *Fibulia*, and its generic placement must be reconsidered. It is clearly not related to *N. nolitaugere*.

Fibulia bermuda de Laubenfels, 1950, p. 52, is clearly not related to sponges of the genus *Neofibularia*. A re-examination of the holotype at the British Museum (Natural History) [BM (NH) Reg. No. 1948.8.6.2.1] has shown that the only spicules present are thin strongylote subtylostyles arranged in spongin fibers. The raphides mentioned by de Laubenfels must have been broken

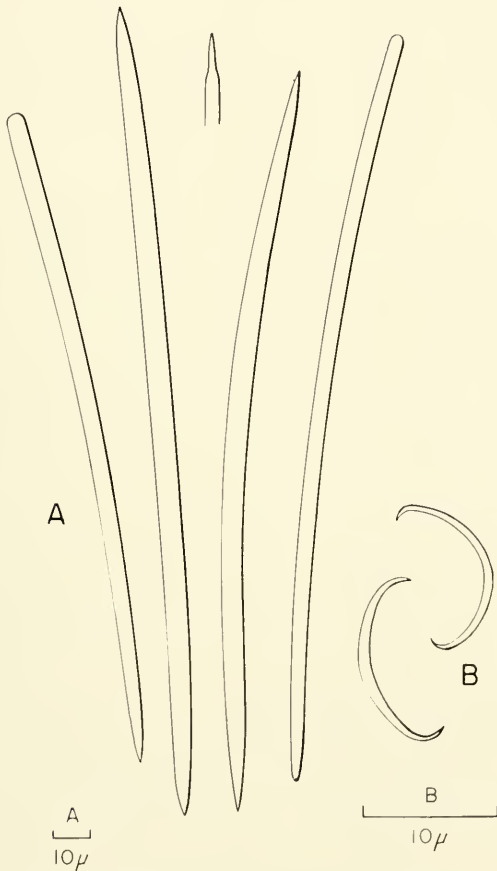


FIGURE 5. Spicules of *Fibularia* [= *Gelliodes*] *ramosa* Carter. A. Oxeas, styles. B. Sigmas. CLM No. 76. Holotype.

spicules mistaken for microscleres. The question of the correct allocation of *bermuda* must be restudied.

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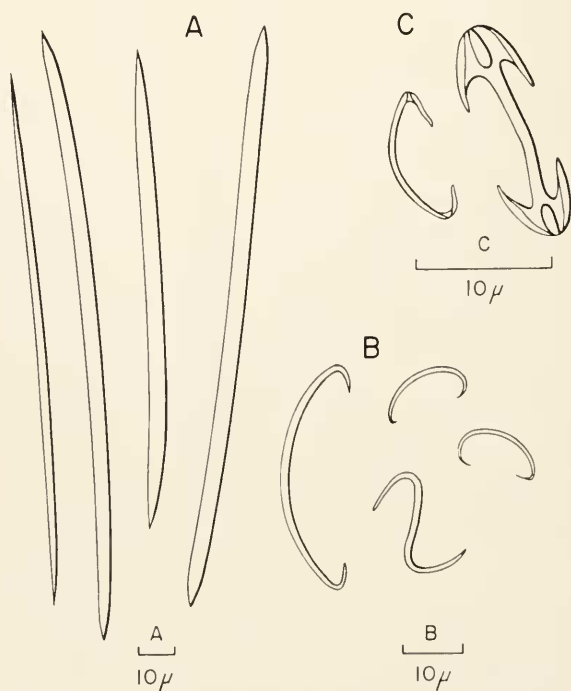


FIGURE 6. Spicules of *Fibularia* [= *Desmapsamma*] *anchorata* Carter. A. Oxeas. B. Sigmas. C. Isochelas. CLM. Holotype.

the United States National Museum, kindly lent specimens identified by de Laubenfels. I am also grateful to the Trustees of the British Museum (Natural History) for permission to publish the photographs shown on Pl. I, fig. 2, and Pl. VII, figs. 1, 2. Dr. R. V. Southcott of Adelaide, South Australia, sent me the specimens of *Neofibularia mordens* and kindly provided colored photographs taken in the field. Dr. Reynaldo Pfaff, chairman of the Department of Phyto- and Zoochemistry, University of Cartagena, sent the specimen of *N. nolitangere oxeata*. I am indebted to Mr. John Howard and Mrs. Diane Barker for assistance in photography and to my wife, Shirley G. Hartman, for preparing the drawings.

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TABLE 2. SPICULE DIMENSIONS

Spicule Category	Length: Range	Length: Mean	Width: Range	Width: Mean	Number Measured
<i>Amphimedon nolitangere</i> D. & M. Holotype. St. Thomas, Virgin Is. MZT.					
Strongyles	226-348 μ	316 \pm 5 μ	6.1-9.2 μ	7.2 \pm 0.2 μ	30
Microxeas	104-124 μ	112 \pm 2 μ	1.8-2.2 μ	2.0 \pm 0.5 μ	10
Raphides	82-110 μ	95 \pm 1.5 μ	0.8-1.0 μ	—	20
Sigmas	18-22 μ	20 \pm 0.5 μ	1.4-1.6 μ	—	10
Commas	7 μ	—	0.8 μ	—	2
<i>Fibularia massa</i> Carter. Holotype. Long Cay Is., N. P., Bahamas. CLM No. 108.					
Strongyles	229-348 μ	329 \pm 3 μ	6.1-17.1 μ	14.0 \pm 0.5 μ	20
Microxeas	125-142 μ	137 \pm 1 μ	3.2-5.2 μ	4.1 \pm 0.1 μ	20
Raphides	102-124 μ	115 \pm 1 μ	1.0 μ	—	20
Sigmas	16-20 μ	17 \pm 0.5 μ	1.2-1.3 μ	—	10
Commas	5-8 μ	—	0.7-0.9 μ	—	5
<i>Neofibularia n. nolitangere</i> (D. & M.) East of Loggerhead Key, Dry Tortugas, Florida. 17 meters. USNM No. 22414.					
Strongyles	207-311 μ	283 \pm 6 μ	3.1-6.1 μ	4.8 \pm 0.2 μ	20
Microxeas	104-120 μ	111 \pm 1.5 μ	2.0-2.6 μ	2.2 \pm 0.1 μ	10
Raphides	98-114 μ	106 \pm 2 μ	0.8-1.2 μ	1.0 \pm 0.05 μ	10
Sigmas	16-20 μ	18 \pm 0.5 μ	1.2-1.3 μ	1.3 \pm 0.02 μ	10
Commas	7 μ	—	0.8 μ	—	3
<i>Neofibularia n. nolitangere</i> (D. & M.) Collecting data as above. USNM No. 22590					
Strongyles	256-342 μ	296 \pm 5 μ	3.1-7.3 μ	5.4 \pm 0.2 μ	20
Microxeas	113-119 μ	115 \pm 0.6 μ	2.0-2.8 μ	2.4 \pm 0.1 μ	10
Raphides	90-110 μ	102 \pm 2 μ	0.6-1.0 μ	0.8 \pm 0.05 μ	10
Sigmas	17-24 μ	20 \pm 0.6 μ	1.3-1.4 μ	1.4 \pm 0.02 μ	10
Commas	8 μ	—	0.8 μ	—	1
<i>Neofibularia n. nolitangere</i> (D. & M.) West of Cape Romano, Florida. 14 meters. USNM No. 23399.					
Strongyles	256-329 μ	300 \pm 4 μ	4.9-12.2 μ	7.9 \pm 0.4 μ	20
Microxeas	98-121 μ	108 \pm 2 μ	2.0-2.9 μ	2.5 \pm 0.06 μ	20
Raphides	87-99 μ	92 \pm 1.5 μ	1.0 μ	—	10
Sigmas	14-22 μ	18 \pm 0.6 μ	0.9-1.3 μ	1.2 \pm 0.05 μ	10
Commas	8 μ	—	0.8 μ	—	3

TABLE 2. SPICULE DIMENSIONS (continued)

Spicule Category	Length: Range	Length: Mean	Width: Range	Width: Mean	Number Measured
<i>Neofibularia n. nolitangere</i> (D. & M.) Maiden Cay, Jamaica. <3 meters. YPM No. 5179.					
Strongyles	167-361 μ	311 \pm 8 μ	4.4-15.8 μ	8.0 \pm 0.5 μ	30
Microxeas	108-132 μ	121 \pm 2 μ	2.0-3.0 μ	2.6 \pm 0.1 μ	10
Raphides	88-108 μ	98 \pm 1 μ	1.0-1.2 μ	—	20
Sigmas	16-24 μ	19 \pm 0.5 μ	1.4-2.0 μ	—	10
Commas	6 μ	—	0.6 μ	—	1
<i>Neofibularia nolitangere oxedata</i> subsp. nov. Holotype. Bahía de Cartagena, Colombia. 4 meters. YPM No. 7604.					
Oxeas	348-433 μ	393 \pm 4 μ	8.5-24.4 μ	18.6 \pm 0.5 μ	40
Microxeas	134-150 μ	141 \pm 1.5 μ	3.0-4.0 μ	3.7 \pm 0.1 μ	10
Raphides	100-126 μ	115 \pm 1.5 μ	2.0 μ	—	20
Sigmas	18-20 μ	19 \pm 0.3 μ	1.3-1.6 μ	—	10
Commas	9-12 μ	—	0.7-0.9 μ	—	5
<i>Neofibularia nolitangere oxedata</i> subsp. nov. Off Cape Lookout, N. C. 46-74 meters. YPM No. 1186.					
Oxeas	348-427 μ	377 \pm 4 μ	8.5-18.3 μ	13.3 \pm 0.7 μ	20
Microxeas	124-140 μ	134 \pm 1.5 μ	3.0-5.0 μ	4.1 \pm 0.1 μ	20
Raphides	102-122 μ	113 \pm 2 μ	1.0-1.6 μ	1.3 \pm 0.05 μ	10
Sigmas	20-23 μ	21 \pm 0.3 μ	1.0-1.4 μ	1.3 \pm 0.1 μ	10
Commas	8-9 μ	—	0.5-0.7 μ	—	5
<i>Neofibularia mordens</i> sp. nov. Holotype. Willunga Reef, South Australia. 9.2 meters. YPM No. 5092					
Styles	262-348 μ	320 \pm 3 μ	7.9-13.4 μ	11.6 \pm 0.1 μ	40
Microxeas (I)	108-144 μ	128 \pm 2 μ	1.0-1.8 μ	1.6 \pm 0.05 μ	20
Microxeas (II)	88-100 μ	95 \pm 1 μ	1.0-1.4 μ	1.2 \pm 0.1 μ	10
Sigmas (I)	11-22 μ	14 \pm 0.5 μ	1.1-1.8 μ	1.4 \pm 0.05 μ	20
Sigmas (II)	28-44 μ	39 \pm 1 μ	2.0-3.6 μ	2.8 \pm 0.1 μ	20
Sigmas (III)	70-97 μ	82 \pm 1.5 μ	2.2-4.0 μ	3.2 \pm 0.1 μ	30
<i>Neofibularia mordens</i> sp. nov. Paratype. Locality as above. 12.3 meters. YPM No. 7688.					
Styles	258-357 μ	315 \pm 3 μ	4.4-13.1 μ	10.3 \pm 0.8 μ	50
Microxeas (I)	100-162 μ	143 \pm 2 μ	2.1-3.3 μ	2.8 \pm 0.1 μ	30
Microxeas (II)	82-112 μ	96 \pm 3 μ	1.0-1.3 μ	1.2 \pm 0.05 μ	10
Sigmas (I)	14-22 μ	16 \pm 0.6 μ	1.0 μ	—	20
Sigmas (II)	38-58 μ	46 \pm 1 μ	1.2-3.0 μ	—	20
Sigmas (III)	74-104 μ	89 \pm 2 μ	1.8-3.0 μ	—	20

TABLE 2. SPICULE DIMENSIONS (continued)

Spicule Category	Length: Range	Length: Mean	Width: Range	Width: Mean	Number Measured
<i>Neofibularia mordens</i> sp. nov. Paratype. Troubridge Lighthouse, South Australia. YPM No. 7689.					
Styles	235-351 μ	308 \pm 4 μ	4.9-12.2 μ	8.6 \pm 0.2 μ	50
Microxeas (I)	114-152 μ	132 \pm 2 μ	2.3-3.3 μ	2.6 \pm 0.05 μ	20
Microxeas (II)	82-102 μ	94 \pm 2 μ	0.9-1.2 μ	1.1 \pm 0.1 μ	10
Sigmas (I)	12-22 μ	15 \pm 0.7 μ	1.0-1.2 μ	—	20
Sigmas (II)	38-58 μ	45 \pm 2 μ	2.3-2.6 μ	—	20
Sigmas (III)	82-93 μ	88 \pm 1 μ	2.3-3.3 μ	—	10
<i>Fibularia ramosa</i> Carter. Holotype. Puerto Cabello, Venezuela. CLM. No. 76.					
Oxeas, styles	183-249 μ	218 \pm 3 μ	4.4-8.7 μ	5.7 \pm 0.1 μ	30
Sigmas	13-21 μ	15 \pm 0.8 μ	0.9-1.2 μ	1.0 \pm 0.04 μ	10
<i>Fibularia anchorata</i> Carter. Holotype. Falmouth Harbor, Antigua. CLM.					
Oxeas	124-176 μ	161 \pm 2 μ	2.2-5.4 μ	4.0 \pm 0.1 μ	40
Isochelas	10-16 μ	12 \pm 0.5 μ	—	—	10
Sigmas (I)	14-16 μ	—	1.0 μ	—	7
Sigmas (II)	26-34 μ	29 \pm 0.7 μ	1.2-1.4 μ	—	10

Abbreviations

CLM — City of Liverpool Museums

MZT — Museo di Zoologia, Università di Torino

USNM — United States National Museum

YPM — Peabody Museum of Natural History, Yale University

- Plate I. Figure 1. *Amphimedon* [= *Neofibularia*] *nolitangere* D. & M.
St. Thomas, V. I. MZT. Holotype. $\times 0.6$.
- Figure 2. *Fibularia massa* Carter [= *Neofibularia nolitangere*.]
Long Cay Is., N. P., Bahamas. CLM No. 108. Holotype.
 $\times 1.2$.



1



2

"ARGO" Long Key Island
EXPEDITION, 1876.
Coll. by _____ *Preserved*

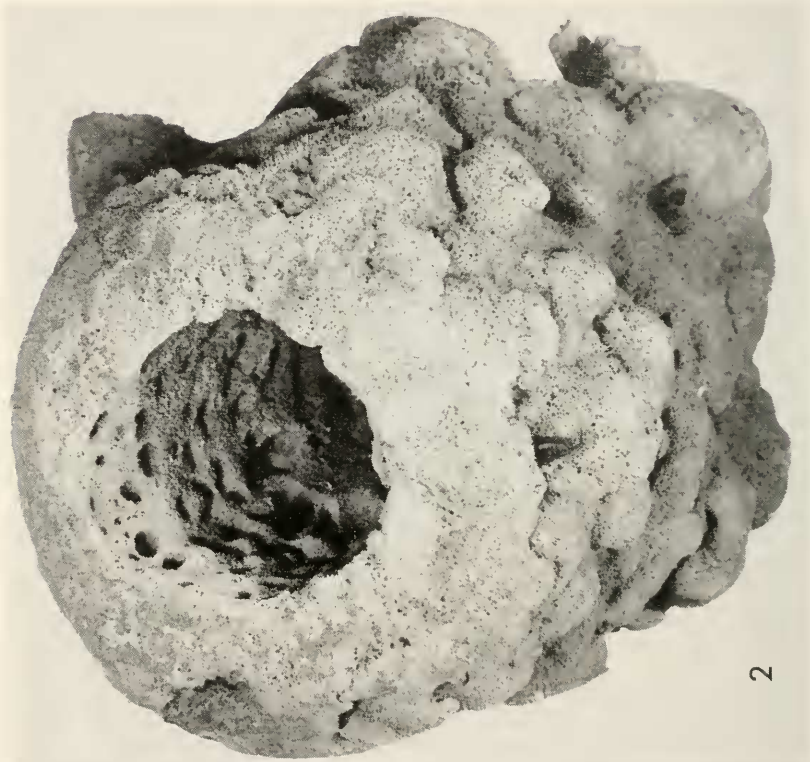


Plate II. Figure 1. *Neofibularia n. nolitangere*. Vase-shaped individual from Maiden Cay, Jamaica. YPM No. 5179. $\times 7/8$.

Figure 2. *Neofibularia nolitangere oxcata*. Viewed obliquely from above. Bahía de Cartagena, Colombia. YPM No. 7604. Holotype. $\times 1/2$.

Plate III. Figure 1. *Neofibularia mordens*. Photographed alive shortly after collection. Note clusters of oscules. Willunga Reef, South Australia. PYM No. 5092. Holotype. \times ca. 1/3.



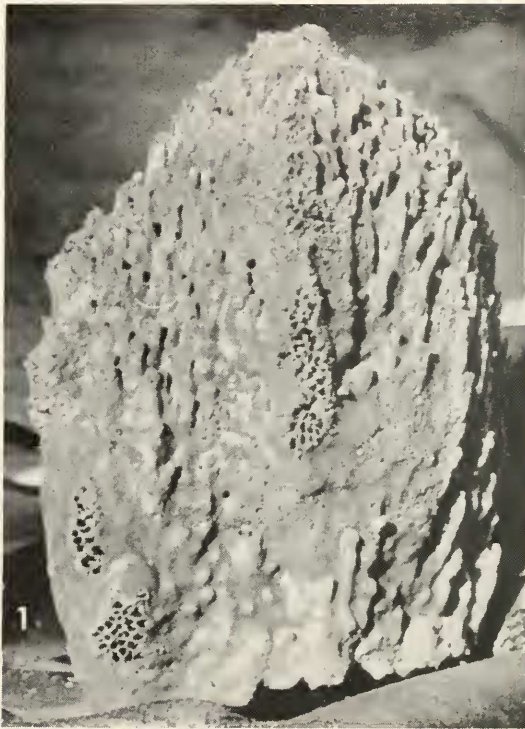
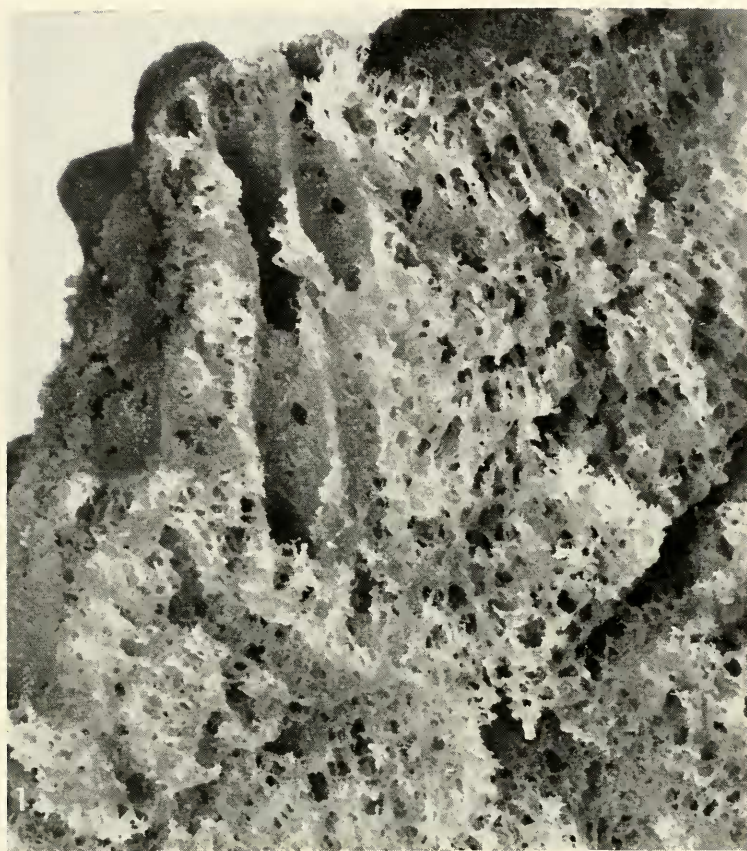


Plate IV. Figure 1. *Neofibularia mordens*. Photographed alive shortly after collection. Oscular clusters are clearly shown. Willunga Reef, South Australia. YPM No. 7688. Paratype. \times ca. $\frac{1}{4}$.

Figure 2. *Neofibularia mordens*. Same specimen as above, photographed from opposite side. \times ca. $\frac{1}{4}$.

- Plate V. Figure 1. *Neofibularia mordens*. Enlarged view of cut surface after preservation, showing skeletal reticulation and excurrent channels leading to surface. YPM No. 5092. Holotype. $\times 2$.
- Figure 2. *Neofibularia mordens*. Cut surface of living specimen showing a cluster of oscules opening into cavities at base. YPM No. 5092. Holotype. \times ca. $\frac{1}{2}$.



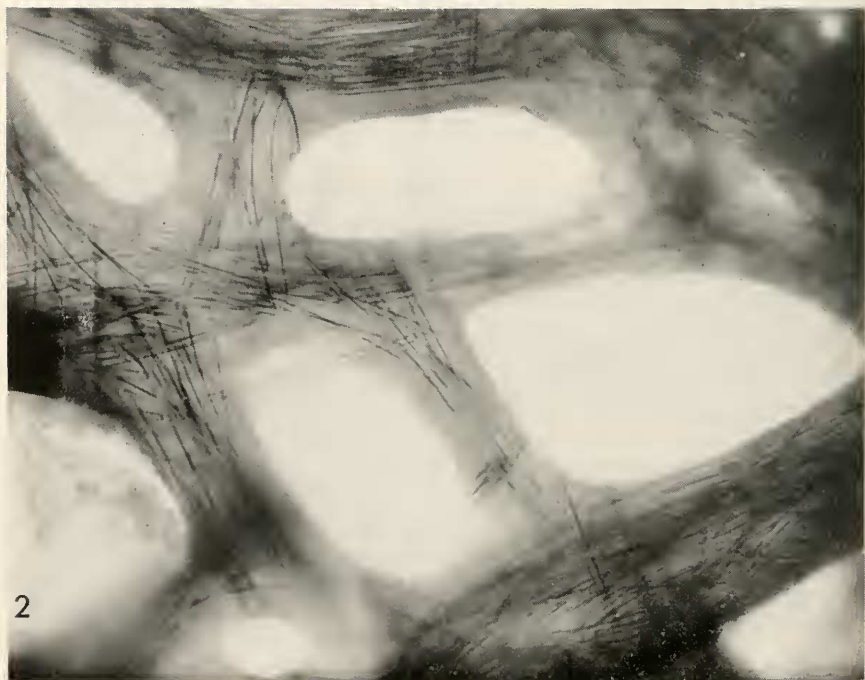


Plate VI. Figure 1. Fibrospicular tracts of *Neofibularia n. nolitangere*.
Off Cape Romano, Florida. USNM No. 23399. $\times 80$.

Figure 2. Fibrospicular tracts of *Neofibularia mordens*. Wil-
lunga Reef, South Australia. YPM No. 5092 Holotype. $\times 80$.

- Plate VII. Figure 1. *Fibularia* [= *Desmapsamma*] *anchorata* Carter. Holotypic specimens. Falmouth Harbor, Antigua. CLM. $\times 0.9$.
- Figure 2. *Fibularia* [= *Gelliodes*] *ramosa* Carter. Holotypic specimens. Puerto Cabello, Venezuela. CLM No. 76. $\times \frac{3}{4}$.

