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TRANSACTIONS

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THE ZOOLOGICAL SOCIETY

OF LONDON.

The Porifera of the Bermuda Archipelago.

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(Plates I, II and 65 figures in the text.)

[Communicated by Dr. Edward Hindle, F.R.S.—Received June 7th, 1949.]

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INTRODUCTION.

The specimens here treated were all collected in marine waters about Bermuda, always so shallow that collection could be made by hand, none dredged. There appear to be no intertidal sponges in the Bermudas ; these are all from just below low tide to a depth of perhaps five metres, but probably every species occurs at depths of less than three metres.

The specimens here treated were all studied during 1947. A collection was made by Dr. Werner Bergmann of Yale University and forwarded to me early in the year. I then spent the summer in the field, and at the Bermuda Biological Laboratory for Research, with gratitude to the American Philosophical Society for a generous grant, and to the Director of the Laboratory, Dr. Dugald Brown, for excellent cooperation. Nearly all the species were studied alive, where they were growing naturally in Bermuda.

Duplicate specimens or syntypes of all but about three of the species have been deposited in the British Museum (Natural History), Cromwell Road, London, S.W.7, England. The remaining or principal collection is maintained, at least temporarily, at the Bermuda Government Aquarium, Flatts, Bermuda, (Major Louis Mowbray, Director).

In the literature on sponges there are a number of listings as of the locality "Bermuda" which do not concern the present discussion because the specimens came from deep water. The ocean becomes extremely deep only a few miles offshore, introducing an entirely new habitat. The various references in the reports of the 'Challenger' expedition fall under this category.

In 1901, R. P. Whitfield described *Siphonochalina stolonifera,* sp. n. from Bermuda. His description and figures show that this is merely one of the common variations of the abundant local species, *Callyspongia vaginalis.*

In 1918, B. B. Crozier described three species, not new, as occurring in Bermudan waters. These were *Donatia lyncurium, Donatia seychellensis,* and *Donatia ingalli.* All of Crozier's specimens were clearly the same species, namely, *Tethya actinia.* Crozier stressed that in one the cortex was 1·5 mm. thick, while in another it was 2·5 mm. thick. As *actinia* grows older, its cortex thickens, from zero in the larva to 3·0 mm. in older specimens, with all conceivable intermediate thicknesses.

In 1907, A. E. Verrill published what has been by far the most significant paper on the Porifera of the Bermudas. Only a first part ever appeared ; it concludes with the phrase "to be continued" but apparently Professor Verrill died before completing the work. Curiously, different copies of the otherwise identical paper bear different paginations. The corresponding pages in one printing run from 286 to 300, but in another from 330 to 344—a difference of 44 pages. Verrill mentions having forty species, but discusses just twenty, obviously saving the other half for the part that was then never published.

Unfortunately the descriptions in Verrill's paper are not at all adequate. Ectosomal structures are seldom mentioned, or the arrangement of the skeleton, and much is left to surmise. Dr. Bergmann instituted a search at Yale, where Professor Verrill taught, but neither there nor at Bermuda could types of Verrill's species be located. There was a large collection at Yale of Verrill's sponges from Bermuda, doubtless containing the specimens upon which he relied, but they were unlabelled, or the labels lost, or hopelessly confused. Some were labelled with names vaguely resembling the names that were used in the paper, but not the same names ; one may wonder if they correspond or not. The state of preservation of this collection is also described as being very poor.

The species listed by Verrill may be here considered, one by one, with my best surmise as to what well-known species corresponds to each :—

1. *Geodia gibberosa* Lamarck=*Geodia gibberosa* Lamarck.

2. *Chondrilla nucula* Schmidt=*Chondrilla nucula* Schmidt.

3. *Spinosella sororia* (Duchassaing and Michelotti)=*Callyspongia vaginalis* (Lamarck).

4. *Spinosella stolonifera* (Whitfield)=*Callyspongia vaginalis* (Lamarck).

5. *Pachychalina cellulosa*, nov. I could not find any sponge at Bermuda answering to this description. It reads as though it might be the abundant West Indian species, *Haliclona rubens*. It may be that some epidemic or ecological change has exterminated this form, but that it was common in 1907 ; certainly I could not find it in 1947.

6. *Pachychalina elastica*, nov. The Bermuda sponge that most closely answers to Verrill's excessively brief description is the solid, ramose rather than tube-shaped phase of *Callyspongia vaginalis*.

7. *Pachychalina millepora*, nov. I could not find any Bermuda sponge that I could reconcile with Verrill's description, in spite of its vagueness. Are his descriptions accurate ? At present *Haliclona variabilis* is very abundant in the archipelago, and it seems very probable that it was also common in Verrill's day. He would have classified it as a *Pachychalina ;* in fact Dendy established it as a species of that genus. Every other species that Verrill mentions differs more from *variabilis* than does his *millepora*. The conflict there is not so great but that conjecture is possible. I venture, therefore, the guess that perhaps *millepora* Verrill, 1907=*variabilis* Dendy, 1890.

8. *Pachychalina monticulosa*, nov. It is possible, in view of Verrill's inadequate description, to synonymize this with a *Liosina* that I found in the Bermudas. Were Verrill's descriptions more thorough, differences might appear.

9. *Pachychalina micropora*, nov. So very little data or descriptions are given for this name that I have placed it with *Haliclona viridis* (Duchassaing and Michelotti).

10. *Cribrochalina bartholmei* (Duchassaing and Michelotti). This is the wrong genus; it should be *Xestospongia*, and it is almost certainly not *bartholmei*, and requires a new name.

11. *Desmacella jania*, nov. This was full of an alga, as more recent specimens are not, nevertheless the identification appears to have been correct. This is rather more common now than he found it to be: *Desmacella jania* Verrill.

12. *Esperiopsis fragilis*, nov. This is certainly not an *Esperiopsis*; it is very inadequately described, but seems likely to represent the abundant *Lissodendoryx isodictyalis* (Carter).

13. *Tedania ignis* (Duchassaing and Michelotti)=*Tedania ignis* (Duchassaing and Michelotti).

14. *Axinella apressa*, nov. See the following notes.

15. *Axinella rudis*, nov. Both this and *A. apressa* fall within the range of variation of an abundant local species. Verrill stresses such items as that the one remained red when dry, while the other turned pale brown: this difference occurs even in different portions of the same specimen, and probably has to do with the exposure to air currents and amount of water remaining in the sponge's cavities. The one species is here treated as *Homaxinella rudis* (Verrill).

16. *Axinella rosacea*, nov.=*Pseudaxinella rosacea* (Verrill).

17. *Polymastia varia*, nov. Very inadequately described, like most of this collection. The Bermudan species that most closely resembles Verrill's description of *varia* is the common *Terpios fugax* Duchassaing and Michelotti.

18. *Heterocliona cribraria* (Schmidt). Verrill set up a new genus for this species, but it belongs to the very abundant genus *Spheciospongia* Marshall. Most zoologists long overlooked Marshall's work, because it appeared in a "Festschrift" and these publications are very inadequately distributed. Although the genus was not new, the species is; it is not *cribraria* of Schmidt, but a new one.

19. *Cliona caribboea* Carter=*Cliona caribboea* Carter.

20. *Spirastrella mollis*, nov.=*Spirastrella coccinea* (Duchassaing and Michelotti).

Systematic Section.

Some sixty-five species of Bermuda sponges are available for description at the present moment. None belongs in the class Hyalospongiae, but the other two classes of Porifera are well represented.

Class **DEMOSPONGIAE** Sollas.

These are sponges of compact rhagon architecture, usually (but not always) characterized by the presence of spongin in the skeleton. Siliceous elements are often also present, but both spongin and silica may be wanting. In contrast, the Hyalospongiae always have silica, never have spongin, and are always of a very distinctive open-work structure; they are rhagon, but not "typical".

Order *KERATOSA* Bowerbank.

These are sponges having spongin skeletons which are usually well developed, and never contain any proper mineral material. Bits of foreign material may, however, be picked up from the environment, and not always accidentally, because it is clear that some Keratosa regularly avoid this, even when foreign debris surrounds them, whereas others accumulate it, even when it appears to the human observer to be rare in that environment. Most keratose sponges have a " spongy " consistency, and a fleshy, conulose surface.

Family SPONGIIDAE Gray.

Gray spelled it " Spongidae ", but the type genus is not " Sponga " but *Spongia*. The corrected spelling, and therefore perhaps the authorship, dates from de Laubenfels, 1936, page 7. Sponges of this family have small, round, flagellate chambers, whereas all the other families of the order have large, sack-shaped, flagellate chambers.

Genus Spongia Linné.

Sponges of this genus have abundant interlacing fibres that are free from foreign material; yet in spite of their abundance they are regarded as being secondary. Among them, about 0·5 to 2 mm. apart, primary fibres ascend more or less perpendicularly to the surface, and these fibres are cored with foreign debris. There are no large, ramifying, subdermal cavities. The fibres are extremely elastic, even when dry, and many individuals of the genus have commercial value and use.

In the West Indies there are :—

I. The yellow sponges: *Spongia barbara* Duchassaing and Michelotti or *Spongia zimocca* Schmidt, subspecies *barbara*. It is difficult to decide whether or not to elevate *barbara* to full species rank. Formerly I did so (1936), now I am not of that opinion.

II. The grass sponges : *Spongia graminea* Hyatt.

III. The reef sponges : *Spongia obliqua* Duchassaing and Michelotti or *Spongia officinalis* Linné, subspecies *obliqua*. In 1936 I favoured full species rank for *obliqua*, now (by the narrowest of margins) reduce it to subspecific rank.

IV. The hardhead sponges : *Spongia dura* Hyatt or *Spongia officinalis* Linné, subspecies *dura*.

Two of these seem to have occurred at Bermuda.

Spongia officinalis, subspecies obliqua Duchassaing and Michelotti.

Bermuda specimens of this sponge are represented by the British Museum (Natural History) register number 1948.8.6.1.

Dates collected.—At the Bermuda Biological Station there was a specimen that had been collected on the 29th of November, 1937. At the Government Aquarium Museum there were two or three specimens of this variety, lacking data, but certainly collected prior to 1940.

Localities.—The first-mentioned specimen was taken at Three Hills Shoal, about five kilometres north of Hamilton. What must have been this species is locally described as having been moderately common about Daniel's Head and near Agar's Island, both in the western portion of the Bermudas.

Abundance.—At present, absent or very rare.

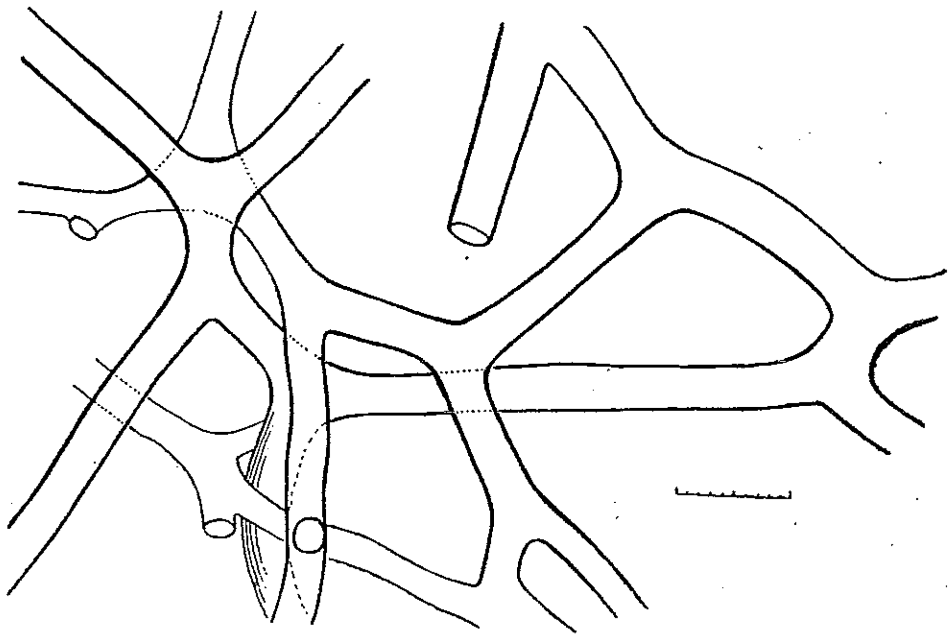
Shape.—Head-size specimens are common. A diameter of 30 or more centimetres may be attained.

Colour.—The living sponge is black or nearly so, as to exterior. Specimens which grow in shaded areas are paler than those which grow in illuminated regions; the less light, the paler the grey or drab coloration. The interior in life is a reddish brown, copper-like colour, sometimes even resembling a piece of meat, or liver. Pickled specimens retain the melanin external pigment, but the interior colours fade to a dull, pale brown. Dried, macerated skeletons are a light amber.

Consistency.—Very spongy, elastic, strong. This obtains in life, in spirit specimens, and even in dry ones.

Surface.—Conulose, conules often 1 to 2 mm. high, 2 to 4 mm. apart.

Fig. 1.



Camera lucida drawing, ×150, of a bit of macerated skeleton of a specimen of *Spongia officinalis* from Bermuda, and which is exhibited at the Museum of the Government Aquarium, Flatts, Bermuda. The enclosed scale shows 100 microns by tens.

Oscules.—Often about 1 cm. in diameter, and less than 4 cm. apart.

Pores.—Microscopic and contractile; a diameter of 15 microns may be cited.

Ectosome anatomy.—A fleshy dermis, about 15 microns thick, not overlying extensive subdermal cavities.

Endosome anatomy.—The protoplasm is rather dense, and abundantly provided with small, round, flagellate chambers.

Skeleton.—Fibro-reticulate, with fibres of amber spongin, granular as to surface, and opaque, about 30 microns in diameter. The ascending fibres are twice as thick, and have a core about 30 microns thick (but varying greatly) of foreign debris.

This species or subspecies was described by Duchassaing and Michelotti, 1864, page 32, from the Caribbean. It is abundant throughout the West Indian region.

It differs from the typical subspecies, which occurs in the Mediterranean Sea, in that *obliqua* is much coarser, less elastic and regular. This is a consistent and considerable difference. *Officinalis* proper is the most valuable and useful of all commercial sponges; *obliqua* is one of the least, though somewhat valuable and useful. The subspecies *dura* looks to the eye more like *officinalis* proper than *obliqua* does, but it is often even less valuable commercially because (as indicated in its name) it is very hard and inelastic. It may be that the subspecies *dura* formerly occurred in the Bermudas as well as *obliqua*.

SPONGIA ZIMOCCA subspecies BARBARA Duchassaing and Michelotti.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.2.

Date collected.—Prior to 1940, otherwise unknown.

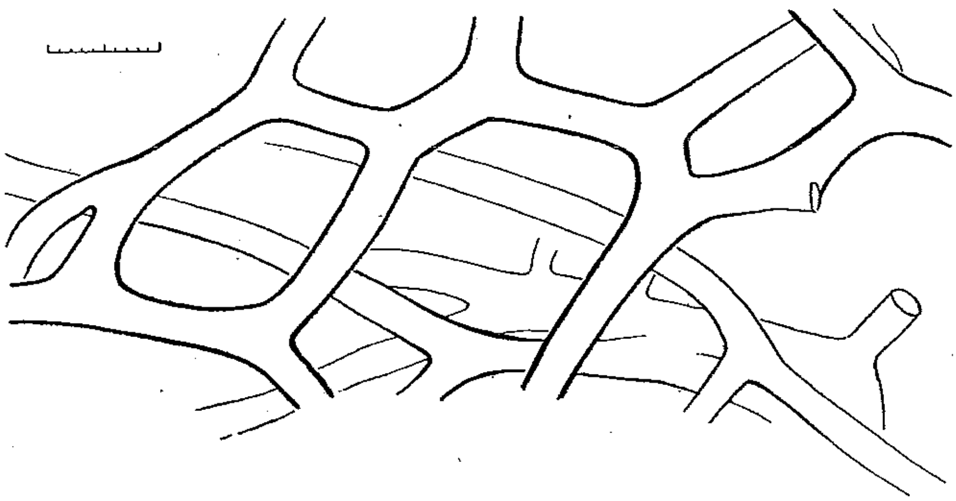
Localities.—Shallow marine waters about the Bermudas, otherwise unknown.

Abundance.—At present absent or very rare.

Shape.—Massive, often subspherical. The oscular location is noteworthy.

Size.—Head-size specimens are common. A diameter of 40 or more centimetres may be attained.

Fig. 2.



Camera lucida drawing, ×150, of a bit of the macerated skeleton of a *Spongia zimocca* from Bermuda. The enclosed scale shows 100 microns by tens.

Colour.—The living sponge is black or nearly so. The more the illumination to which it is exposed during growth, the more nearly jet-black it becomes. The interior in life is a rich reddish orange, with brown tints. Spirit specimens maintain the external tints, but the internal colours fade to ochre or drab. Macerated, dry specimens are golden brown, the yellow tint often quite noticeable.

Consistency.—Very spongy, elastic, strong, even in dry specimens.

Surface.—Conulose, conules often 1 to 2 mm. high, 2 to 4 mm. apart.

Oscules.—Often about 1 cm. in diameter, and frequently clustered on an upper surface, absent from most of the rest of the sponge. They show a decided tendency to have individual raised collars, often up to 1 cm. high.

Pores.—Microscopic and contractile; a diameter of 15 microns may be cited.

Ectosome anatomy.—A fleshy dermis about 15 microns thick, not overlying extensive subdermal cavities.

Endosome anatomy.—Dense, with abundant, small, round, flagellate chambers.

Skeleton.—Fibro-reticulate, with fibres of golden-coloured spongin, granular as to surface, and opaque. The common ones of the network are about 30 microns in diameter. The ascending fibres are a little thicker, and contain a thin strand of foreign mineral debris.

This species or subspecies was described by Duchassaing and Michelotti, 1864, page 31, from the Caribbean Sea. It is abundant throughout the whole West Indian region. It differs from the typical subspecies, which occurs in the Mediterranean region, in that the fibres of *barbara* are more yellowish, and of a rather better commercial nature—stronger and more elastic than are those of *zimocca* proper.

I believe that we should be frank to admit that we would probably not bother to discuss and record the subspecies of these *Spongias* were it not that they are common and commercially valuable. Doubtless equally great differences exist in other species that are not similarly split into subspecies. Yet the splitting is here warranted by the importance. One properly wishes and needs to know and tell which variety of *Spongia* is present in the locality that he is describing.

Genus Ircinia Nardo.

Sponges of this genus superficially bear a great resemblance to those of the genus *Spongia*. The two genera consistently have a very striking sulphureous odour that seems identical for all species of both genera (and perhaps for *Hippiospongia* also) wherever they occur, all over the world. The resemblance between the two ceases under the microscope, and also emphatically ceases in dried specimens. The latter, of *Ircinia*, are very hard and stiff, their fibres comparatively brittle, and different in structure. *Ircinia* fibres are more translucent, less granular as to surface; they make a much coarser network, with meshes about 500 instead of 200 microns average diameter (there is much variation within single specimens of both genera). In *Ircinia*, not only the primary, but also the secondary fibres may contain foreign inclusions. These inclusions are usually fewer in number, more irregularly spaced, but larger than those picked up by *Spongia*. Many *Ircinia* fibres are far thicker than any in *Spongia*, but this arises from the aggregation of a number of parallel fibres that are individually only a little larger (if any) than *Spongia* fibres. Within these fascicular bundles there may be obvious separate strands, connected by short transverse ones, or the amalgamation may be so dense that the components cannot be made out, except where here and there windows pierce through the fibre and maintain a residue of the earlier mesh-spaces.

The description so far given would apply also to the genus *Polyfibrospongia*, and —if the fibres were concentrically stratified or laminated and were also clear (translucent)—it would apply also to the genus *Fasciospongia*. From each of these, and all others in the Phylum Porifera, *Ircinia* is sharply separated by its possession of filaments. These structures are usually less than ten microns in diameter, but over a millimetre long, and at each end there is a spherical swelling that ranges from slightly thicker to twice the diameter of the filament strand. These filaments are often abundant throughout the flesh, and increase the toughness of the sponge; *Ircinia* specimens can be cut only with difficulty—one wants a strong, sharp knife and strength and patience. The filaments are chemically quite different from the spongin fibres, although at least as flexible and as tough; they resist boiling with caustics better than does undoubted spongin. None the less they definitely resemble it, and their substance might be regarded as being a peculiar variety of spongin.

IRCINIA FASCICULATA (Pallas) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.4.

Date collected.—July 28, 1947, and many others.

Localities.—Harrington Sound, Walsingham Pond, and the coasts of Bermuda in general.

Abundance.—Extremely common in many localities.

Shape.—Amorphous to massive, often with rounded processes arising. Some few specimens even become ramose (see Pl. I); in this case they have rather acute terminations to their many branches.

Size.—Head-size specimens are common. The ramose specimens attain a height of at least 30 cm., and a branch diameter of 2 to 4 cm.

Colour.—The living sponge is brown, with both greenish and lavender glints. It may actually be a mixture of green and lavender pigments, blending. Is the green chlorophyll? Its solubility in alcohol seems to suggest this. In the preservative, which is at first bright green, a drab colour is given to the sponge, and dry specimens are also a dull brown.

Consistency.—Very spongy in life and in spirits; extremely tough and difficult to tear; even difficult to cut. Dried specimens are stiff.

Surface.—Strongly conulose, with conules 1 to 2 mm. high and 2 to 4 mm. apart. The spaces between the conules are obviously punctiform, with optically evident pores in great abundance.

Oscules.—Large, 5 to 10 mm. in diameter, and conspicuous. Their rims, and especially the linings of the oscular cloacas, are heavily pigmented, almost black, so that they stand out vividly.

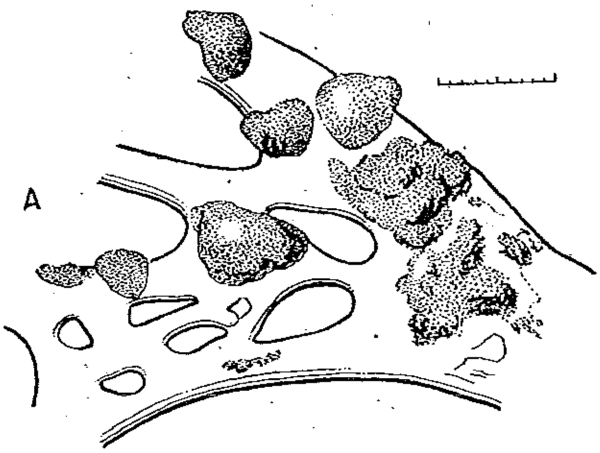
Pores.—Large and abundant, 130 to 200 microns in diameter, and with partitions between them which are often much narrower than 130 microns.

Ectosome anatomy.—There is a special organic dermis, more than 70 microns thick, even over 110 microns thick in places. It seems to contain spongin in thin sheets and certainly contains many cells which are filled with dark pigment granules. It also contains much foreign debris, such as siliceous spicules and fine grains of coral sand. It is, furthermore, packed with the filaments that characterize the genus *Ircinia*. In some specimens, including that listed above by museum register number, there are also present brown, granular, kinky strands; these are found in both ectosome and endosome. They may be a special kind of fibre, but much more probably are algal filaments, perhaps the source of the chlorophyll.

Endosome anatomy.—The protoplasmic structures are very dense, with small, round, flagellate chambers that are closely packed together. In larger specimens there are very conspicuous gross canals, lined with dark membrane; they receive from smaller canals and deliver to the oscules. The skeletal structures of course ramify throughout the flesh.

Skeleton.—Fibro-reticulate, with fibres of clear, translucent, yellow spongin. The principal fibres rise practically perpendicular to the substratum on which the sponge grows, and then their branches are perpendicular to the surface; their extreme upper ends lift the dermis, thus forming the conules. The size of the fascicles is often very great in comparison to *Spongia* fibres, which latter are usually 30 to 100 microns. The aggregated basket-masts of *Ircinia* are more than ten times as great—but are made of components about the size of *Spongia* fibres.

Fig. 3A.



Camera lucida drawing, ×150, of a portion of one of the principal or ascending fibres of *Ircinia fasciculata* to illustrate the holes that fenestrate it as a result of the lattice or fascicular amalgamation. This also illustrates the very large bits of foreign debris which are incorporated in the fibres. The enclosed scale shows 100 microns by tens.

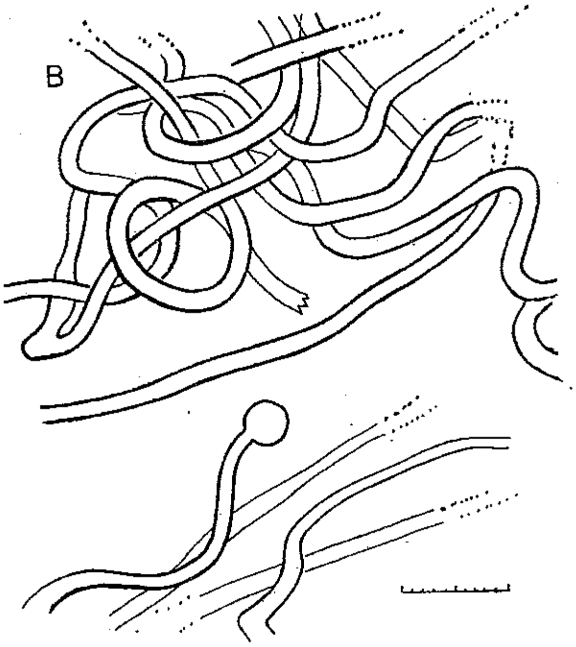
There are transverse and meandering secondary fibres in *Ircinia* that are only a little larger than the corresponding ones in *Spongia*, but are far less numerous, and they contain foreign inclusions. The debris is very irregularly distributed in *Ircinia* fibres; here and there strands are chock-full, here and there bits of fibre are clear.

The typical *Ircinia* filaments make up from 10 to 20 per cent. of the bulk of the specimen of *Ircinia fasciculata*. They are so intertwined and tangled that they form a fibrous, leather-like structure. Each filament is about 5 microns in diameter, and much more than 1000 microns long. It is difficult to extract a single filament and stretch it out, thus the maximum lengths cannot here be stated. The spherical knob at each end of the filament is 8 microns in diameter.

This species was described as *Spongia fasciculata* by Pallas, 1766, page 381. *Ircinia* was first described by Nardo, 1833, page not numbered. In 1834 he wrote that he preferred the name *Hircinia*, which is a better transcription of the Greek, and unfortunately this quite incorrect change has been consistently followed by spongologists. Not even the original author has a right to change a genus or species name, once given. Nardo described no species for *Ircinia.* The first to be put here was this *Spongia fasciculata* of Pallas, by Schmidt, 1862, page 34, and it thus becomes the type of *Ircinia,* although Schmidt used the spelling *Hircinia.*

On the same page Schmidt described *Hircinia variabilis,* sp. n., and dropped the earlier *fasciculata* in synonymy to it. Of course this cannot be—if the two are conspecific, the name *fasciculata* must be used. Numerous students of sponges

Fig. 3B.



Camera lucida drawing, ×666, of a bit of the endosome of *Ircinia fasciculata*, emphasizing the filaments. Near the centre of the figure can be seen one of the balls with which every filament is ornamented at each end. The enclosed scale shows 20 microns by twos.

have identified sponges from the Mediterranean and West Indian regions as being *variabilis*; what should be done about these names? As will be shown later, in 1947 I found several species of *Ircinia* in the Bermudas. One of these, here number six, grows among the specimens of *fasciculata* quite commonly, and shows such consistent differences that it should definitely be regarded as a separate species. I have studied Schmidt's descriptions carefully and am confident that his *variabilis* certainly included this other species, whether or not it included *fasciculata.* The two are not synonyms, but are distinct.

Instances where students of sponges describe and record *variabilis,* whereas their specimens were practically certainly the genuine *fasciculata,* include the following references :—

Schulze, 1879, page 13. Mediterranean Sea.
Lendenfeld, 1889, page 557. Australia.
Wilson, 1925, page 494. Philippines.
de Laubenfels, 1936, page 19. West Indies.
de Laubenfels, 1946, page 35. North Carolina, U.S.A.

The species *fasciculata* may usually be recognized by the brown colour, and the very dark oscular cloacas. The shape is most variable, more so than in the true *variabilis*, thus encouraging the misuse of names which has been so common.

IRCINIA RAMOSA (Keller) de Laubenfels. (See Pl. I, fig. 1.)

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.5.

Date collected.—July 18, 1947 and others.

Locality.—Harrington Sound.

Abundance.—Very local, not numerous.

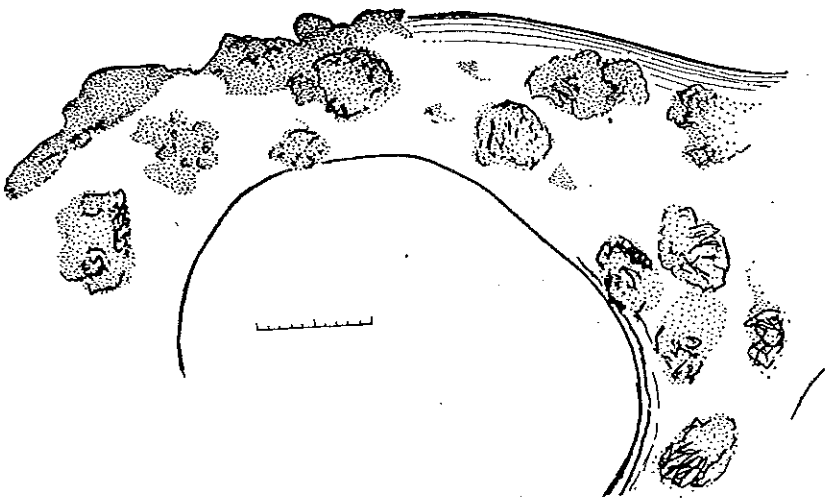
Shape.—Always ramose, with thin branches that are blunt at the ends.

Size.—Branches only 1 or 2 cm. thick ; heights of 20 cm. or more are common.

Colour.—Living and preserved specimens are all of a brown that is slightly ochraceous.

Consistency.—Spongy, in the manner typical of the genus *Ircinia*.

Fig. 4.



A camera lucida drawing, ×150, of a bit of the fibre of *Ircinia ramosa*. The enclosed scale shows 100 microns by tens.

Surface.—Conulose, with conules about 1 mm. high, and little more than 1 mm. apart.

Oscules.—Often near the ends of branches, without special collars ; diameters usually 2 to 4 mm. Their cloacal linings are not especially dark.

Pores.—Small and contractile.

Ectosome anatomy.—A tough, organic dermis, over 100 microns thick, containing foreign detritus.

Endosome anatomy.—A coarse reticulation of spongin fibres ; the ascending ones are aggregated into fascicular bundles. The protoplasm is dense, fine grained, and is packed with filaments that are about 4 or 5 microns in diameter, and much more than 1 mm. long.

Skeleton.—Translucent but not obviously stratified fibres, with a sprinkling of coarse foreign inclusions in both ascending and transverse fibres. The principal fibres are fascicular. Many secondary fibres, and units in the lattice-work of the fascicles, are about 150 microns in diameter.

This species may easily be overlooked among specimens of *fasciculata*, until one takes account of the several differences, as follows :—

The shape of *ramosa* is distinctive : long, thin, blunt branches—not merely stretched-out conical eminences as in *fasciculata*. The colour is consistently brown, although slightly different from the somewhat greenish and lavender brown of *fasciculata*. The dark cloacal linings of *fasciculata* offer a good field mark. The pores of *ramosa* are much smaller than the conspicuous ones of *fasciculata*. The filaments of *ramosa*, in my experience, average smaller than those of *fasciculata*, they often are as little as 2 microns in diameter.

Keller, 1889, page 345, described this species as *Hircinia ramosa* from the Red Sea, and de Laubenfels, 1934, page 24, extended its recorded range to include the West Indies. Keller found the filaments in his specimens to be only 2 microns in diameter. He does not comment one way or the other on the colour of cloacal linings, but otherwise his description matches the present Bermuda species nicely.

Plate I, fig. 1 illustrates two dried specimens, one of *Ircinia ramosa* typical form, and the other *Ircinia fasciculata* in a ramose growth, which is not typical of that species. The contrast in shape, surface, and other respects is brought out, so that one may discriminate between the unusual ramose *fasciculata* and typical *ramosa*.

IRCINIA STROBILINA (Lamarck) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.6.

Date collected.—November 29, 1937.

Locality.—Three Hills Shoal, about five kilometres north of Hamilton, Bermuda.

Abundance.—It is not known if this was ever common in the Bermudas. Certainly in 1947 it was rare, inasmuch as prolonged search failed to reveal a single specimen.

Shape.—Massive to subspherical.

Size.—The one Bermuda specimen is about 3 by 4 by 5 cm. Elsewhere in the West Indies specimens up to 50 cm. in diameter occur.

Colour.—The Bermuda specimen is grey. Elsewhere this species is grey, but the more it is illuminated while growing the darker it becomes, so that shallow water specimens are all but black. The endosome of *strobilina* is reddish orange, with brown tints, as in many species of *Spongia*.

Consistency.—In life and in alcohol, very spongy. Elsewhere dry specimens have proven to be as stiff and hard as wood.

Surface.—Coarsely conulose, conules 2 mm. high, and usually 4 or more mm. apart. There is a tendency, rather more noticeable in this than in other related species, for ridges to connect conules, making polygonal, depressed areas in between. It is typical of large specimens of *strobilina* to have conules 6 to 8 mm. apart. In any case, they represent the apices of the fascicular ascending fibres.

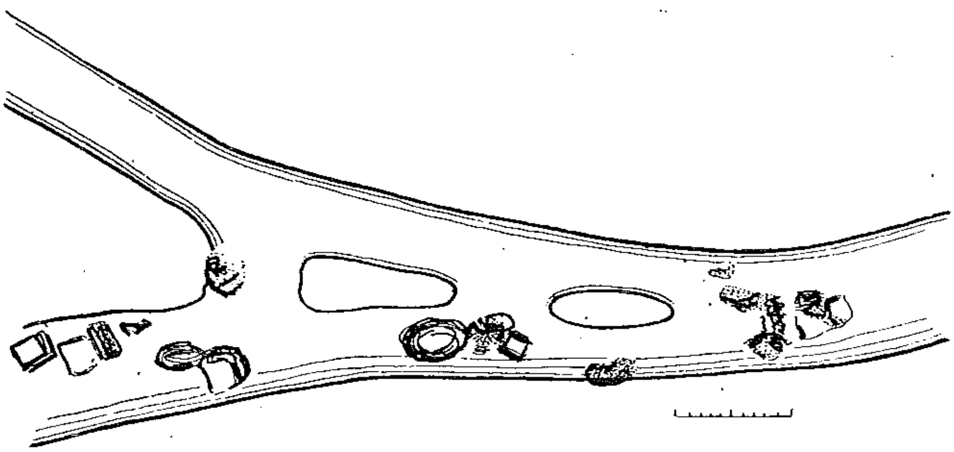
Oscules.—Large, flush, 4 to 6 mm. in diameter, usually on the upper surface.

Pores.—Small and contractile.

Ectosome anatomy.—There is a tough dermis, much more than 100 microns thick. It contains inanimate material (perhaps spongin sheets) and certainly contains myriads of the *Ircinia* filaments, also much foreign debris. It is in this skin that one finds the majority of the cells with darkly pigmented granules, which granules are responsible for the slaty colour of the sponge.

Endosome anatomy.—Dense protoplasmic structures occur, together with coarse canals; some of the latter are several millimetres in diameter. The flagellate chambers are small, and as a result the flesh is compact, like meat.

Fig. 5.



Camera lucida drawing of a small bit of the fibre of *Ircinia strobilina*, illustrating how two strands are connected, leaving windows. This condition is called fenestrated. Many *Ircinia* fibres are more densely filled with foreign inclusions than are the ones here shown. The enclosed scale shows 100 microns by tens.

Skeleton.—The primary fibres are fascicular, with foreign inclusions, as typical of the genus. The secondary fibres, 100 microns in diameter, or thereabouts, are also typical of *Ircinia.*

This species was first described by Lamarck, 1816, page 383, as *Spongia strobilina.* I studied Lamarck's specimens in the Paris Museum in 1928. One may recognize *strobilina* from other *Ircinias* by its grey to blackish colour, and by its very coarsely conulose surfaces.

Ircinia variabilis (Schmidt) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.7.

Date collected.—July 2, 1947, and others.

Locality.—Harrington Sound, Bermuda, and the coasts of Bermuda generally.

Abundance.—Easily overlooked, but probably fairly common.

Shape.—Massive to subspherical—like very thick encrustations.

Size.—The specimen that is represented by the museum number cited above was 3 cm. thick, and covered a space 5 by 5 cm.

Colour.—The living sponge is blue when growing in good illumination, but even then the less illuminated portions are grey, and many entire specimens are grey.

This is a soft, blue-grey, not the same as the slaty tinge of *Ircinia strobilina.* In alcohol, however, the blue regions of *variabilis* turn to a dark grey which does resemble the colour of *strobilina.*

Consistency.—Extremely spongy, alive and in alcohol. It is to be presumed that dry specimens would become hard.

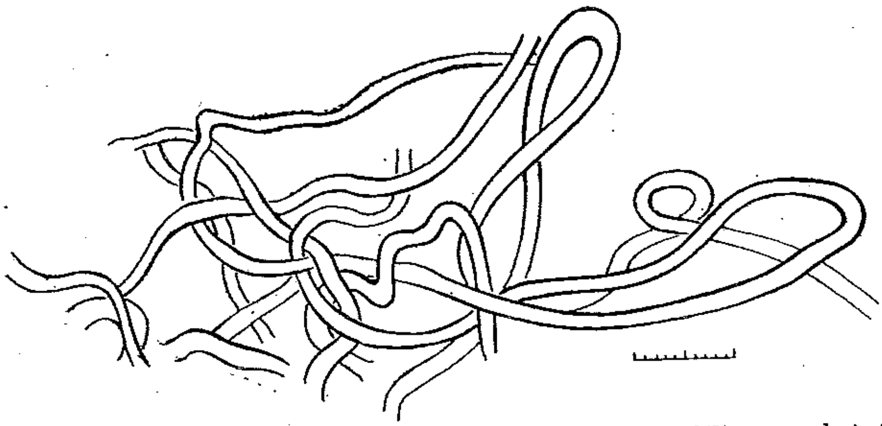
Surface.—Conulose, with conules about 0·3 mm. high, and 1 to 1·15 mm. apart.

Oscules.—About one for each 10 sq. cm. of surface, up to 4 mm. in diameter, with slightly raised rim or collars, and not darkly lined.

Pores.—About 150 microns in diameter.

Ectosome anatomy.—There is a tough organic dermis, probably containing spongin, and well filled with foreign material, especially siliceous spicules. It is also packed with the cells that contain the darkly pigmented granules. This dermis is well over 100 microns thick.

Fig. 6.



Camera lucida drawing, ×666, of a portion of the interior of *Ircinia variabilis,* somewhat stretched out, and emphasizing the filaments. In the ordinary view of these structures, being a three-dimensional arrangement, the much twisted and interlaced filaments keep disappearing into deep, opaque masses of other tissue. The enclosed scale shows 20 microns by twos.

Endosome anatomy.—Dense, with relatively small cavities. There are extremely abundant filaments, 5 microns in diameter and perhaps several millimetres long.

Skeleton.—In addition to the filaments there is a typical reticulation of fibres. The primary fibres are not at all well developed, however, as compared to other species of *Ircinia,* and instead the "secondary" fibres are most abundant and important.

The blue colour, when present, is very distinctive of *Ircinia variabilis.* I searched the literature for records of blue specimens of this genus, and find only the one, which is in Schmidt's original description. He described this as *Hircinia variabilis,* 1862, page 34, from the Mediterranean region. Actually, as he often did, he spoke of *Filifera variabilis,* but he shows elsewhere that he was referring to the older genus. *Filifera,* as a name, was established by Lieberkühn, 1859, page 353, and Schmidt clearly recognized it as a synonym of *Ircinia.* In the same article he may use the two names interchangeably, or regard *Filifera* as a subgenus of *Ircinia.*

Schmidt not only mentions the blue colour, but associates with it the same fine-grained structure which also distinguished the Bermuda specimens. He put these with the coarser, brown *fasciculata* as expressing great variability. I find no trace of intergrading, however, but very sharp distinction. Furthermore, in Harrington Sound the two species grow at the same depth, a few metres from each other, with not the slightest indication that their environments differ significantly. This would seem to confirm the existence of a true or genetic difference.

Genus VERONGIA Bowerbank.

Sponges of this genus are often yellow in life, and seldom as dark as those of *Spongia* or *Ircinia*, but otherwise resemble them closely; they are fleshy and conulose with similar protoplasmic structures. The fibrous skeleton, however, is distinctive. The fibres are relatively large, and their meshes coarse—often greater than a millimetre in diameter. The fibres are not homogeneous, but are conspicuously made of concentric cylinders of clear, translucent spongin. In the centre of each fibre there is a conspicuous pith. It may be that all fibres have a distinct core of some sort, but in most *Spongia* fibres one does not perceive any such, even with the high powers of the microscope. The pith of *Verongia* fibres is commonly a third of the total diameter. In early taxonomic descriptions, much attention was paid to the percent or fraction represented by the pith diameter but it soon became evident that there was great variation in the fraction given over to pith, and also in the actual size of the pith from place to place within the same specimen.

Like most keratose sponges other than *Spongia* and *Hippiospongia*, *Verongia* becomes quite stiff and hard when dry.

A most vexatious situation exists in regard to the correct name of this genus. Up until 1845 no one had recognized the existence of the pithed fibre, but in that year Bowerbank, who had what was for his day a superlative microscope, discovered it. He erected for this sport of sponge a well-defined genus (page 403), and the type is the Bermuda species *fistularis*, based on West Indian specimens. Yet there is some slight confusion even about that, because Bowerbank said the type was *fistularis* Linné, whereas the author is really Pallas.

Meanwhile, in 1833, page 519, Nardo had set up the name *Aplysia* with no described species, just a lot of Latin words. *Aplysia* was preoccupied. In 1834, page 714, Nardo said he wanted to change his *Aplysia* to *Aplysina*, but still described no species. No one could recognize anything from Nardo's diagnosis of his *Aplysia*, or *Aplysina* if his alteration can stand, or contrariwise nearly any sponge in the world would be a little bit like it. Most especially, Nardo says nothing at all about pithed or hollow fibres. In 1862 Schmidt had a sponge for description, one that had hollow fibre. In all decency he should have called it a *Verongia*, and he knew of Bowerbank's seventeen-year-old genus. But he openly wrote his disrespect for the Englishman, apparently in part because Bowerbank was not a university professor, whereas he, Oscar Schmidt, was one. So he called his specimen *Aplysina*.

The International Committee on Zoological Nomenclature has rendered an opinion number 46, " if it is not evident from the original publication of the genus how many or what species are involved, the genus contains all the species of the world which would come under the generic description as originally published, and the first species published in connection with the genus becomes *ipso facto* the type ".

Thus some systematists feel that Schmidt should be allowed to succeed in his effort to nullify a well-established genus. Others feel that Schmidt's sponge would positively not "come under the generic description as originally published" because the generic description says nothing of the pithed fibres. This is my preferred disposition of the case; but it is in turn contradicted by those who interpret the rules as permitting a revised diagnosis for genera that have no species, no specimens or animals in them, only words. They maintain that Schmidt's description thus revises Nardo's. If Schmidt can revise thus, so can I; and in this case I will yet further amend the diagnosis of *Aplysina* in such a way as to make it more like Nardo's original wording; I amend it to omit the inclusion of sponges with pithed fibres, and propose to establish it on a firm basis by giving it a type specimen, which it never yet has had. The characteristics of this actual preserved animal serve as a firmer basis than amendable words—after all, zoological names should be the names of animals, not of imaginary concepts. I propose as diagnosis that portion of Nardo's diagnosis which emphasizes the fact that *Aplysina* is a sponge with fibres. The type must have as a species name *aerophoba* Schmidt, 1862, page 25. I propose as neotype of both the genus *Aplysina* and the species *aerophoba* the specimen represented by British Museum (Natural History) register number 83.12.4.28. This was collected at the locality (Adriatic) where Schmidt collected his (now lost) specimen of *aerophoba*. It differs somewhat from Schmidt's wording, but is more like Nardo's wording than is true of Schmidt's words. Its description must be a revision of Schmidt's, just as his was a revision of Nardo's. Its description, in fact, becomes like that given above for *Spongia officinalis*; the specimen cited and the species *Aplysina aerophoba* thus become *Spongia officinalis*.

Two attitudes toward this proposed action may be taken. One may say that my disposition of *aerophoba* is not valid, but in this case it follows that Schmidt's corresponding alteration of *Aplysina* is also invalid, and so *Verongia* is free from attack. Or one may argue that Schmidt had a right to alter *Aplysina*, in which case so have I, and my action brings us back to the status that obtained before Schmidt acted. It would, of course, be most helpful if the International Committee would take action to drop the name *Aplysina* out of this complex, and let us use *Verongia* with assurance. It is here suggested that it would be welcome, reasonable, and just, if an opinion might be rendered, which would protect well-established, long-used genera of real animals from being nullified by the radical redescription of ancient, vague diagnoses, merely because these diagnoses comprised no animals, but only words.

May I repeat, however, that my opinion as to the present disposition of this perplexing situation is that Schmidt's species *aerophoba* does not "come under the generic description as originally published" and therefore is not available as type of *Aplysina*, hence I continue the use of Bowerbank's *Verongia*.

VERONGIA FISTULARIS (Pallas) Bowerbank. (See Pl. I, fig. 2.)

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.8.

Date collected.—July 3, 1947, and many others.

Locality.—Harrington Sound, and the coasts of Bermuda in general.

Abundance.—Fairly common ; nearly every extensive field trip about Bermuda yielded at least one specimen of *fistularis*.

Shape.—Cylindrical, hollow. It is here proposed that the name *Verongia fistularis* form *ansa* be established for a peculiar form that is rather common at Bermuda. No decision is here made as to the genetic value of this form ; it may be purely ecological, but it is distinctive (see Pl. I, fig. 2). Two specimens of *ansa* were collected in 1946, and four specimens in 1947. The form basically is the usual hollow cylinder, or perhaps a tube of greater than usual diameter, say 3 cm. diameter and 10 cm. high. Then, from one side of the rim, a solitary digital process rises an additional 3 to 6 cm. This process is less than 1 cm. in diameter—like a flagpole on the rim of a round chimney. The fact that the identical odd shape was found in as many as six specimens, out of less than twenty of the species *fistularis* that were found, gives it a sort of standing, and deserves notice.

Size.—Cylinder diameters vary from 1 to 4 cm., and the height varies from 3 to 30 cm. A height of 10 cm. is common.

Colour.—The living sponge is yellowish, usually somewhat brownish and dingy. If it grew in bright sunlight it might show greenish tinges, too. In alcohol, or in air, it slowly turns dark purple—but much slower than is true of some other species of the genus. Dried specimens become black. Characteristically bits of amber fibre protrude here and there from the dried specimen, or even (to a less extent) from the living specimen. The alcohol in which *fistularis* is placed first turns a dull dark green, later murky. Probably there is chlorophyll present, and it leaches out rapidly. Then there is the pigment which has a water-soluble, colourless phase, but which readily oxidizes to a dark purple.

Consistency.—The living sponge is very spongy and fleshy, and so are spirit specimens. When dried, *Verongia* becomes hard, like wood, *fistularis* rather less hard than some other *Verongias*.

Surface.—Conulose, with conules about 1 mm. high and 2 mm. apart.

Oscules.—The large apical openings of the central cavities may be the oscules, in which case the diameter is 5 to 20 mm., that is to say, in each case about half the total diameter of the cylinder. It may be that this large cavity should be regarded as external, rather than a cloaca ; in this interpretation the oscules are the numerous minute openings into the cavity.

Pores.—Microscopic, contractile, and abundant. They probably can open to at least as much as 30 microns diameter.

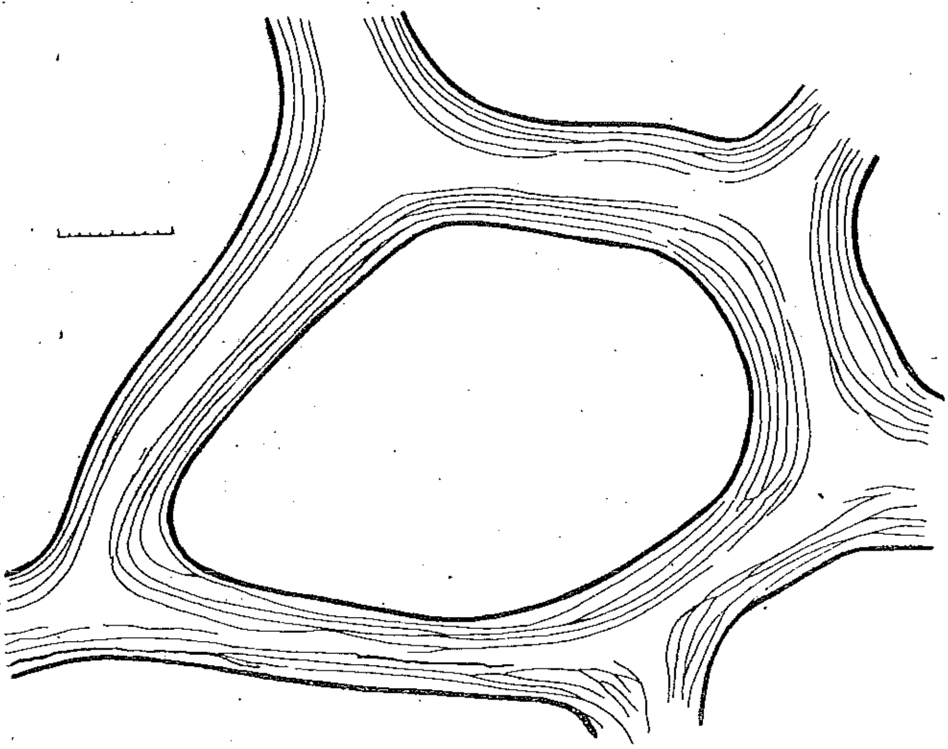
Ectosome anatomy.—There is an organic dermis or cuticle, which is 15 to 20 microns thick. A surface region, 130 microns thick, is densely packed with pigmented cells, and is underlain by fairly extensive subdermal canals that are some 100 microns in diameter.

Endosome anatomy.—Densely fleshy and fibro-reticulate. The protoplasm is exceptionally fine grained ; it is packed with small, round, flagellate chambers, barely 20 microns in diameter.

Skeleton.—A reticulation of clear, translucent, amber-yellow fibres, 100 to 140 microns in diameter, forming meshes 500 to 1500 microns in diameter. The fibres are distinctly laminated, and contain a central pith that is about one third of the diameter of the fibres. It often appears that the region called " pith " was actually empty (other than water) when the sponge was collected.

This species was first described as *Spongia fistularis* by Pallas, 1766, page 385. It would appear that his and all other known specimens of this species are West Indian in distribution. It is set off from most other *Verongias* by its pigmentation and hollow shape; other hollow forms are differently coloured. There are *Verongias*, such as *aurea*, that are brighter yellow than *fistularis*, and which much

Fig. 7.



Camera lucida drawing, ×150, of a bit of the skeleton of *Verongia fistularis*. The fibre lamination is indicated, and the central cavity or pith (blank). The enclosed scale shows 100 microns by tens.

more promptly react to oxygen by turning purple, but this change does occur in *fistularis*. A noteworthy characteristic of *fistularis* concerns its surface saucers. These are shallow depressions, of polygonal outline, about 1 cm. in diameter. In some specimens they are not conspicuous, and similar but smaller saucers do occur on other species of *Verongia*, but they are a helpful recognition mark.

Genus THORECTOPSAMMA Burton.

Sponges of this genus, like most Keratosa, are usually fleshy and conulose. Their fibres, unlike those of *Spongia*, are translucent and stratified. Where *Spongia* fibres are comparatively homogeneous, those of certain other genera, including the present one, are conspicuously compounded out of concentric cylinders. Such fibres may have a central pith as in *Verongia*, or may not; they may contain a central core of foreign debris, or may not. As in *Spongia*, such cored fibres may be only the primary or ascending columns. In *Thorectopsamma*, however, the common, interlacing fibres are likewise cored with mineral detritus—so that the sponge contains very large quantities of inorganic material. This is implied in the name (psamma=sand). Such profusion of foreign inclusions is commonplace in the family Dysideidae, where the flagellate chambers are larger and sack-shaped, but it is rare in the Spongiidae.

THORECTOPSAMMA CHROMOGENIA, sp. n.

The syntype, which is a portion of the holotype, is represented by British Museum (Natural History) register number 1948.8.6.3. The residue of the holotype is deposited, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—June 18, 1947.

Abundance.—Uncommon.

Shape.—Massive, with more or less numerous short digitate processes.

Size.—To at least 5 cm. diameter, processes 1 to 2 cm. thick, 3 cm. high.

Colour.—The living sponge is recorded as being red; in alcohol it turns to drab, and the alcohol is only slightly discoloured. It is said that when handled the living (injured) sponge gives off great quantities of red exudate.

Consistency.—Spongy in life and spirit specimens. The laminate type of fibre is consistently stiff and rather brittle when dry, therefore the same would be expected of dried specimens of this species.

Surface.—Conulose, conules 1 to 2 mm. high and 3 to 4 mm. apart.

Oscules.—Few in number, usually on the sides rather than on the ends of the processes. They are about 4 mm. in diameter and do not have conspicuous collars.

Pores.—The external layer of this sponge is full of skeletal pores, which occupy nearly half the surface area. Their diameter is about 150 microns. Each of them, however, is filled in by a fleshy membrane which is perforated by closeable proper pores, and these are only 30 to 50 microns in diameter at the largest. Two to five of these occur to each skeletal pore.

Ectosome anatomy.—There is an organic dermis about 15 microns thick. It does not contain much (if any) foreign material. It can be detached, as there are small but definite subdermal cavities.

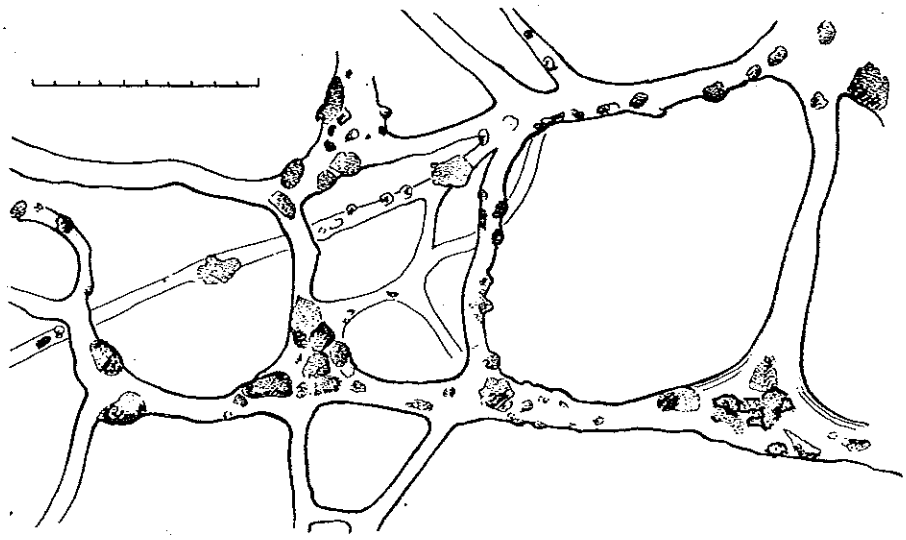
Endosome anatomy.—Large portions of each of the two specimens that are now available for study evidently were dead at the time of collection; they are merely bits of macerated skeleton. There are scattered islets of soft parts that evidently had been alive when the specimens were preserved, but these are difficult to study because of their small size and the abundance of sand that is present. The assumption is here made that the flagellate chambers were the small ones, such as ordinarily go with the laminated fibres; it is likely that if the other type of chamber had been present, that one could have found them. Small, round chambers are, of course, more obscure, more readily obliterated.

Skeleton.—Fibro-reticulate, with fibres of clear, translucent, yellow spongin. Both primary and secondary fibres contain scattered foreign material, especially sand grains. The fibre diameter varies from 75 to 750 microns, and the meshes tend to be polygonal in outline.

The genus *Thorectopsamma* was established by Burton, 1934, page 577, for the one species *Thorectopsamma irregularis*. This, a single specimen only, came from a depth of 45 metres, just north of Australia. It was massive, black as to exterior, drab as to interior. Its conules were much like those of the Bermuda species, but it was lipostomous. Many items about it are not known ; for example, its pores and its flagellate chambers ; Dr. Burton was forced to deduce the chamber type from the laminated fibres, just as I was similarly constrained at Bermuda. The primary fibres were 200 microns, and the secondaries 120 microns in diameter, thus significantly larger than the fibres of *chromogenia.* Needless to say, being a museum specimen, it is not known if *irregularis* gave off a coloured exudate or not. The colour difference alone, however, would serve to differentiate the Australian and the Bermudan species.

It is clear that sponges with laminated fibres rarely have these cored both in the primary and in the secondary placements ; Burton's one specimen and my two seem to fill the whole list of such.

Fig. 8.



Camera lucida drawing, ×30, of a bit of the skeleton of *Thorectopsamma chromogenia.* The enclosed scale shows one millimetre, divided into ten parts of 100 microns each.

In 1932 I collected two specimens (June 30 and July 10) at the Dry Tortugas, north of Cuba, and described them in 1936, page 16, as *Oligoceras hemorrhages.* These were coloured like Burton's *Thorectopsamma irregularis,* but were classified as *Oligoceras* because the fibre was not evidently stratified. They had this other difference, that upon the slightest jostling the living specimen gave off great quantities of crimson exudate, quite like bleeding. Naturally one must wonder at the connection, if any, between *Thorectopsamma chromogenia* and *Oligoceras hemorrhages.* For a long time I considered that they might be conspecific, in spite of skeletal differences. Dr. Werner Bergmann, however, has determined that the pigment of *hemorrhages* is water-soluble, whereas that of *chromogenia* is insoluble in water, but soluble in lipoids, hence probably is carotenoid. Thus the curious resemblance in bleeding does not at all indicate close relationship.

Does it perchance have some value to the sponge, in some way enhancing its survival value ?

Additional physiological and biochemical studies of *Thorectopsamma chromogenia* are, of course, to be desired.

Family DYSIDEIDAE Gray.

Sponges of this family are set off from those in the Spongiidae by having large, sack-shaped, flagellate chambers. This is also true of the ensuing two families, the Aplysillidae and Halisarcidae, but these two do not have reticulate fibrous skeletons, as the Dysideidae do. It is often impossible to identify dried, macerated sponge skeletons even as to family, in that the skeletons of some Spongiidae are much like the skeletons of some Dysideidae. Those skeletons that are still elastic when dry are certainly Spongiidae, and so are those with conspicuous pith ; after that, confusion begins. It is true that most species of the Dysideidae have all their fibres, both ascending and transverse, or principal and secondary, loaded with foreign material, whereas few species of the Spongiidae do, but it is noteworthy that some Spongiidae do have both types of fibre so loaded. The reverse also exists ; a few of the Dysideidae have skeletons which are as devoid of foreign inclusions as are the skeletons of the majority of the Spongiidae.

Living Dysideidae are usually fleshy and conulose, as are the majority of the Keratosa. Dried specimens are often brittle, and when handled they may give conspicuous indication of the fact that they are full of sand.

Genus Dysidea Johnston.

Sponges of this genus are quite typical of the family described above—other genera therein may be described by noting their points of difference.

Dysidea fragilis (Montagu) Johnston. (See Pl. I, fig. 3.)

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.9.

Date collected.—July 26, 1947.

Locality.—Castle Harbour, Bermuda, at the west side, but north of the causeway, on an abandoned wharf. Numerous minute specimens of *Dysidea* were observed in the shallow water about Bermuda, and not identified further because of their smallness ; many of these may have been *fragilis*.

Shape.—There is a basal mass from which processes often arise ; these latter are about 1 cm. in diameter, 2 cm. high, and are definitely enlarged at the distal end ; see Pl. I, fig. 3.

Size.—Masses the size of a human hand are common.

Colour.—The living and preserved sponge is essentially grey. A greenish colour which is observed in the field is obviously that of the algae to be discussed further below.

Consistency.—Extremely soft, fragile, and compressible, as easily torn as wet tissue paper.

Surface.—Finely and densely conulose, conules less than 1 mm. high and only about 1 mm. apart.

Oscules.—Large and conspicuous, up to at least 7 mm. in diameter, and situated at the summits of the above-mentioned processes. The oscular cloacas render these processes hollow. The openings undergo iris-type closure by horizontal membranes. This is illustrated in Pl. I, fig. 3.

Pores.—Microscopic and very contractile. There are apertures through a dermis that may just possibly contain spongin; these are 250 microns in diameter. Each aperture is closed, however, by an obviously protoplasmic membrane that may possess two to eight potential openings, here regarded as the true pores. These have been found opened as wide as 100 microns, which may be abnormal—40 microns is rather to be regarded as normal.

Ectosome anatomy.—There is a conspicuous, yet semi-transparent organic dermis over the surface of the specimens. This is about 20 microns thick, but is difficult to study because it is very contractile. When cut, it shrinks seriously.

Endosome anatomy.—*Dysidea fragilis*, typical specimens, contain a fibro-reticulation in which the spongin is occasionally conspicuous; there may be neat fibres cored with a row of foreign objects. There is a strong tendency, however, to pick up rather large inclusions, and often the strand is merely a mass of sand and other debris, of which the individual particles are coherent as the result of minute bits of spongin. Whole specimens may consist more of sand than of anything else.

In the Bermuda specimens which are here identified as *Dysidea fragilis*, there occurred no evident spongin at all, nor any typical fibres. They were precisely replaced, however, by strands of an alga. Although it was a clear, dark green in colour, and very flexible, it is probably a member of the so-called Red Algae, Rhodophyceae, and is probably of the genus *Jania*. Verrill in 1907 found an alga of this genus filling the sponge that he called, therefore, *Desmacella jania*. In 1947 what is evidently the same sponge was found, but not containing any *Jania* at all. On the other hand, a Desmacidonid sponge (*Xytopsues*) was found that was nearly as full of *Jania* as was this *Dysidea*.

The algal strands are 65 microns in diameter, green, externally longitudinally striated, and divided by softer regions into nodes. These sections are about 270 microns long, that is to say, slightly more than four times as long as the thickness. It appears that this ratio is considered significant by algologists.

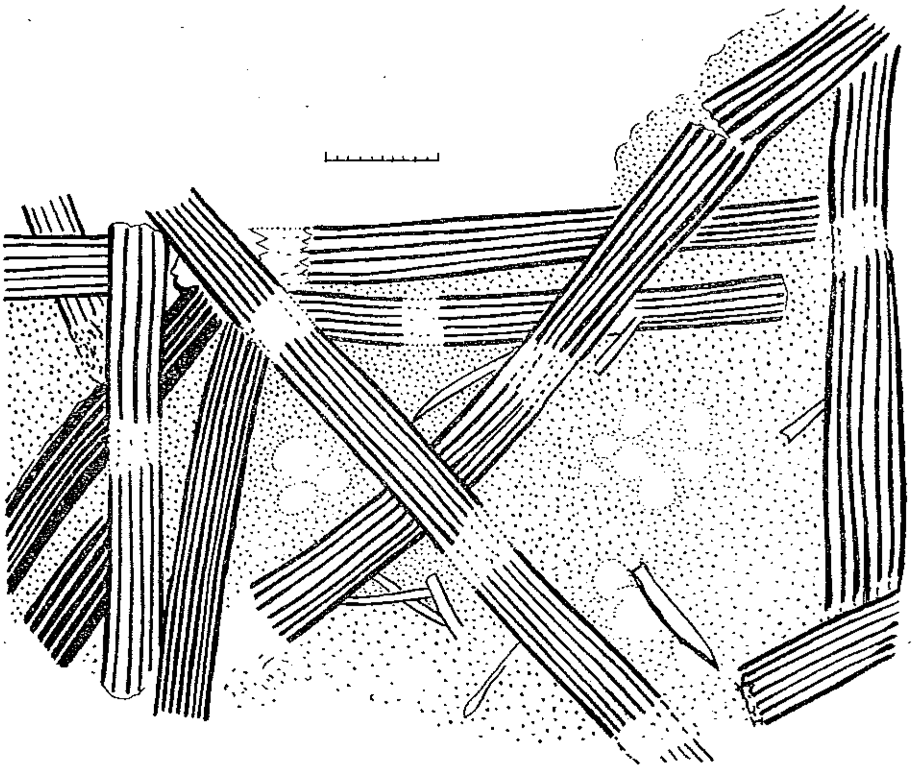
Scattered through the flesh were fairly numerous foreign spicules, a few each of many sorts. Some of the other sponges thus represented are rare anywhere, and the only proof of the existence in Bermuda of certain two genera is the fact that recognizable spicules of their skeletons were found in this *Dysidea*. These two other genera are *Cyamon* (see page 68) and *Samus* (see page 130).

The flagellate chambers are typical sponge organs, but are a little small for *Dysidea*; their diameter is often only 40 to 50 microns.

Dysidea fragilis typically has a skeleton of foreign inclusions, knit together by almost invisible bits of spongin. It may be separated from other species by the pale, usually grey colour, coupled with the finely conulose surface. Emphasis has seldom or never been laid on the swollen tips to the digitate processes, and I am not certain that this is a valid specific trait, but it may be.

Obviously the present specimens constitute a problem in identification. The shape and dermis are clearly sponge, the contractile pores and oscules, the canals and chambers, all fix this in the Porifera. Yet there is little or no sponge skeleton, usually so conspicuous. Sponges of the family Halisarcidae have no proper skeleton, other than the colloidal ground substance, but this Castle Harbour mystery appears very different from the gelatinous, translucent encrustations of *Halisarca.* I have studied carefully the sponges of various portions of the West Indian region, where there is a common sponge that I have long identified as *Dysidea fragilis :* see de Laubenfels, 1936, page 27, and especially plate 6, fig. 3,

Fig. 9.



Camera lucida drawing, ×150, of a section of the Bermudan sponge which is here identified as *Dysidea fragilis.* Algal filaments predominate. The area that is filled by sponge protoplasm is shown stippled, and in it, in several places, are shown some of the flagellate chambers which happened to be in focus. About nine of the foreign spicules show. The enclosed scale shows 100 microns by tens.

opposite page 28. This figure would do very well for the Bermuda sponge which is now under discussion. It is largely on the basis of this close resemblance to a familiar species that I make the identification. It seems to me logical that a sponge which has as a specific characteristic the accumulation of coarse and abundant foreign material might be likely to make use of algae instead of sand. However, for the form here described, I propose the limiting designation of *Dysidea fragilis*, form *algafera.* It is possibly genetically identical with other specimens of *fragilis* ; the use of algae may be purely environmental, and yet some means of discrimination may be useful in future references to this type.

The species *fragilis* was first described as *Spongia fragilis* by Montagu, 1818, page 114, from European waters. It is a common, practically cosmopolitan sponge, and is the type of the genus *Dysidea.*

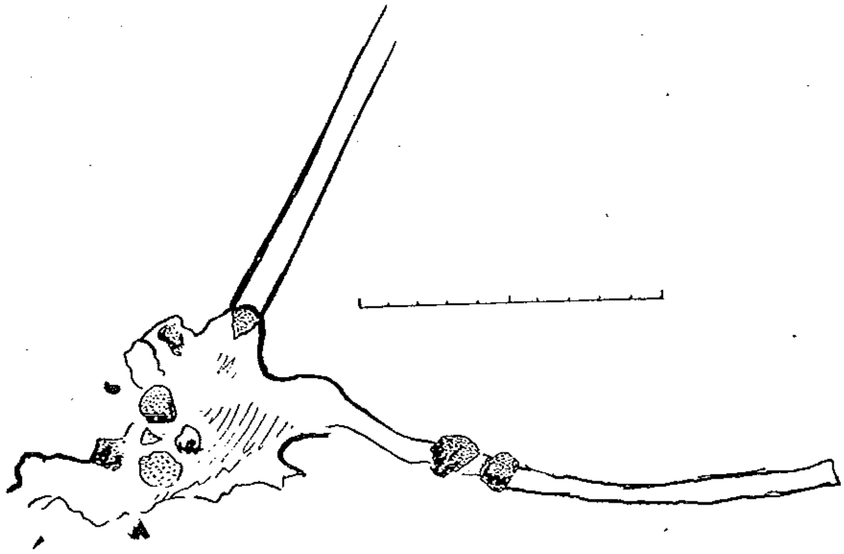
DYSIDEA ETHERIA de Laubenfels.

Bermuda specimens of this species are represented by British Museum (Natural History) register number 1948.8.6.10.

Date collected.—July 28, 1947.

Locality.—Harrington Sound, also Walsingham Pond, and coasts of Bermuda in general.

Fig. 10.



Camera lucida drawing, ×40, of a bit of secondary fibre of *Dysidea etheria.* An illustration of a primary fibre would appear merely like a row of rocks, nevertheless it should be kept in mind that this illustration does not represent the whole skeleton. The enclosed scale shows 1 mm. divided into ten parts.

Abundance.—Very common.

Shape.—Encrusting to massive, sometimes with short, thick processes.

Size.—The masses are often 4 to 7 cm. thick. The processes, if any, are 2 to 4 cm. in diameter, and about as high. Sometimes they are enlarged toward the tips.

Colour.—The living sponge is bright, clear, light blue. It quickly fades in alcohol to nearly white, colouring the fluid a brownish orange. Dried specimens are pale brownish grey.

Consistency.—The living sponge is very spongy, only moderately easily torn. Dried, as well as spirit specimens retain this elasticity rather well, in quite a great contrast to specimens of *Dysidea fragilis* and some other species of this genus. On the other hand, they are by no means as elastic as are the commercial sponges.

Surface.—Conulose, conules about 1 mm. high and 2 or 3 mm. apart.

Oscules.—There are surface openings, up to nearly 10 mm. in diameter. Some of these, however, may be accidental tears. There are very numerous round openings, 1 to 2 mm. in diameter; these are probably the true vents.

Pores.—Microscopic, contractile, and regularly completely contracted in preserved specimens.

Ectosome anatomy.—An organic dermis, very elastic or contractile, about 10 microns thick.

Endosome anatomy.—Fibro-reticulate and cavernous, with cavities of all sizes from 10 mm. in diameter downward. The principal fibres ascend through the sponge, roughly perpendicular to the surface, and terminate at the surface conules. Flagellate chambers are about 30 by 60 by 70 microns.

Skeleton.—The principal fibres are loaded with foreign inclusions, usually calcareous sand, or the spicules of calcareous sponges. The spongin is merely a cement, and the whole has a pronouncedly irregular outline. These tracts are at least 100 microns in diameter. They are interconnected by an irregular network of numerous secondary fibres, a little smaller and less packed with foreign matter than the ascending fibres. Mesh sizes are in the neighbourhood of 1 mm. in diameter.

Dysidea etheria was described by de Laubenfels, 1936, page 38, from the Dry Tortugas, north of Cuba. In that portion of the West Indies the species is not so common as it is in Bermuda, and there are no records of its occurrence elsewhere. The colour is most distinctive. The obvious preference for calcareous inclusions, especially in the principal fibres, is worthy of comment. The shape differs a little, and the conule pattern differs yet more, from *Dysidea fragilis*.

DYSIDEA CRAWSHAYI de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.11.

Date collected.—July 28, 1947, and many others.

Locality.—Harrington Sound, also Walsingham Pond and the coasts of the Bermudas in general.

Abundance.—Extremely common in the Sound, and in the pond, where areas each greater than one square metre are covered many centimetres thick by this sponge. In other localities, off the coast and in bays, an occasional shilling-size bit of this species may be found growing on the underside of a rock.

Shape.—Encrusting to massive, sometimes sending up broad, low lobes.

Size.—The masses are often as much as 10 cm. thick, and grow laterally indefinitely. They frequently achieve a total area of over one square metre.

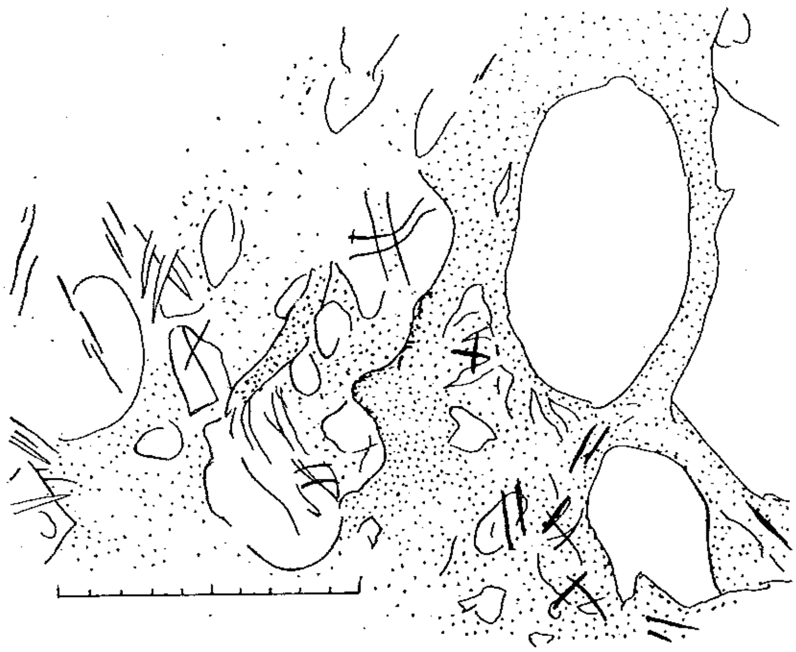
Colour.—The living sponge is a bright orange. It appears yellow as viewed through several metres of blue-green sea-water. It fades and dulls somewhat in alcohol, but still may be termed orange; it colours the alcohol brownish orange. Dried specimens are buffy white.

Consistency.—Softly spongy, extremely easily torn and compressible; both living and spirit specimens of *Dysidea crawshayi* fall apart of their own weight if lifted out of water. This may have some bearing on items thought worthy of comment in the original description of this sponge. The compressibility is such that a live or alcoholic specimen may easily be squeezed between the fingers into less than a tenth of its original volume.

Surface.—Very conulose, conules about 2 mm. high and 4 mm. apart. The skin between the conules is obviously porous or punctiform.

Oscules.—There are holes in the surface, 2 mm. and upwards in diameter, but extremely irregular; at least some of them are probably accidental tears, which happen so easily to *crawshayi*. There may be, in this species, some natural confusion as to which openings are exhalent, and which are inhalent.

Fig. 11.



Camera lucida drawing, ×40, of a portion of macerated skeleton of *Dysidea crawshayi*. The structure is so confused (between sheets and fibres) in three dimensions, that it is difficult adequately to illustrate it. In this drawing the spicules show in only a few of the places where they actually occurred; elsewhere they were buried in semi-opaque spongin. One may gain from this illustration, in spite of its limitations, the impression of a confusion of tracts and sheets that actually occurs. The enclosed scale shows 1 mm. divided into ten parts.

Pores.—The surface is full of apertures about half a millimetre in diametre, but so contractile that the " normal " size can only be estimated. These are large for pores, and—as noted—some may be vents. Large as they are, these openings are yet less than a millimetre apart over considerable areas of the sponge.

Ectosome anatomy.—There is a fleshy dermis, but it is so fragile that it becomes lost from portions of the sponge even while the animal is alive and healthy. Comment on this may be found in the original description. This detachable dermis is less than 10 microns thick.

Endosome anatomy.—Very cavernous. Some of the gross cavities are more than 3 mm. in diameter. The protoplasm together with the skeleton still makes up only a small faction of the total volume that the sponge occupies. Early in August, 1947, this species was loaded with embryos, almost 1 mm. in diameter, and bright rich reddish orange in colour. The surrounding flesh was, at this time, in a somewhat degenerate condition.

Skeleton.—Exceptionally difficult to illustrate. There is spongin, but it is rather in sheets and almost flocculent masses than in proper fibres. The sheets are so fenestrated in places that it may be assumed that they are built up by a fibrous reticulation, fibres represented by frameworks about the windows. Most of these irregular, highly modified fibres or fibrous sheets are loaded with foreign inclusions, almost exclusively siliceous spicules. There are also many spicules loose in the flesh. At times the environment provides spicules of only one kind ; then a false impression arises that the *Dysidea* is instead the species whose spicules it has appropriated. At other times numerous sponge species are represented by the spicules within a single *Dysidea* specimen.

This species was first described by de Laubenfels, 1936, page 28, from the Dry Tortugas, north of Cuba. Only one small fragment was found in that part of the West Indies, nor are any reported elsewhere ; Bermuda appears to be the centre of abundance of this sponge. Furthermore, other than in Harrington Sound and Walsingham Pond, there appear to be only tiny growths of it—much like the one from the Tortugas.

In the original account I said of my one specimen that it looked as though the ectosome had been removed, because the interior was cavernous and nakedly exposed, but I further said that this denudation was improbable. After studying the live species at Bermuda, I must reverse the opinion ; it is highly probable that the Tortugas specimen (type of the species, U.S.N.M. 22454) was really just a basal region. I feel sure now that there had been much more rising above that base, which portion fell off during collection. The specimen was on a bit of limestone that was dredged from a depth of 70 metres, and such an accident could easily happen, in the dredge, to so fragile a sponge.

On the basis of the original description alone, this species would have seemed to be an *Euryspongia,* because it was said to have secondary fibres devoid of foreign inclusions. Study of the many specimens at Bermuda show that this clear condition obtains here and there in secondary fibres of *crawshayi,* but is not typical ; most of the secondary fibres are cored. Of course, it must be kept in mind that the whole skeleton is confused, not sharply divided into primary and secondary fibres as keratose sponges usually are. The allocation to *Dysidea* is confirmed by the studies at Bermuda.

Genus DENDRILLA Lendenfeld.

The type, and thus the typical *Dendrilla,* is the sponge which was originally described as *Spongelia cactus* by Selenka, 1867, page 565.

In describing and naming *Dendrilla,* Lendenfeld emphasized a dendritic type of skeleton, that is to say, one that consists of trunks which branch as trees branch, but do not anastomose into a network. It is true that portions of the skeletons of this species consist of fibres of this sort, but on the other hand, in considerable regions the fibres do anastomose to form a network, as Lendenfeld's detailed descriptions show.

A redescription of *Dendrilla,* or rather a corrected emphasis, is in order. Lendenfeld's descriptions also show that this is a sponge which is otherwise like *Dysidea* (or even more like *Euryspongia*) in that—like those genera—it has large, sack-shaped, flagellate chambers. But, whereas in *Dysidea* both ascending and transverse fibres are cored with foreign detritus, and in *Euryspongia* the ascending but not the transverse are thus cored, in *Dendrilla* neither the ascending nor the transverse fibres are filled with foreign material. The sponges of this genus are fleshy and conulose as are most Keratosa. It thus becomes evident that the genus *Megalopastas* Dendy is congeneric with, and must fall in synonymy to *Dendrilla.*

DENDRILLA NUX, sp. n.

The syntype, which is a portion of the holotype, is represented by British Museum (Natural History) register number 1948.8.6.12. The residue of the holotype is preserved in Bermuda, at least temporarily, in the Museum of the Government Auarium at Flatts.

Date collected.—August 8, 1947.

Locality.—Walsingham Pond, Bermuda, and perhaps also in Harrington Sound. No specimens are as yet recorded from the latter region, but there are reports of sponges seen which superficially resembled *Dendrilla nux.*

Abundance.—Not common. Nearly every search of several hours' duration at Walsingham Pond in 1947, yielded one specimen, but this means in all only four specimens, one of which was minute. Two or three specimens were collected there in 1946 by Dr. Bergmann.

Shape.—A basal mass, with or without short digitate processes.

Size.—Up to 10 cm. high, at least. The processes, when present, are about 2 cm. in diameter, and only a little more than 2 cm. high.

Colour.—The living sponge at first seems to be jet-black. In many lights, however, there are blue gleams, and careful study reveals that it is actually very dark blue, but not at all violet. When tampered with, this sponge " bleeds " a rich, clear blue pigment. Here occurs a curious possibility for misunderstanding. The following species (*Ianthella*) gives off a deep violet or purple exudate, but is locally known by the colloquial designation of " blue bleeder " ; *Dendrilla* more appropriately earns such a title.

In alcohol the blue-black colour is maintained, but the fluid itself is coloured prussian blue.

Consistency.—Fleshy, softly spongy.

Surface.—Conulose, with conules about 2 mm. apart. It is difficult to assign a height to the conules ; they are certainly over 1 mm. high, but often seem higher because a bit of naked fibre protrudes from the apex. This characteristic of the genotype led Selenka to name it " *cactus* ".

Oscules.—Minute, contractile.

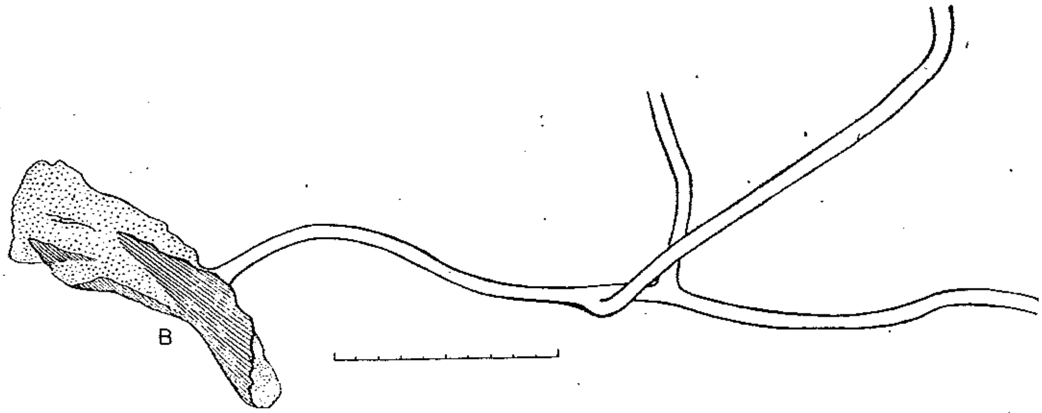
Pores.—Microscopic, contractile.

Ectosome anatomy.—There is an organic dermis, about 15 microns thick.

Endosome anatomy.—Fleshy, microcavernous. The flagellate chambers are large and sack-shaped, about 60 by 80 microns in measurement.

Skeleton.—There is a basal plate of spongin, as in the Aplysillidae. It is not without some reason that sponges which are here regarded as *Dendrilla* have been regarded as belonging to the Aplysillidae. From this basal plate, at distances of some 2 to 3 mm. apart, arise fibres that are rather uniformly 80 microns in diameter. These do not taper noticeably, which is remarkable ; even after giving off branches they remain practically the same size. This is not the case with typical dendritic fibers, whose branching is like a splitting, and is therefore bound to yield smaller and smaller strands. Instead, it is like the branching of a truly reticulate skeleton, where the fibre diameter is maintained. In further confirmation of this relationship, rather numerous anastomoses of the fibres can be found.

Fig. 12.



Camera lucida drawing, ×30, of a portion of the fibre of *Dendrilla nux*. At " B " a bit of the basal plate of spongin is shown. The enclosed scale shows 1 mm. in ten parts.

The fibres of *Dendrilla nux* contain, here and there, an isolated foreign inclusion, such as a bit of spicule. This renders classification difficult, but not impossible. These are definitely not " cored " fibres as in *Dysidea*. They are distinctly and emphatically laminate in structure, which structure is here considered to be probably true of all the Dysideidae. The immense amounts of foreign matter with which the fibres of other Dysideid species are cored prevent observation of the lamination in many cases.

Dendrilla nux is closely related to *Dendrilla nigra*, a species of the vicinity of Ceylon. For quite a while I was disposed to call it *nigra*, but have decided to erect the new name for several reasons. In *nigra* the ascending fibres are only 50 microns in diameter, and the transverse fibres only 30 microns, where they are all 80 microns in *nux*. The Ceylon species is tuberculate where the Bermuda species is conulose ; this is a very significant difference. It is lamellate, whereas *nux* is massive; this is a minor difference. It is described as merely black, not blue-black; it is possible that Dendy might have regarded the two terms as synonymous—yet he was a careful writer, disposed to give very precise descriptions. He described *nigra* first as a *Spongionella* (1889, page 94). *Spongionella* is a genus with pronouncedly reticulate skeleton and laminate fibres. If it had small, round, flagellate chambers it would be a synonym of *Cacospongia*. With large, sack-shaped, flagellate chambers, it might match *Dendrilla*, or *Euryspongia*. The significant fact is that the chamber system of *Spongionella* is not known. Therefore Dendy himself, in 1905, page 205, abandoned *Spongionella* and erected for *nigra* as type the genus *Megalopastas*. It is true that *Dendrilla* had been long established (Lendenfeld, 1883, page 271) but the "diagnosis" did not give the proper emphasis, hence Dendy overlooked it.

The type of *Dendrilla*, *cactus* or *cacta*, is a rosy red sponge, emphatically different in colour from the rest that may be assigned with it. These include, besides *nux* and *nigra*, a dark purple sponge (*Dendrilla janthelliformis* Lendenfeld, 1888, page 29). This and *cacta* are Australian. *Nux* appears to be the first record of a *Dendrilla* from the Western Hemisphere.

Genus Ianthella Gray.

Sponges of this genus, otherwise very much like *Dendrilla*, have in their fibres a large central pith such as occurs in the fibres of *Verongia*. Furthermore, there are rather numerous, scattered cells in this pith, giving rise to much speculation and need for further research. Many authors have put *Ianthella*, as well as *Dendrilla*, in the Aplysillidae, for example, Minchin, 1900, page 154; yet both genera have definitely reticulate skeletons, quite unlike the proper Aplysillidae. *Ianthella* is set off chiefly for intra-fibre cells or cell-like bodies.

Ianthella ardis, sp. n.

The syntype, which is a portion of the holotype, is represented by British Museum (Natural History) register number 1950.5.23.1. The rest of the holotype is preserved in Bermuda, at least temporarily, in the Museum of the Government Aquarium at Flatts.

Date collected.—July 15, 1949, and many others.

Locality.—Harrington Sound, Bermuda. On July 2, 1947, two small specimens were found near North Rock, near the north edge of the slightly submerged plateau known as "Greater Bermuda".

Abundance.—Extremely common in Harrington Sound, elsewhere equally uncommon.

Shape.—At first encrusting, but soon huge clavate processes arise.

Size.—The processes are 4 to 6 cm. in diameter, and at least as much as 40 cm. high in specimens near Abbott's Cliff. A common height is 20 cm.

Colour.—When this species grows in dim light, as for example back under an overhanging ledge, it is yellow. The greater the illumination, the greener it grows; some specimens in unshaded water as little as 2 metres deep, are emerald or grass green. Taken out of water, or put into preservative, *Ianthella ardis* at once begins to turn more bluish. After a few hours, or a day, depending on temperature and unknown factors, probably concerned with the sponge's physiologic condition and pH, it turns dark purple, almost black. The alcohol in which this species is preserved is coloured opaque dark reddish purple. The dried sponge is black. The living sponge when roughly handled gives off a purple exudate, and for this reason is somewhat illogically known by the colloquial name of " blue bleeder ".

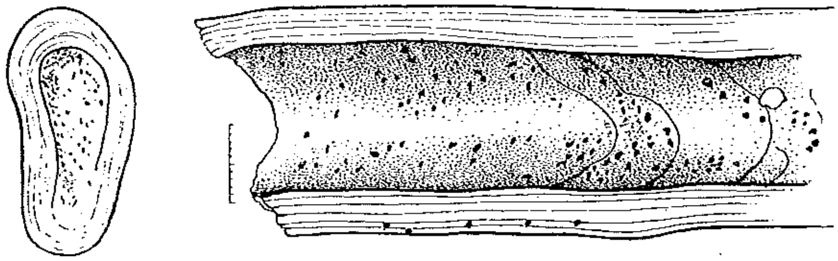
Consistency.—In life and in spirits this species is fleshy, somewhat stiffly spongy. The dried specimens are like very hard rubber, almost like ebony.

Surface.—Conulose, with conules about 1 mm. high and 3 to 6 mm. apart; other than this, the surface is exceptionally smooth.

Oscules.—Often terminal, extremely contractile. In the live sponge they are so large that one's finger can be placed into them, down into the cloaca. In dead specimens they can scarcely be found.

Pores.—Small, abundant. The openings in the sponge dermis are about 160 microns in diameter. Each of these is then filled in with a protoplasmic layer that contains six to thirteen proper pores, which are often 10 microns in diameter; they may open to 20 microns in some dried specimens, perhaps then being unnaturally stretched, and they may close completely in the living or dying sponge.

Fig. 13.



Camera lucida drawing, ×100, of bits of the fibre of *Ianthella ardis*; at the left, a transverse or slightly oblique section; at the right, a fibre longitudinally bisected, and viewed from the inside. The hundred larger dots are cells. The laminations of the fibre are indicated. The enclosed scale shows 100 microns by tens.

Ectosome anatomy.—A tough dermis, apparently made—at least in part—of spongin. It is about 15 microns thick.

Endosome anatomy.—Dense, fleshy. The flagellate chambers, while sack-shaped, are only a little larger than the round chambers of the Spongiidae; they are some 40 microns in diameter.

Skeleton.—Coarse fibres, making a reticulation with meshes 2 to 4 mm. in diameter. Much of the skeleton, especially near the surface, is dendritic; the fibres branch more often than they anastomose. They are about 300 microns in diameter, with a central core some 200 microns in diameter. The shell of the fibre is obviously laminate, translucent, amber-yellow spongin, as in *Verongia*, and like other laminate fibres it is very flexible when wet, but very stiff, even brittle, when it is dry. Inside each fibre there is colloidal organic material, and a sprinkling of cells. These seem to correspond to those abundant amoeboid cells of the sponge flesh that contain dark pigmented granules.

The type of *Ianthella* is the species that Linné, page 1348, named *Spongia flabelliformis*. It is an Australian species, and differs from *ardis* in that it has a pronounced tendency to become fan-shaped, as its name implies. Although it has abundant environmental encouragement, for Harrington Sound has no violent currents and does have some steady, gentle ones, nevertheless *ardis* shows no trace of flabellate form. The Australian sponge probably has some colour changes akin to those of *ardis*, however, because there are contradictory reports as to its hue.

There has been some idea that in all the world there exists but one species of *Ianthella*. In 1927 I collected a small specimen near the Dry Torgugas, north of Cuba. There was so little to deal with that I reported it in 1936, page 32, as being the West Indian representative of a cosmopolitan race. This Tortugas specimen, however, was almost certainly *ardis* and not *flabelliformis*. I used the species name *basta* incorrectly; *flabelliformis* has priority, if *basta* belongs here at all, which is dubious.

How does it happen that there are cells in the fibre? Are they trapped there when the fibre forms, and imprisoned? Are they free to come and go, as the amoeboid cells in general are? If so, how do they gain egress and access? The fibre bark certainly appears imperforate. Are they even alive? It is not certain that they are—although one would expect them to decay if they remained moribund for the length of time that must be required for a fibre to grow around them.

It may possibly be that *Ianthella* is moderately common in some portions of Australia, but this is far from sure, to judge from the literature. Certainly specimens of this genus are quite rare in most parts of the world. There are not only very numerous specimens in Harrington Sound, but easily collected and convenient to a well-equipped modern biological laboratory. It is therefore greatly to be hoped that someone will take advantage of this combination to investigate carefully the fibre of *Ianthella ardis*.

There has been some confusion between the genus *Ianthella* and the genus *Basta*. *Basta* was established by Oken, 1814, page 77. He described it as being for sponges with a woody basis, branches in one plane, anastomosing. He described two species, first *ventilabrum*, second *flabelliformis*. The latter has often been assumed to be *Spongia flabelliformis* of Linné, 1759, page 1348, although there is nothing in Oken's paper to make this evident—he does not credit Linné. Still, it is a fair guess that Linné's species is involved. Gray, 1869, page 49, established *Ianthella* to have Linné's *flabelliformis* as type, hence the assumption that *Basta* and *Ianthella* are congeneric.

The species *flabelliformis*, however, cannot be the type of *Basta*. Oken added, in his original description, two more species, which he indicated had already been described—these were *Spongia basta* and *Spongia grossa*. Because of Article 30 *d* of the International Rules of Zoological Nomenclature (type by absolute tautonymy) the species *basta* must be the type of the genus *Basta*. Thus the genus does not follow Oken's diagnosis, but instead assumes the traits that will permit it to retain the type species, the one species that cannot be transferred out of it.

Spongia basta was described by Pallas, 1766, page 379. His original description is extremely brief, and unrecognizable, and his specimens are lost; therefore it is in order to establish a neotype, and for this I select British Museum (Natural History) register number 83.12.4.28. This sponge is fibrous, and so as nearly consistent as possible. It is a *Spongia*, species *officinalis*, therefore *basta* falls in synonymy to *officinalis* and *Basta* to *Spongia*.

Esper, 1794, page 245, plate xxv, had a specimen which he surmised might be *Spongia basta* of Pallas, although this is, of course, highly problematic. His specimen might be considered as being a sort of neotype, but it is positively not so designated at all. Esper's specimens were preserved in the Cabinet of Hermann, and for them, in 1931, page 90, Topsent established the new species name *hermanni* on the assumption that it was not the same as *basta* of Pallas. For *hermanni* as type, he established the genus *Pseudobasta*, which has dark, stratified fibres with no proper pith. Because the flagellate chambers are unknown, its systematic position is completely mysterious, but it certainly falls to the equally mysterious but similarly characterized genus *Spongionella* Bowerbank, 1862, page 1119. If it were true, as is probably not the case, that Esper's specimen fixed a type for the species *basta* on which the genus *Basta* is grounded, then *Pseudobasta*, *Spongionella*, and *Basta* would be congeneric, the other two falling in synonymy to the earlier *Basta*. It is therefore helpful to the cause of stable nomenclature to establish (as I have done) a neotype for Pallas' species, and thus to keep the species *basta* (as Pallas had it) within the genus *Spongia*, dropping also the genus *Basta* to *Spongia*.

Family APLYSILLIDAE Vosmaer.

This is the family also called Darwinellidae. The genus *Darwinella* antedates the genus *Aplysilla*, but *Aplysilla* is typical of all the genera referred here except *Darwinella*, which is unique, and susceptible to removal for the formation of a family of its own. This separation has not yet been proposed, nor is it here proposed, nevertheless it is so conceivable, that *Darwinella* is not a suitable type genus for Aplysillidae.

Sponges of this family look and feel much like all the other Keratosa, fleshy and conulose, but they are seldom very tall, often merely encrusting. Like sponges of the family Dysideidae they have large sack-shaped flagellate chambers. Unlike either Spongiidae or Dysideidae, their skeletons are not reticulate. They do have fibres, but these branch without anastomosing. There is a basal plate of spongin, which is either absent or inconspicuous in the species of the preceding families. From this base, trunk-like fibres arise, largest at the base, tapering—smaller and smaller—into tree-like branches. These fibres are laminate, and like all such, are quite elastic when still wet, but become stiff and brittle upon drying.

Genus APLYSILLA Schulze.

Sponges of this genus are well characterized by the family description. The other genera of the family can be described by telling in what respects they are peculiar, having distinctive added factors.

APLYSILLA SULFUREA Schulze.

Bermuda specimens of this species are represented by British Museum (Natural History) register number 1948.8.6.13.

Date collected.—July 28, 1947, and many others.

Locality.—Harrington Sound, Bermuda.

Abundance.—Moderately common.

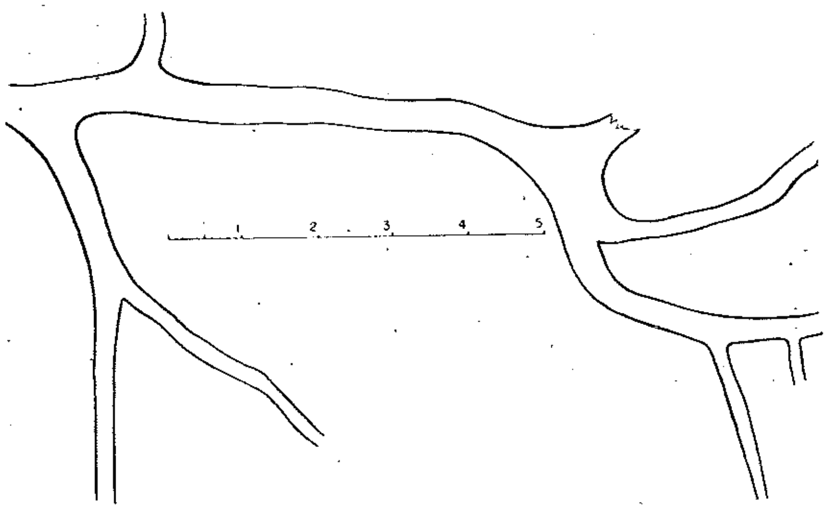
Shape.—Encrusting.

Size.—Up to about 1 cm. thick, and often 10 to 15 cm. in diameter.

Colour.—The living sponge is bright sulphur yellow, but it turns dark purple when taken out of water, when it is put in preservative, or when it merely dies for any reason whatever. The purple colour begins to appear almost instantly in air or alcohol, and continues to deepen or become more intense for several hours. A maximum is reached in about six hours. The warmer, the faster, as might be expected.

Consistency.—Soft, fleshy, compressible.

Fig. 14.



Camera lucida drawing, ×10, of a bit of the fibre of *Aplysilla sulfurea*. The base was toward the left. The enclosed scale reads in millimetres.

Surface.—A very smooth skin over coarse conules. These latter are sharp pointed, and 3 mm. or more in height. Often the conule is a projection 5 mm. or more tall, with two to four branches at its distal end; of course, this is an expression of the skeletal pattern, yet its protrusion beyond the principal surface is interesting. These compound conules are often 10 to 15 mm. apart, whereas simple conules are 5 mm. apart, because the simple ones are covered by flesh out nearer to their tips.

Oscules.—Inconspicuous, not readily identified. There are occasional 1 mm. holes, but these often (or always ?) appear to be accidental ruptures.

Pores.—Microscopic, contractile.

Ectosome anatomy.—A conspicuous, fleshy dermis, about 20 microns thick, tough, but elastic.

Endosome anatomy.—The flesh is rather dense, although the flagellate chambers are large and sack-shaped. In many sponges there is much that seems to the human observer to be " waste " space, but there is little such in *Aplysilla sulfurea*.

Skeleton.—As noted in the family description, there is a basal plate of spongin, affixed firmly to the substrata. From it dendritic fibres arise, at distances usually over 2 mm. apart. The upper, outer ends of these fibres are often exposed, owing to the circumstance that the flesh pulls away from them. This characteristic of sponges that seem quite healthy may be regarded as normal. The spongin of these *Aplysilla* fibres is dark brown, translucent, and pronouncedly laminated. There is a sort of pith or core in the centre, reminiscent of *Verongia*, and the dried fibres are brittle. These fibres are upwards of 500 microns in diameter at the base, tapering to less than 100 microns at the tips of the branches.

This species was first described by F. E. Schulze, 1878, page 404, from Mediterranean waters. Keller, 1889, page 356, extended its known range to include the Red Sea, and Lendenfeld the same year, page 707, recorded it from Australia. Topsent, 1905, page 503, reported this species from the Antarctic ; there is some possibility, however, that this is instead another species of *Aplysilla.* George and Wilson, 1919, page 163, described an *Aplysilla* from North Carolina, U.S.A., as *longispina,* sp. n., but de Laubenfels, 1947, page 35, after personal study in the field, pointed out that this is typical *Aplysilla sulfurea.* It is a very widespread, almost cosmopolitan sponge, although nowhere really abundant.

The species *sulfurea* is the type of the genus, and is set apart from others that have since been referred to *Aplysilla,* by reason of its peculiar pigment ; yellow in life, and purple when dead.

Aplysilla glacialis (Merejkowsky) Lendenfeld.

Bermuda specimens of this species are represented by British Museum (Natural History) register number 1948.8.6.14.

Date collected.—July 8, 1947, and others.

Locality.—Walsingham Pond and also Hungry Bay, Bermuda.

Abundance.—Not common.

Shape.—A thin encrustation, usually hidden. The typical location is on the underside of a well-submerged rock.

Size.—The crusts are usually 2 to 4 mm. thick. In one sense of the word they grow laterally indefinitely, but in actual practice they soon reach some barrier, such as another sponge, or the exposed part of the rock. Specimens over 6 cm. in diameter are uncommon.

Colour.—A beautiful rose pink. It is noteworthy that this species is somewhat opaque, whereas there is a translucent quality to the appearance of most or all other species of the genus *Aplysilla.* After as much as a month in alcohol the pink colour, although fading, is still evident.

Consistency.—Fleshy.

Surface.—Conulose, otherwise very smooth, as typical of the genus. This smoothness is doubtless associated with the great contractility of the surface openings. The conules are nearly 2 mm. high, and are 3 or more mm. apart.

Oscules.—Minute and strongly contractile. Even in life this sponge appears to be completely lipostomous. Doubtless, before the rock was disturbed by being turned over, that is to say, while the sponge was still in the quiet darkness under the sheltering stone, then the oscules and pores may have been still open.

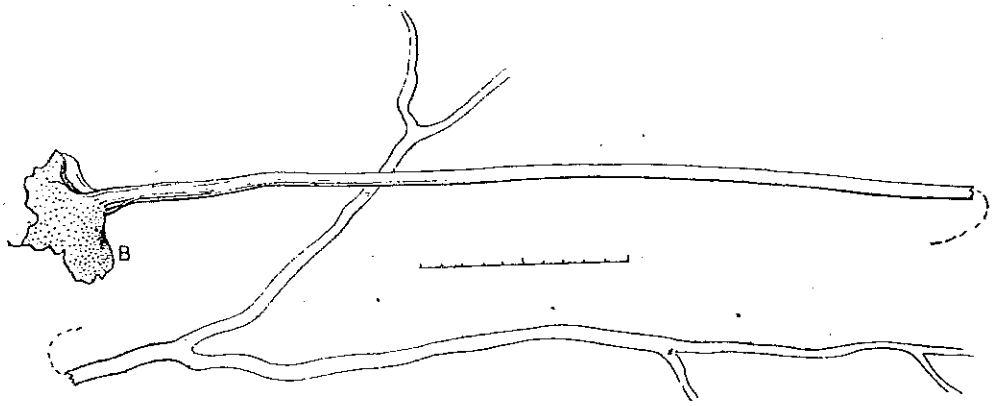
Pores.—Microscopic, completely contractile.

Ectosome anatomy.—There is a tough organic dermis about 15 microns thick.

Endosome anatomy.—The protoplasmic portions are very dense, as in the type specimen, or perhaps even more so. The whole flesh tends to contract upon dying, which certainly contributes to the appearance of density. It should be noticed that the lack of a reticulate skeleton facilitates such a contraction, also that the exposure of bits of the apical ends of the fibres may—at least in part—result from this contraction.

Skeleton.—There is the usual basal plate of spongin, and dendritic ascending fibres. These are basally some 100 microns in diameter ; they occasionally branch and practically never anastomose. They are usually more than 1 mm. apart. Each contains a central pith, which varies from 20 to 60 per cent. of the total fibre diameter.

Fig. 15.



Camera lucida drawing, ×28, of one of the fibres of *Aplysilla glacialis*. The entire fibre is shown, but in two instalments. Part of the basal plate of spongin shows at the left, labelled " B ". The outer portion of the fibre is displaced and moved back, under the basal half. The enclosed scale shows 1 mm., divided into ten parts.

This species was described as *Simplicella glacialis* by Merejkowsky in 1878, page 259, from the Arctic region. It was transferred to *Aplysilla* by Lendenfeld, 1889, page 706. In 1889 Lendenfeld reported it from south of Australia, which seemed a most remarkable distribution, with an amazing gap in between, but Thiele, 1905, page 489, again found it in the South Pacific. It was then reported by de Laubenfels, 1932, page 125, from the coast of California, thus tending to bridge the gap. The present record from mid-Atlantic carries on the growing body of data ; this is evidently a wide-ranging, practically cosmopolitan species, almost independent of water temperature, but always growing back in dark, narrow cracks, or other dimly lit locations.

The species *glacialis* is distinguished by its rose-red or pink colour and by its appearance of opacity. Its fibres are scarcely a fifth the diameter of those of *Aplysilla sulfurea*. In the field it is more likely to be confused with Diademnid Ascidians than with other sponge species.

Genus DARWINELLA Müller.

Sponges of this genus have many of the characteristics of *Aplysilla*, such as the basal plate of spongin and scattered dendritic fibres; they are fleshy and conulose like all keratose sponges. The chambers are reported as being large and sack-shaped. But the distinctive item of the genus is worthy of careful consideration, perhaps elevation to family rank. There is a whole category of skeleton added, namely, spicules made of spongin. These spicules most often bear close resemblance to the shapes of those of the Calcispongiae, and the triaxon form is abundant. Tetraxon spicules of similar shape occur in both the calcareous sponges and in *Darwinella*, with (of course) the great difference in physical composition. There is this further difference, that in *Darwinella* one sometimes finds five, or even six-rayed spongin spicules. Corresponding calcareous spicules are rare to wanting in the Calcispongiae of today, but may have occurred in past geological ages.

DARWINELLA MÜLLERI (Schultze) Müller.

The Bermuda specimen of this species is in the collections of Peabody Museum of Yale University, New Haven, Connecticut, U.S.A.

Date collected.—Perhaps about 1907. The specimen shows no date.

Locality.—" Bermuda "—no further information available.

Abundance.—Extremely rare.

Shape.—Ramose.

Size.—Branches some 2 cm. in diameter, total mass 8 cm. high.

Colour.—The dried specimen is dull brown, but one may deduce that the colour was originally red, because Verrill had called the specimen *Darwinella rubra*, doubtless intending to describe it as a new species.

Consistency.—The dried specimen is fragile.

Surface.—Conulose, with conules 1 to 2 mm. high, about 3 mm. apart.

Oscules.—Not evident.

Pores.—Likewise not evident, presumably very contractile.

Ectosome anatomy.—A thin organic dermis.

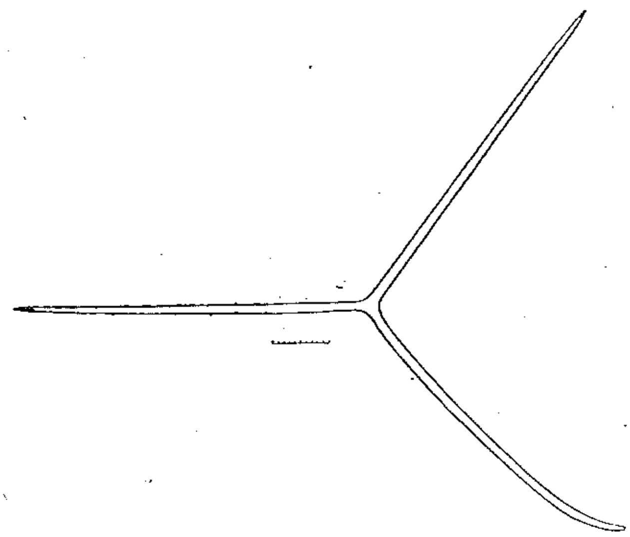
Endosome anatomy.—The specimen has been dried, therefore no details are available as to its protoplasmic structures. *Darwinella* has elsewhere been reported as having large, sack-shaped, flagellate chambers.

Skeleton.—A few, scattered, dendritic fibres arise from a thin but wide spongin base. Each fibre is about 80 microns in diameter at its base or trunk, but the branches become progressively thinner with each bifurcation, up toward the surface of the sponge mass.

Scattered through the sponge, in between the dendritic fibres, are the free spongin spicules that characterize *Darwinella*. In this specimen only the commonest sort, the triaxon, occurs. These spicules have rays that are each about 16 by 640 microns. They have axial canals and all the other obvious anatomical features of normal calcareous (or siliceous) spicules.

This species was first described as *Darwinia mülleri* by Max Schultze, 1865, page 5. (One must be careful not to confuse him with F. E. Schulze.) *Darwinia* had been preoccupied, thus was not available. The genus name *Darwinella* was therefore established by F. Müller, 1865, page 351, the man for whom the species is named. Müller called it *Darwinella aurea,* but his later name must fall to Schultze's earlier one.

Fig. 16.



One of the spongin spicules of *Darwinella mulleri,* ×75, redrawn after a camera lucida drawing. The enclosed scale shows 100 microns by tens.

The original specimens were from the Mediterranean. Carter records the genus also from Australia (1885, page 202). Thus the Bermuda record indicates a wide distribution, but these sponges are nowhere common, instead they are remarkably rare. All seem definitely to be so closely inter-related that only a single species is warranted.

Family HALISARCIDAE Vosmaer.

Sponges of this group have no spicules nor proper mineral skeleton of any kind, which is true for the entire order, and like most of the Keratosa they are fleshy, but they are not very conulose. Conules are usually the upper termini of fibres, and the Halisarcidae are especially characterized by their lack of fibres. The only skeleton present may be the interstitial jelly or ground substance. The flagellate chambers are large and sack-shaped, as in all Keratosa except the Spongiidae.

It may be that species of Halisarcidae do occur in the Bermudas. I have repeatedly seen thin, slimy, translucent encrustations on dead corals; this is exactly the appearance of such sponges. It is very difficult to detach such crusts and fix them suitably for histological study. In those few cases in which I was able to do this, the specimens proved not to be sponges at all, or else turned out to be spiculiferous sponges. Attention is here called to the possibility that some of the unsuccessful attempts conceivably may have concerned Halisarcidae. Continued investigation should be made of thin, translucent, slimy encrustations. Such should be carefully detached, fixed in strong alcohol, sectioned, stained and studied.

Order *HAPLOSCLERINA* Topsent.

Sponges of this order have spicules, but usually they have only one kind, and that kind very simple. They also contain spongin; in some species the spongin is very scanty, but more often it is abundant. The same specimen may show great variation in the amount of spongin present in one region as compared to its abundance in another region.

It seems clear to me that this group is polyphyletic, and some rearrangement may be necessary in future classification. This has little bearing, however, on the sponges that occur in the Bermudas, and so may be postponed.

Family HALICLONIDAE de Laubenfels.

Sponges of this family have very simple spiculation, usually only oxeas. The amount of spongin varies greatly, but the skeleton arrangement is always reticulate. A very distinctive feature concerns the surface structure. There is practically no ectosome present at all, nor any extensive subdermal cavity, no easily separable dermis. It is as though the sponge (endosome) just stopped—and that is the surface.

Sponges of this sort are very abundant throughout the world, emphatically including the Bermudas. Comparatively few genera are required, however, for their classification; very many specimens and species fall within the genus *Haliclona*.

Genus Haliclona Grant.

This genus exemplifies to a high degree the characteristics of the family of which it is the type. Other genera of Haliclonidae are suitably held up to it for contrast, and their peculiarities stressed. *Haliclona* has only generic peculiarities that are likewise the family peculiarities. It was established by Grant, 1841, page 5.

Haliclona molitba de Laubenfels.

The syntype, which is a portion of the holotype, is represented by British Museum (Natural History) register number 1948.8.6.15. The rest of the holotype is preserved, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—August 7, 1947, and many others.

Locality.—Mullet Bay, also near Flatts.

Abundance.—Locally quite common, but not widely distributed. This species consistently grows on marine vegetation of the various sorts that are termed " eel grass ", *Zostera* or *Ruppia*.

Shape.—Amorphous, semi-encrusting on vegetation. Occasionally short, digitate processes protrude, but one wonders if perhaps they arose originally over bits of the vegetation.

Size.—Finger-size masses or smaller are the rule. Many specimens are under 1 cm. in greatest measurement.

Colour.—The living sponge is clear, vivid violet. In alcohol it fades promptly to a pale brownish white, and stains the fluid a dark orange colour.

Consistency.—Very softly spongy, and compressible to an amazing extent. In this respect it compares to, and feels like, some fine Levant bath sponges (*Spongia* *officinalis*) after they have been prepared for market. This species, however, is more easily torn than *Spongia*.

Surface.—Superficially smooth, or somewhat punctiform.

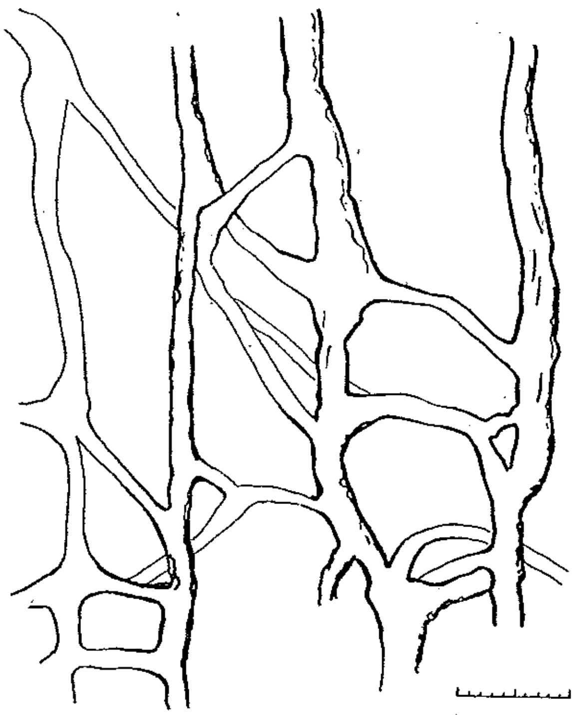
Oscules.—About 1 mm. in diameter. On the smaller specimens it is difficult to discriminate between the inhalent and exhalent apertures.

Pores.—Large and abundant, up to at least 300 microns in diameter. But as already noted, the exhalent and inhalent apertures are not sharply differentiated.

Ectosome anatomy.—No specialization at all.

Endosome anatomy.—The flesh is scattered, rather loosely, on the very conspicuous skeleton.

Fig. 17.



Camera lucida drawing, ×150, illustrating the fibro-reticulation of *Haliclona molitba*, but not showing the scanty soft parts. The enclosed scale shows 100 microns by tens.

Skeleton.—Fibro-reticulate. The ascending or principal fibres are about 30 microns in diameter, and are often 150 microns apart, roughly parallel to each other. The secondary fibres are about 15 microns in diameter, and form very irregular meshes. Both sorts are lumpy, with frequent enlargements and contractions. Both sorts contain spicules ; in places none, often a single row, and occasionally 2 or 3 spicules per cross-section of fibre. Remarkably few spicules occur loose in the flesh—nearly all are embedded. The spicules are simple oxeas about 2 by 100 microns.

Far too many species names have been written into the genus *Haliclona*. Under the various synonyms, especially *Chalina* and *Pachychalina*, approximately a hundred designations have accumulated ; there are not that many species of this genus. It is therefore with regret that I put another name in the *Haliclona* literature. *Haliclona molitba* is entirely of the *Chalina* type, even pronouncedly so.

Quite a number of so-called Chalinine sponges, *Chalina*, *Cladochalina*, and *Ceraochalina* particularly, which were characterized by much spongin and little spicule—like *molitba*—prove on careful study to be *Callyspongias*, in another family! Actually there are rather few species of genuine *Haliclona* with a high spongin ratio.

One may compare *molitba* to *Haliclona palmata*, originally described as *Spongia palmata* by Ellis and Solander, 1786, page 189. The Bermuda species has longer spicules, much fewer interstitial spicules, and is violet where *palmata* is recorded as being " yellow "—but *molitba* turns yellow upon preservation. A redescription of all the old *Haliclonas*, based upon type specimens, would be helpful, but is perhaps impossible to achieve. The cold northern Atlantic is the habitat of *palmata*. It appears that *molitba* is narrowly confined to small portions of Bermuda.

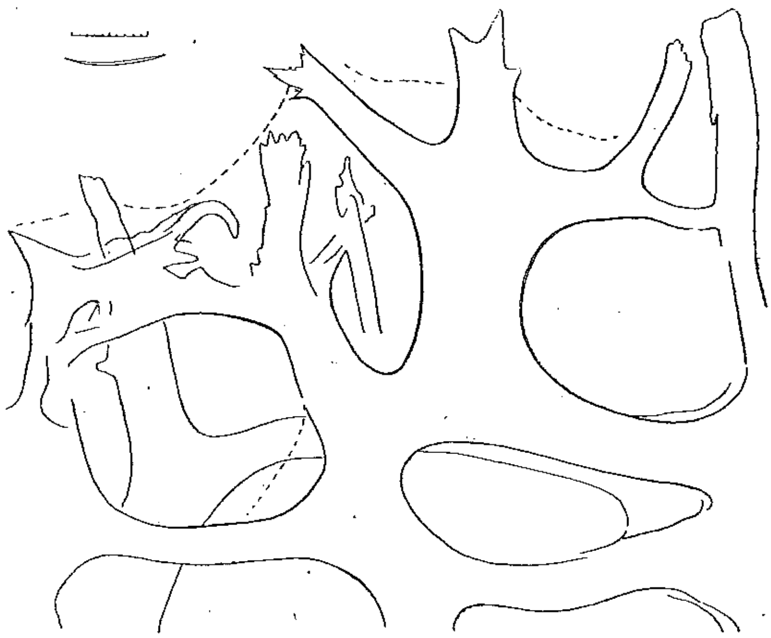
The species *molitba* was later found in the Bahamas, and described as new from there (with the same type specimens, however) by de Laubenfels, 1949, page 9 (American Museum Natural History, Novitates No. 1431).

HALICLONA VARIABILIS (Dendy) de Laubenfels.

Bermuda specimens are represented by British Museum (Natural History) register number 1948.8.6.16.

Date collected.—June 30, 1947, and many others.

Fig. 18A.



Camera lucida drawing, ×100, of a portion of the skeleton of *Haliclona variabilis*, perpendicular to the surface. The protoplasmic surface is indicated by a dotted line. The enclosed scale shows 100 microns by tens. A spicule is shown, to scale, nearby.

Locality.—Harrington Sound, and the coastal waters of the Bermudas in general.

Abundance.—Very common and widespread.

Shape.—Persistently ramose, under diverse ecological placements. The branches are quite irregular and variable in cross-section, and likewise in diameter. They seldom fork; the total sponge has usually only one or two dichotomous branches.

Size.—The cylindrical diameters range from 1·5 to 3 cm., 2 to 2·5 cm. being commonest. Total sizes as tall as 15 to 20 cm. are common, but even taller ones may occur.

Fig. 18B.

Camera lucida drawing, ×150, of a portion of the skeleton of *Haliclona variabilis*, emphasizing the placement and pattern of the spicules with reference to the fibres. The enclosed scale shows 100 microns by tens.

Colour.—The healthy growing tissue is a clear lavender. Older tissue, perhaps moribund, turns rusty brown. It is quite common to find specimens of which the upper, outer (newer) portions are lavender, while the lower parts are brown. An intermediate or half-dead colour exists, a blend of the two, thus a sort of grey or drab. This may occur as a narrow zone between the violet tissue and the brown. Again, most of an entire specimen may be of this dingy colour, as though it were ageing or dying all over instead of locally. Alcoholic specimens bleach to a brown so pale that it is almost white. Dry specimens turn dark walnut brown.

Consistency.—Spongy; not so elastic as the better commercial sponges, but definitely suggestive of the same texture. The skeleton, when dry, is firm, stiff, slightly brittle.

Surface.—Even, slightly pilose, and obviously punctiform. All over the surface, about 3 mm. apart centre to centre, holes about 1 mm. in diameter lead down from the surface; these account for the punctiform appearance. The entire surface is beset with minute projecting fibre-ends; these account for the pilose appearance. These fibrous projections are about 100 microns high and 100 to 200 microns apart.

Oscules.—Conspicuous, 3 to 6 mm. in diameter, usually 4 to 5 mm. Many are flush, but some have rims raised slightly, say 1 mm. In some specimens, or parts of a specimen, they may be only 1 cm. apart, in others they be 3 cm. apart, or even wanting from areas more than 10 cm. square. This distribution is doubtless correlated with the situation as regarding currents where the sponge grew; there is more oscular area, and there are more raised rims, in relatively calmer places.

Pores.—Common and large, as already described in connection with consideration of the surface. By no means all are as large as 300 microns, in fact, such size may be due to post-mortem shrinkage of the surrounding flesh, whereas in contrast many other sponges close their pores when they die. Pore size for *Haliclona variabilis* may be cited as 100 to 300 microns.

Ectosome anatomy.—No specialization. Attention may appropriately be called to the directness with which pore canals go down from the surface. Of course, the lack of subdermal canals (parallel to the surface) is quite characteristic of *Haliclona*.

Endosome anatomy.—The rather scanty soft parts are scattered on the very conspicuous skeleton.

Skeleton.—Fibro-reticulate. There is no sharp distinction of primary as contrasted to secondary fibre, or principal and transverse. The fibres are irregular as to cross-section size and shape of cross-section, but are often over 15 microns thick. They are much curved and bent, often branching and anastomosing. The resulting meshes are rounded, and are 200 to 600 microns in diameter, often about 300. The fibres consist principally of spongin, but are fairly well filled with spicules arranged lengthwise, say 5 to 15 spicules per cross-section. A few spicules occur loose in the flesh. There is but one spicule sort, a simple oxea, 3 by 150 microns. While there is some variation, even up to 6 by 160 microns, the size first mentioned is much the commonest.

This species was described as *Pachychalina variabilis* by Dendy, 1890, page 353, from the West Indies, in their eastern portion. I was never able to find this species in the Dry Tortugas, which is in the western part of the West Indies.

Verrill's species *Pachychalina millepora* is described as irregularly ramose, fragile when dry, smooth reticulate surface—this could apply to many *Haliclonas*, but of course could be *variabilis*. Verrill described branches 12 to 25 mm. in diameter, which matches, as does his comment on oscules 2 to 4 mm., scattered. But he mentions fibres only 30 to 40 microns thick, which is small for *variabilis;* fibres of this latter species range from 50 to 150 microns. Verrill omits any reference to thickness of spicule, but gives lengths as 200 to 220 microns. The spicules of *variabilis* are 3 by 150 microns.

The species *variabilis* is a commonplace, generalized *Haliclona*, and many subsequently named species resemble it. It is coarser than the genotype (*oculata*), coarser and much fuller of spicules than *molitba*, much fuller of spongin than are the next two species (*crassiloba* and *permollis*). The colour finishes the necessary distinguishing pattern.

HALICLONA CRASSILOBA (Lamarck) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.17.

Date collected.—July, 8, 1947.

Locality.—Walsingham Pond, also Harrington Sound, Bermuda.

Abundance.—Uncommon.

Shape.—Massive, with rounded, almost hemispherical processes.

Size.—A vertical measurement of at least 7 cm. is attained, and a lateral growth almost as great.

Fig. 19.

Camera lucida drawing, ×150, of a bit of the skeleton of *Haliclona crassiloba*. Only the spicules appear. The enclosed scale shows 100 microns by tens.

Colour.—The living sponge is violet. It quickly becomes grey in alcohol, staining the fluid yellow.

Consistency.—Soft, compressible, easily torn.

Surface.—Microtuberculate ; tubercules about 0·3 mm. high and 0·6 mm. apart.

Oscules.—Up to at least 8 mm. in diameter, without sharp rims, but often situated at the summits of lobes.

Pores.—Microscopic, contractile.

Ectosome anatomy.—No specialization.

Endosome anatomy.—Microcavernous and vaguely reticulate. The flesh is arranged in gross and flagellate chambers, with abundant canals. The flagellate chambers are spherical, 25 microns in diameter.

Skeleton.—There is a ground mass that verges upon being isodictyal, many of the spicules being interconnected at their tips by a modicum of spongin. Through this framework meanders strands that consist of a few spicules per cross-section, cemented by a little transparent spongin. They are almost fibres, probably are better to be termed tracts. A diameter of 5 to 20 microns can be assigned to them; they are crooked, but are usually between 100 and 200 microns apart. They do sometimes branch and anastomose, but only occasionally.

The spicules are oxeas, 3 by 90 microns.

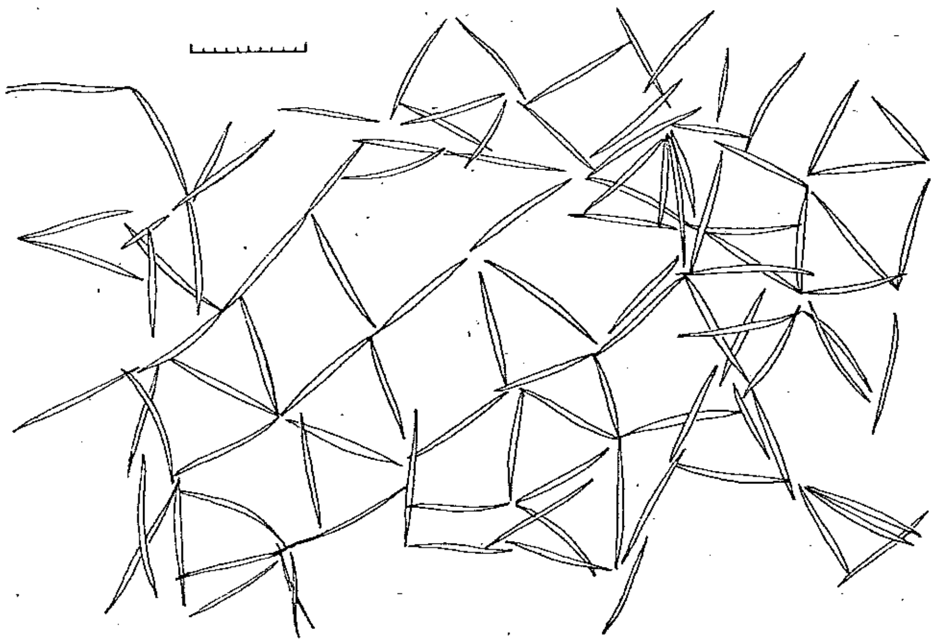
Spongia crassiloba was described by Lamarck, 1814, page 370, locality not known. The amplified description, based on original specimens by Topsent, 1931, page 21, makes it clear that this is a *Haliclona* (Topsent said *Chalina*). Even so, the specimen being so old, *crassiloba* of Lamarck is not too well known. As already observed, however, I object to multiplying names in the already overcrowded genus *Haliclona*, and *crassiloba* fits our Bermuda species sufficiently well that Lamarck's name may be used rather than a dubious new one.

HALICLONA PERMOLLIS (Bowerbank) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.18.

Date collected.—July 12, 1947, and others.

Fig. 20.



Camera lucida drawing, ×150, of a portion of the skeleton of *Haliclona permollis*. Only those spicules are drawn that were simultaneously in focus—those nearer and those farther away are omitted. Needless to say the reticulation is three-dimensional, but in all directions it appears much as here figured. The enclosed scale shows 100 microns by tens.

Locality.—Hungry Bay, also coasts of Bermuda in general.

Abundance.—At Hungry Bay it occurred in great masses, aggregating several square metres. Elsewhere it occurs only in small encrustations, often coin-size.

Shape.—Primarily an encrusting sponge, it is remarkable that in Hungry Bay it becomes so thick.

Size.—In that favourable location it grew to a thickness of over 5 cm. Elsewhere it is usually under 1 cm. The lateral growth, while seldom more than 5 or 10 cm., is actually indefinite; it proceeds slowly but steadily until some impassable obstacle is reached.

Colour.—The living sponge is violet. In alcohol it quickly fades to a dingy pinkish white, and the fluid is promptly coloured a deep orange.

Consistency.—Softly spongy, easily torn, and significantly somewhat slimy.

Surface.—Microtuberculate, tubercles a small fraction of a millimetre high and apart.

Oscules.—Typically like little volcanoes, raised on conical elevations, which is to say that they have conspicuous, elevated rims. One finds encrustations 4 mm. thick with oscules 2 mm. in diameter, 3 mm. high above the other surface, and less than 10 mm. apart. In the large Hungry Bay specimens the oscules reach a diameter of 10 mm., but their collars are still only some 5 mm. high, therefore they are not so conspicuous.

Pores.—Abundant, microscopic, contractile.

Ectosome anatomy.—No specialization at all.

Endosome anatomy.—The soft parts are well developed, somewhat cavernous, with generous quantities of ground substance. The skeleton permeates the interior ubiquitously.

Skeleton.—A pronouncedly isodictyal reticulation; only a small amount of spongin unites the spicule-ends. Thus the polygonal, often triangular meshes are bounded by just one spicule per side.

The spicules are oxeas about 4 by 105 to 5 by 110 microns.

This species was described as *Isodictya permollis* by Bowerbank, 1866, page 278, from Great Britain and transferred to *Haliclona* by de Laubenfels, 1936, page 40. Since then it has been discovered that there is in many parts of the world just such an encrusting, isodictyal, lavender sponge, with raised vents and only oxeas as spicules, these about 5 by 100 microns. I have found it on both the Pacific and Atlantic coasts of North America. *Haliclona permollis* may be regarded as a cosmopolitan species.

HALICLONA VIRIDIS (Duchassaing and Michelotti) de Laubenfels. (See Pl. I, fig. 3.)

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.19.

Date collected.—July 28, 1947, and others.

Locality.—Harrington Sound, Walsingham Pond, and the coasts of Bermuda in general.

Abundance.—Extremely common.

Shape.—At first encrusting, then massive, then with digitate processes, and finally a few old specimens become ramose.

Size.—The larger specimens, that is to say, those that are ramose, may reach a height of 20 cm. The cylindrical portions are usually between 2 and 3 cm. in diameter.

Colour.—The living sponge is a soft, clear green. In alcohol this changes almost instantly to a pale, nearly white appearance, but with tinges of grey and lavender.

It is curious to note that the many *Haliclona* species which are lavender in life lose all trace of that colour when they are preserved in alcohol, whereas this one species that is not lavender, but green, is the only one to show a lavender tint in preservative. The alcohol itself takes on an amber shade. Dried specimens are dark, dull grey or brownish grey.

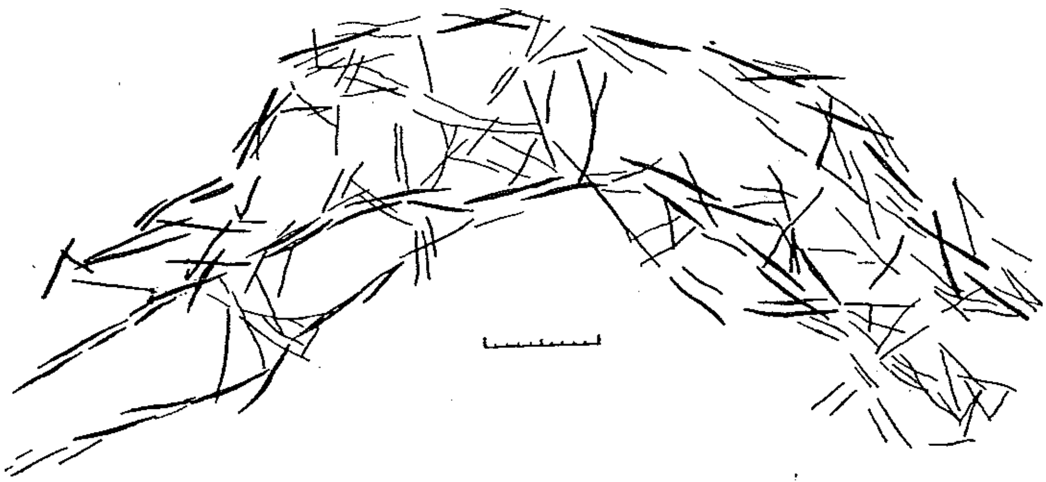
Consistency.—Extremely soft and spongy, even to be described as limp. Very readily torn, and—in the dried state—easily broken.

Surface.—Punctiform, relatively even, not conulose, nor evidently tuberculate.

Oscules.—Up to 6 mm. in diameter, round, flush (that is, no raised rims) and often at the summit of a process. They are closed by a transparent membrane which is pulled across them. See Pl. I, fig. 3.

Pores.—The meshes of the skeletal reticulation are conspicuous all over the surface; meshes that are about 1 mm. across, centre of fibre to centre of fibre. The true pores are minute, contractile apertures in the flesh between the fibres.

Fig. 21.



Camera lucida drawing, ×150, of the spicules in a section of *Haliclona viridis*. Two or three of the vague tracts can be made out, and their relation to the ground-work of scattered, sub-isodictyal spicules can be observed. The enclosed scale shows 100 microns by tens.

Ectosome anatomy.—No specialization at all.

Endosome anatomy.—Reticulate, microcavernous.

Skeleton.—Principally spicular, with no conspicuous fibres. There is a groundwork that is vaguely almost isodictyal, and through it run vague tracts that are seldom more than 3 or 4 spicules thick; they are some 75 to 150 microns apart. A minute amount of spongin may be present.

The spicules are oxeas, 3 by 120 microns.

This sponge was first described as *Amphimédon viridis* by Duchassaing and Michelotti, 1864, page 81. The original descriptions by these authors are so extremely inadequate, even erroneous, that I made a journey to Turin, Italy, to study the original specimens, or rather what was left of the original specimens. Where there were specimens at Turin, I took portions to serve as official types, and deposited these in the British Museum (Natural History) in London. Thus the official type of *viridis* is B.M.N.H. register number 28.11.12.36.

Burton, 1937, page 18, established a genus *Hemihaliclona* for the species (*viridis*) as type. I fail to see wherein it deviates from typical *Haliclona*, however. Burton emphasizes the simultaneous occurrence of sub-isodictyal ground-work, plus tracts. The type of *Haliclona* (*oculata*) is much like that, too. Many *Haliclonas*, such as *variabilis*, emphasize the tracts or fibres, others, such as *permollis*, emphasize the isodictyal structure. *Haliclona viridis* is rather medium.

Genus Xestospongia de Laubenfels.

Sponges of this genus may appropriately be compared to *Haliclona*, especially to those *Haliclona* that have a high ratio of spicules, and a low ratio of spongin. In *Haliclona* there is often a reticulation (isodictyal) with polygonal meshes outlined by one spicule per side. In *Xestospongia* it seems as though there were instead a score of spicules per side. As a result of the inevitable crowding, the sharp-angled meshes tend to give way to rather rounded ones. But the spicules, so far from being slimmer to accompany this crowding, are rather shorter and thicker on the average than *Haliclona* spicules. Naturally *Xestospongia* specimens are hard and almost stony in consistency. The presence of a little spongin and the existence of movement between the individual spicules gives just enough elasticity to the mass that a better comparison than to stone is a likeness to wood. This is implied in the generic designation. The genus *Petrosia* is suitable for comparison here. Its species are more rock-like, as its name implies. Perhaps this is due to the fact that its spicules include some long and thick, others long and thin, others short and thick and still others short and thin. Because the smaller units fill in the interstices, and interlock or knit the mass, a harder consistency should be expected. *Petrosia* also has a special tangential dermal skeleton, which is emphatically different from the *Haliclona*-like surface of *Xestospongia*.

Xestospongia calyx, sp. n.

The syntype, which is a small portion of the holotype, is represented by British Museum (Natural History) register number 1948.8.6.20. The large residue of the holotype has long been preserved in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—Unknown, but probably between 1910 and 1940.

Locality.—White flat, North Shore, Bermuda.

Abundance.—One specimen certainly known, others are orally reported.

Shape.—A bowl or thick-walled basin, with an especially small base.

Size.—About 20 cm. in diameter, 15 cm. high. The walls are 2 or 3 cm. thick at the upper edge, and probably are thicker toward the base.

Colour.—The long-dried specimen is nearly white as to exterior, much more brownish as to interior.

Consistency.—Hard, like wood.

Surface.—Fairly smooth, but undulating.

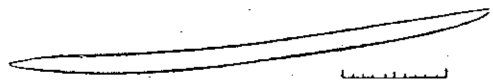
Oscules.—Not evident, but perhaps some of the small openings which are discussed under the heading of " pores " may actually have been exhalent.

Pores.—The surface is beset with openings 30 to 50 microns in diameter, less than 150 microns apart. In cases like this, where a mineral skeleton is present and quite rigid, the shrinkage of flesh that accompanies dying and drying may result in holes which are larger than they were in life ; the flesh pulls back to reveal the larger skeletal aperture which it formerly partially filled. On the other hand, with a flexible skeleton that " gives ", the necrotic shrinkage will tend to close or at least reduce in size the openings that were larger when the flesh was relaxed.

As already noted, one may assume that some of the minute openings of *Xestospongia calyx* were vents. It is likely that those inside the bowl were exhalent and that those on the outside were inhalent. In many vase- or bowl-shaped sponges there are small openings on the outer, convex surface, leading to larger and larger but fewer and fewer canals, finally to larger openings on the inner or concave surface. Then it becomes evident that the oscules are internal. In fact, this gives rise to the problem (a severe one when the vase is narrow and a tube results) : is the upper opening of the vase really the oscule ?

One may not safely assume that the openings on the concave side are the vents. Sponges are reported, especially by Lendenfeld, 1889, in which the direction is reversed, so that the lining of the vase is inhalent and the outer portion exhalent.

Fig. 22.



Camera lucida drawing, ×725, of one of the spicules of *Xestospongia calyx*. The enclosed scale shows 20 microns by twos.

Of course, the author cited is known to be unreliable, and these apparent exceptions may be due to inaccurate reporting ; nevertheless the possibility is so definite that one cannot be certain one way or the other.

Ectosome anatomy.—The skeletal tracts of *Xestospongia calyx* expand as they arrive at the surface, and terminate with dermal brushes. These do not protrude, however, but are so very numerous, and thus close together, that they create a rather uniform plane, a dense stand of parallel spicules, all more or less perpendicular to the surface.

Endosome anatomy.—Dense, microcavernous, but because of the canals and chambers it is not quite so extremely dense as is the surface.

Skeleton.—Not quite typical for a *Xestospongia* ; there are tracts that are densely packed with spicules, total tract diameter about 100 microns, about 30 to 70 spicules per cross-section. These tracts are so close together that the space between them is only about 100 to 150 microns wide. They branch and anastomose frequently to make a reticulation, but do not have the transverse tracts or connections that are to be expected.

The spicules are thinner than is usual in this genus. They are oxeas, rather hastate, and about 4 to 100 microns.

Verrill, in 1907, page 293 (or 337), described a sponge as being *Cribrochalina bartholmei* Duchassaing and Michelotti. He says that it had evident oscules, which were " mostly on the inside of the cup ". This reads as though quite unlike the description of the oscules of *Xestospongia calyx*, but I believe that variation between one specimen and another could account for this. As already discussed, it is probable that the little openings on the concave surface of *calyx* are really oscules. Verrill describes them as " numerous, inconspicuous, 200 to 300 microns ". He had only two specimens, and describes them most inadequately; for example, he gives no sizes for the spicules. Nevertheless, I surmise that his specimens were conspecific with that now under discussion.

Duchassaing and Michelotti described *Spongia bartholmei*, 1864, page 42, but in their collection at Turin I could not find any specimen of this. Their description is, of course, unrecognizable. Schmidt, in 1870, page 36, described *Cribrochalina infundibulum*. This should probably be *infundibula*, so that the species name, an adjective, may harmonize in gender with the genus name, which is the noun it modifies. *Infundibula* was described as having much spongin, tracts of spicules up to 85 microns in diameter, the spicules themselves 4 by 200 microns. These are considerable differences from *calyx*. Schmidt expressed the opinion that his later species should receive in synonymy the earlier *bartholmei* (of course it should be the other way)—but I believe that Schmidt was probably correct in the decision that *bartholmei* and *infundibula* were conspecific. The two came from regions that are close together, and quite far from the region of *calyx*. Neither is well enough known for family allocation. A likely guess may be that the two names represent the single species *Cribrochalina bartholmei*, and that this belongs somewhere in the Haliclonidae, but that is as far as we can go; its genus is not known. I do not regard this species as being congeneric with *Xestospongia*.

Schmidt, 1870, page 44, described a sponge from the West Indies as *Schmidtia muta*. This is evidently a *Xestospongia*, and de Laubenfels transferred it to this latter genus, 1936, page 70. It may be the closest relative to *calyx*, but its spicules were thicker, 10 by 230 to 16 by 360 microns. In fact, it may be regarded as a much more typical *Xestospongia* than *calyx*. Schmidt's descriptions are tantalizingly brief.

Another related form is that which Wilson in 1902, page 389, described from Puerto Rico as *Petrosia halichondrioides*, sp. n. It is here suggested that it be transferred to the genus *Xestospongia*. It is described as dark brown, and subspherical, with a solitary oscule.

Family DESMACIDONIDAE Gray.

Sponges of this family have a skeleton which is very much like that of the preceding family, except that in many cases the smaller spicules, called microscleres, are added. When Ridley and Dendy wrote about sponges in the 'Challenger' Report (1887), this was thought to be a huge difference. Lately there has been a tendency to minimize the role of microscleres. Such a tendency has its value in counteracting the opposite extreme, but can itself be carried to excess.

Among the sponges now put in the Desmacidonidae there are some that are known to have surface structures much like those of the Haliclonidae. These are probably really very close indeed to that family. There are other Desmacidonids that are known to have a fleshy dermis; *Iotrochota* is a good example of this type. These probably deserve to have their own family, or at least to be in a different family from those with less well-developed ectosomes. The trouble is, that in the past so few scholars who have described sponges have bothered to describe the ectosome—yet the ectosome structure has very great taxonomic significance, because those species that have similar ectosomes are evidently closely inter-related. Numerous species are now placed in the Desmacidonidae because of their spicule content, but are species for which we lack the data that would be necessary to allocate them as between the two family divisions which are here contemplated. Thus we are not yet ready to split the Desmacidonidae.

Genus FIBULIA Carter.

Sponges of this genus have strongyles rather than styles as their megascleres, and they possess simple microscleres. In the genotype these latter include straight ones (raphides) and curved ones (sigmas), but some species are referred to *Fibulia* and are rather obviously closely related to the genotype, but lack the sigmas. The surface is typically tuberculate, rather closer to the *Iotrochota* division of the family than to the more Haliclonid portion.

FIBULIA BERMUDA, sp. n.

The syntype, which is a portion of the holotype, is represented by British Museum (Natural History) register number 1948.8.6.2.1. The rest of the holotype is preserved, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—July 14, 1947, and others.

Locality.—Harrington Sound, Bermuda.

Abundance.—Fairly common.

Shape.—Massive, with a tendency to grow up into rounded lobes, hardly to be called digitate.

Size.—Many specimens are about the size of a human fist. Doubtless smaller ones occur, but are overlooked.

Colour.—The living sponge is a rich walnut brown as to exterior, but is an ochre or brownish yellow as to interior. It fades scarcely at all in alcohol, but does become somewhat dull; it tinges the fluid a pale, warm brown (not dull and greyish).

Consistency.—Spongy, very compressible, but rather easily torn.

Surface.—Tuberculate, almost conulose. The little projections are so rounded, however, that the term conule is not quite appropriate. They are less than 0·5 mm. high, and about 1 mm. apart.

Oscules.—Up to at least 5 mm. in diameter, and often (but not always) situated at the summits of the rounded lobes. The edges are smooth and flush, not provided with collars or raised rims.

Pores.—Abundant, and rather large, perhaps over 100 microns in diameter when fully opened, but actually very contractile.

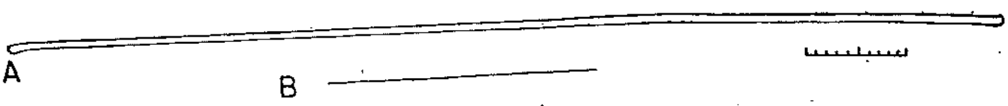
Ectosome anatomy.—There is a fleshy dermis, about 10 microns thick, not easily detachable. It is sufficiently well developed, however, to display a distinct resemblance to keratose or horny sponges. There is a reticulation of fibres at the surface, but it is not peculiar, that is to say, it is much like the endosomal reticulation.

Endosome anatomy.—Microcavernous and fibro-reticulate, fleshy.

Skeleton.—The structures which are here referred to as fibres are not at all typical of sponge fibres in general. Instead, we have here much the same problem that existed in the study and description of the skeleton of *Dysidea crawshayi*. The spongin strands are flattened, almost sheet-like, but so irregular in thickness and outline that they are definitely not strap-like. They are much bent and curved and in places produce an effect which may be described as flocculent. There is much spongin present, so that macerated dried skeletons bear much resemblance to bath sponges until they are viewed under the microscope, when abundant difference becomes evident. These spongin structures are well filled with spicules, but these latter point in all directions, and are likely to protrude from the fibres, so that it becomes difficult to discriminate between the spicules that are in the tracts and the many that occur out of the tracts, merely loose in the flesh of the sponge.

The spicules are of two sorts. The megascleres (fig. 23A) are strongyles. They are very straight unless they occur in a fibre at a place where it bends, then they bend with it. They are about 2 microns thick and 180 to 200 microns long. The microscleres (fig. 23B) are raphides, about 0·5 by 60 microns.

Fig. 23.



Camera lucida drawing, ×666, of the spicules of *Fibulia bermuda*. A : A strongyle. B : A raphid. The enclosed scale shows 20 microns by twos.

This proved to be a very difficult species to classify. For quite a while I thought of it as keratose, because of its appearance and consistency. To be sure, its fibres were full of spicules, but—as in *Dysidea crawshayi*—so may be the fibres of Keratosa, the sponge having picked up foreign debris. In a case like this, it is often impossible to decide on the basis of one or a few specimens. Of course, if many varieties of spicules are present, one does well to conclude that some or all of them are foreign. If many are broken they are probably foreign. If their axial canals are extra large, they probably lay around in sea water for a long time, slowly dissolving, and thus are foreign. A considerable series of *Fibulia bermuda* gradually accumulated during the summer of 1947. Again and again the spiculation was consistent, just the two sorts, and those sorts regular. Finally, it became probable that these must be proper spicules.

Even so, it would have been difficult to place this in *Fibulia*, except for the fact that I am familiar with the *Fibulia* that is common in the region of the Dry Tortugas, north of Cuba. This and the Bermuda one resemble each other enough to confirm the identification.

Fibulia was established by Carter, 1886, page 51, for the species *massa*. In 1936, page 51, I dropped this in synonymy to the sponge that Duchassaing and Michelotti described in 1864, page 82, as *Amphimédon nolitangere*, a species which is abundant in the vicinity of Cuba. It has since been my privilege to examine specimens of *Fibulia* from Florida, and they are clearly *massa* of Carter, with sigmas as well as strongyles and raphides, notably different from the Tortugas *Fibulia*. I therefore here point out that the two species, while congeneric, are not conspecific, and both names should be retained. The Bermuda sponges give us a third member of the genus.

As compared to the other two, *Fibulia bermuda* has much more spongin than either. It lacks the sigmas of *massa ;* so does *nolitangere*, but the latter has strongyles 5 by 335 microns, whereas those of *bermuda* are 2 by 190, and the raphides of *nolitangere* are somewhat longer on the average than are the raphides of *bermuda*.

As implied in the name, *nolitangere* should not be touched. It imparts a violent chemical irritation to the skin, requiring several days to heal. Does *bermuda* have this same property ? The first day that I collected in Bermuda I obtained a pronounced case of this dermal irritation, so severe that my fingers swelled painfully, but I handled many different kinds of sponges that day, and touched other invertebrates such as Anthozoa, which may be poisonous, and therefore I am not sure that the *Fibulia* was to blame. It may have done its share. Locally *Tedania ignis* has a reputation for skin irritation, but I suspect that in some cases where *Tedania* has been blamed the affected person had also touched the less conspicuous *Fibulia*. The same *Tedania* (*ignis*) occurs at Tortugas, and I certainly received little or no irritation from it there, as demonstrated by controlled experiments ; it was the *Fibulia* that caused the more severe symptoms.

Genus Liosina Thiele.

In describing the family Desmacidonidae mention was made of genera placed therein, such as *Iotrochota*, which bears great resemblance to the Keratosa. They have fibro-reticulate skeletons rich in spongin, and have fleshy, often conulose surfaces. Mention was also made of the fact that many of the genera of Desmacidonidae possess microscleres, but that the role of the microsclere in deciding taxonomic procedure could be both over-emphasized and under-emphasized.

Sponges of the genus *Liosina* are probably close to *Iotrochota* and other genera now placed in the Desmacidonidae, but specimens of *Liosina* do not have microscleres. They do have the fleshy dermis and body ; they are fibro-reticulate and rich in spongin. They differ from undoubted Keratosa chiefly in that they do possess proper spicules. These spicules are simple oxeas as in the Haliclonidae.

Liosina monticulosa (Verrill) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.24.

Date collected.—July 18, 1947, and others.

Locality.—Harrington Sound, Bermuda.

Abundance.—Not common.

Shape.—Massive, with short processes.

Size.—Specimens occur up to 4 to 8 cm. high, about 4 cm. wide.

Colour.—The living sponge is bright scarlet. In alcohol it fades to a brownish white.

Consistency.—Very spongy, like the keratose species.

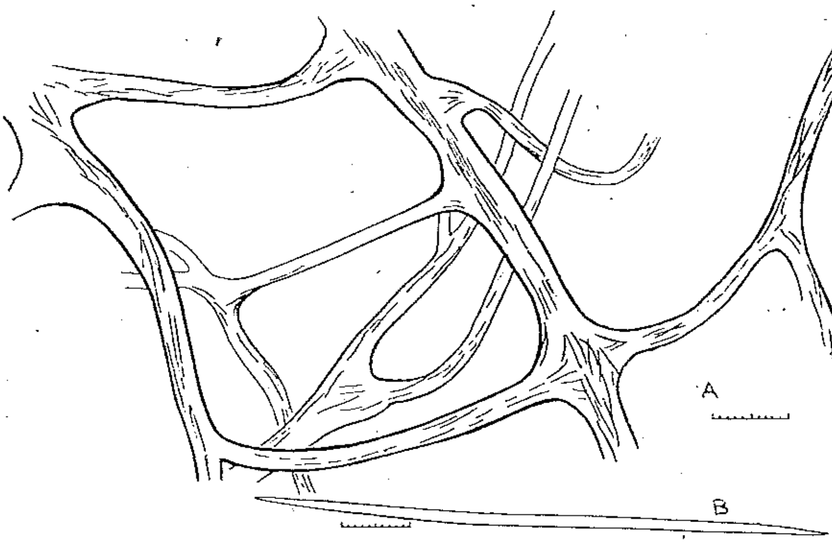
Surface.—Conulose, definitely after the manner of the Keratosa or horny sponges.

Oscules.—These are relatively enormous, and occur at the summits of processes or elevations that are mentioned above. The interior diameter may be as great as 10 mm. in a sponge whose total cross-section is only 20 by 25 mm., height 30 mm. One such specimen not only had the large 1 cm. oscule, but also had three other oscules, each nearly as large.

Pores.—Abundant, astonishingly conspicuous, up to 500 microns in diameter or larger. Few other Bermuda sponges have such ready access to and from the interior.

Ectosome anatomy.—A fleshy dermis, Keratosa style, detachable only with great difficulty, not quite 20 microns thick.

Fig. 24.



Camera lucida drawings of *Liosina monticulosa*, as follows: A: A bit of the skeleton net, ×100, showing the relationship of the coring spicules to the fibres. The appended scale shows 100 microns by tens. B (the lower figures): One of the spicules of *Liosina monticulosa*, ×444. The appended scale shows 20 microns by twos.

Endosome anatomy.—Fleshy, microcavernous, fibro-reticulate. It was regrettably not possible in the summer of 1947 to make out the size and nature of the flagellate chambers. These are not critical to the identification, but it would be interesting to know their type, in view of the resemblance of this sponge to the Keratosa in general.

Skeleton.—The fibres consist of spongin, are 30 to 60 microns in diameter, and are cored with none to ten rows of spicules. The meshes are 130 to 400 microns in diameter, but are of somewhat irregular outline. Rather few of the spicules occur in the flesh, outside the fibres.

The spicules are simple oxeas, 2 by 70 to 4 by 175.

Verrill, 1907, page 292 or 336, described *Pachychalina monticulosa;* he said that it was encrusting to lobate with large oscules, red in life, brown when dry, and that it had oxeas 220 to 260 microns long. The 1947 specimens identified as *monticulosa* have spicules that are shorter than that, but what other Bermuda species could Verrill have had in mind ? It seems a plausible surmise that this scarlet sponge is indeed his *monticulosa*.

Liosina was established by Thiele, 1899, page 16, for the one species *paradoxa*. This name reflects Thiele's astonishment at finding the combination of proper spicules together with the other characteristics of a Keratosa sponge. Similar sponges are rare. Thiele's was East Indian. Burton described one from the Antarctic in 1929 (or 1930 ?), page 425, as *Plumocolumella cribriporosa ;* this was transferred into *Liosina* by de Laubenfels, 1936, page 54. Both of these have spicules that are far larger than those in the Bermuda *Liosina ;* in *paradoxa* they are 20 by 750 microns, in *cribriporosa* they are 12 by 480 microns, but in *monticulosa* they are 3 by 120 microns.

Family CALLYSPONGIIDAE de Laubenfels.

The sponges of this family have an internal skeletal reticulation somewhat like that of those Haliclonidae which are best provided with spongin, but never like those of the Haliclonidae which have little spongin, or which have merely isodictyal reticulation. The type of spongin approaches that of the genus *Spongia* more than is true of most species other than those of the Keratosa, or even those Keratosa which are outside of the family Spongiidae itself. Dried *Callyspongia* fibre is still flexible, elastic, and spongy. In the genera *Dactylia* and *Velinea* of the Callyspongiidae, there are no spicules at all, so that their macerated skeletons would readily be classifiable as belonging to Keratosa sponges. The soft parts of Callyspongiidae, on the other hand, are extremely different from those of the Keratosa ; as in Haliclonidae they are scanty and scattered, not densely packed and flesh-like. The spicules, when present, are also oxeas like those in the Haliclonidae. Callyspongiidae do not have a fleshy dermis, as Keratosa do, but unlike Haliclonidae, they do have a special dermal skeleton, so that in this respect they approach the following order or Poecilosclerina.

Genus CALLYSPONGIA Duchassaing and Michelotti.

This is the typical genus of the family ; it exemplifies to the highest degree the properties of the family. Other genera may be separated from it for their peculiarities, such as their lack of spicules. Especial emphasis needs to be put on the type of surface which is present. In *Callyspongia* there is a dermal reticulation of fibres which outline comparatively large, polygonal meshes, but then—most significantly—within each of these meshes there occurs a finer network of slimmer fibres which outline much smaller meshes.

CALLYSPONGIA VAGINALIS (Lamarck) de Laubenfels. (See Pl. I, fig. 4.)

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.25.

Date collected.—July 28, 1947, and many others.

Locality.—Harrington Sound, and the coasts of the Bermudas in general.

Abundance.—This not only is a very common sponge but its large size and conspicuous shape cause it to seem even more abundant.

Shape.—Branching, with most of the branches hollow. Often the entire sponge consists of a cluster of rather thin-walled tubes. Occasionally a few branches are not hollow, and it is even possible to find specimens entirely solid ; this does not mean solid like a rock—there are usually canals and chambers—but it means not having the immense axial cloaca that the usual *vaginalis* possesses. Non-hollow specimens are more likely to occur in Harrington Sound than out in the open ocean, but even in the Sound the hollow form prevails. In general, calmer waters favour more symmetrical shape, so one would expect to find the tubular habitus even more common in Harrington Sound.

The walls are usually one-seventh as thick as the external diameter of the hollow cylinders. There are often as many as twelve branches per colony, rising from a common base that may be so large (but narrow) that they are parallel, or so small that they radiate from it. It is common for the tubes to coalesce laterally, here and there. If the substrate permits, the lower portions of the colony may grow downwards into crevices, like roots ; actually such projections render the holding or clinging service that roots render. Every conceivable intermediate exists between the specimens with large and abundant root-like structures and those that have short, few, or none such. In 1901, page 47, Whitfield described from Bermuda a sponge as *Siphonochalina stolonifera*, sp. n. ; he emphasized the root-like stolons in his description. His illustration and description show plainly that *stolonifera* is not only a *Callyspongia* but must (here) be dropped in synonymy to *vaginalis*.

The variety in the shapes of the tubes of *vaginalis*, some very short and wide, is illustrated in the photograph which is reproduced in Pl. I, fig. 4.

Size.—Some colonies of this sponge attain a height of a full metre, and an outside cylinder-diameter of 8 cm. Heights of 20 to 40 cm. are common—such usually have an outside cylinder-diameter of about 4 cm.

Colour.—The living healthy sponge is lavender. When it dies, it turns dull drab, or yellowish grey, sometimes it exhibits an olive tint, as an intermediate condition. In the field one finds specimens of which the upper, younger portions are violet, whereas the lower, older portions are drab. It may be that parts of the colony die while others are still vigorously growing. In the field one also finds entire specimens of the drab colour. These may already be dead, or senile, approaching their end. The skeleton is so strong that it endures long after the flesh is gone.

Alcoholic specimens are rather pale grey, and so are some dried specimens, but other dried specimens are dark brown. This may be the result of partial decomposition while drying. The preservative fluid is tinted only pale brownish yellow by this species.

Consistency.—Very spongy, tough and elastic.

Surface.—An occasional specimen is entirely and notably smooth as to surface. The more usual situation is a basically smooth surface raised at scattered points into cone-shaped projections. These have quite a different appearance from the conules which ordinarily occur in the Keratosa. These latter have concave sides, and often represent a single fibre protruding like a tent-pole, with the elastic dermis stretched over it. In *Callyspongia* the structures which are here discussed are as much as twenty or thirty times as thick as one fibre, and are built of a reticulation of fibres ; nor is there any elastic dermis stretched over their exterior. They are far indeed from being homologous with the conules of the Keratosa. The level-surfaced specimens of *Callyspongia* are comparatively rare, but it is the rule to find larger or smaller smooth areas on most colonies. Again, some specimens are so " mountainous " that nearly every square centimeter has its peak. The protrusions range from zero to low, obtuse hills, say 1 mm. high and 10 mm. in diameter, with all intermediates, up to 8 mm. high on a base of only 4 mm. in diameter. The distance between summits varies from 10 mm. on up toward infinity. Some of the protrusions have just such asymmetry that they resemble rose thorns.

Many specimens of *vaginalis*, and some other sponges of the vicinity, are extensively provided with symbiont anemones of the coelenterate genus *Parazoanthus* (see Pl. I, fig. 4). These little anthozoans may be so thickly spaced that they are only 5 mm. apart, centre to centre. More often they are 10 to 15 mm. apart, and from there on up to instances of only a scattered few on the whole sponge. A large fraction of *vaginalis* specimens have no *Parazoanthus*. In preserved specimens these anemones shrink into puzzling-appearing pale grey spherules, less than 1 mm. in diameter, with a hole in the centre. The living, expanded polyp is nearer 2 mm. in diameter. They show on the central tube of the colony of *Callyspongia* that is illustrated in Pl. I, fig. 4.

Oscules.—The openings on the distal ends of the branches are probably homologous with oscules, not certainly so—but such is the opinion here expressed. Their diameter is usually a little less than the inside diameter of the cloaca. The rim is frequently smooth, although a short distance below the summit, on the outside, the top-most circle of projections forms a sort of crown. Doubtless the thorns are made from time to time, and when their time comes at that point in the vertical growth they ornament the rim. As the sponge grows still higher, the rim is unornamented until it arrives at the location for the next batch of spinous elevations.

The lining of the cloaca is comparatively smooth and level. Its walls are abundantly perforated with the openings of the internal vents, perhaps to be regarded as oscules. These are often a little over 1 mm. in diameter, but vary greatly in size.

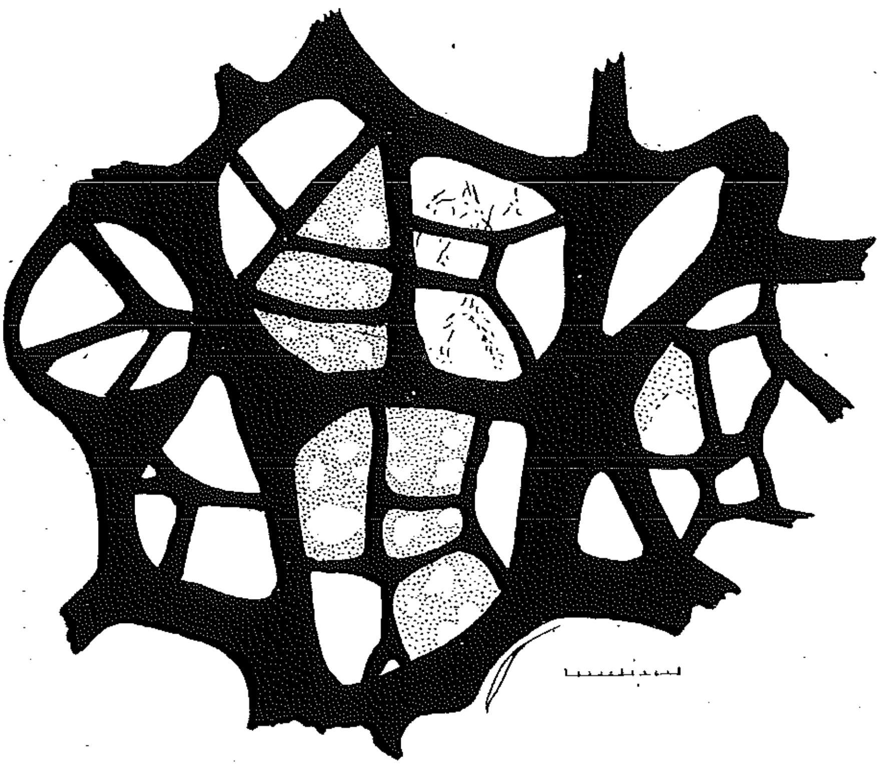
Pores.—The actual flesh-openings vary in preserved specimens from 20 to 100 microns in diameter. Live specimens were not measured to the micron, but are intermediate in size; evidently the larger holes in the dried specimens were somewhat torn, and the smaller ones in the preserved specimens were already somewhat contracted.

Ectosome anatomy.—There is a special dermal skeleton of a double sort. First, there is a gross network of tangentially arranged spongin fibres, 40 to 100 microns in diameter, forming meshes 50 to 200 microns in width of opening; these are polygonal or even rectangular meshes. Each of them is, in turn, filled in by a secondary, finer network of spongin fibres which are only 10 to 20 microns in diameter, with meshes 40 to 100 microns in width of opening. These smallest skeleton meshes are yet again filled in, not by fibres but by a protoplasmic dermis, some 7 microns thick. The apertures through this are the true pores which were discussed above.

Endosome anatomy.—The flagellate chambers and other soft parts are sparsely scattered about, so that the result may be termed " open-work ".

Skeleton.—The internal skeleton comprises fibres that are exclusively of a sort to match the primary or coarser ectosome reticulation, none of the finer net. Here the fibres are crooked, and the mesh outline rambling rather than neatly polygonal. The fibre diameter is 70 to 110 microns. Each fibre is cored with proper spicules, but these are small, and often in but a single file or row the length of the fibre. It is not uncommon to find portions of fibre that are quite devoid of spicules. In other places there may be as many as four spicules per cross-section of fibre.

Fig. 25.



Camera lucida drawing of a portion of the dermal structure of *Callyspongia vaginalis*, ×150. The protoplasmic skin is shown stippled, revealing the pores through it. The enclosed scale shows 100 microns by tens.

The spicules are of but one sort: small oxeas 1 to 2 microns thick, and about 40 to 50 microns long.

In establishing as a museum display a habitat group of Bermuda marine life, among a background of corals and gorgonians at least one sponge is appropriate, and *Callyspongia vaginalis* is that one of all the Porifera which is most suitable. It grows large, not only in Harrington Sound but also in those waters that are contiguous with the open ocean. In this latter habitat no other sponges are nearly so large as *Callyspongia*.

This species was first described as *Spongia vaginalis* by Lamarck, 1814, page 436. I studied his specimens in the Natural History Museum in Paris in 1928; they are quite typical of this abundant West Indian species. The first genus to be erected for it was *Callyspongia* by Duchassaing and Michelotti, 1864, page 56. This referred especially to solid forms. They also set up the genus *Tuba* for hollow sponges of this sort, but this name had been preoccupied, so Vosmaer, 1885, set up the name *Spinosella*. Much of the subsequent literature refers to this species as *Spinosella sororia* (Duchassaing and Michelotti), but my studies of the type specimens, syntype number 28.11.12.3 in the British Museum (Natural History) show that *Callyspongia* is congeneric with and (of course) has priority over *Spinosella*. The genus is cosmopolitan, but *vaginalis* may be confined to the West Indies. It is extremely conspicuous there, so that museum collections of sponges frequently make almost excessive use of *Callyspongia vaginalis*.

CALLYSPONGIA ARCESIOSA de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.26.

Date collected.—July 29, 1947.

Locality.—Near Watford Bridge, western portion of the Bermudas.

Abundance.—Rare.

Shape.—Ramose, with branches which are nearly circular in cross-section.

Size.—Total height about 27 mm. The diameter of most of the branches is about 5 mm., but it exceeds 8 mm. near the base attachment.

Colour.—The living sponge is rich bluish green. In alcohol it bleaches to practically white, but does not greatly discolour the alcohol.

Consistency.—Softly spongy.

Surface.—Superficially smooth.

Oscules.—There are only about three per branch ; these are 1 to 3 mm. in diameter and are not contractile. They open into deep cloacas of the same diameter, and portions of the sponge are rendered quite hollow by these relatively large cloacas.

Pores.—These are represented by the interstices in the dermal network, as described (and figured) below.

Ectosome anatomy.—There is a double dermal reticulation. First there is a network of spongin fibres, containing a very few spicules in an irregular line down the centre of the strand ; these fibres are about 16 microns in diameter, and they outline meshes that are 80 to 160 microns in diameter. Within these meshes lies a second, finer reticulation. It consists of fibres that are merely spicules thinly encased in spongin ; the total resulting diameter is about 4 to 5 microns. No fleshy dermis can readily be made out.

Endosome anatomy.—The soft parts, such as flagellate chambers, are very scanty and scattered. One can scarcely speak of canals as present, rather of open spaces through which currents may readily drift.

Skeleton.—Fibro-reticulate, spongin and spicules. The endosome has only the coarser network, fibres much like those of the surface skeleton. The spicules are oxeas about half a micron in thickness, 40 to 50 microns long.

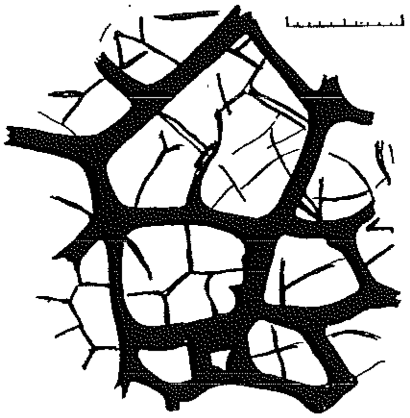
The colour alone (" robin's-egg blue ") is nearly enough to differentiate *arcesiosa* from other *Callyspongias*. The extremely fine-grained miniature structure completes the description. In four summers in the Dry Tortugas region, north of Cuba (where sponges are extremely abundant), only twice did I find specimens of *arcesiosa*. In the whole summer at Bermuda only one was found. Minute specimens of it may be more common than we realize, and only the larger ones receive notice.

This was first described in de Laubenfels, 1936, page 56.

In de Laubenfels, 1936, page 57, the treatment of the family Callyspongiidae requires revision.

First, the genus *Patuloscula* Carter is there still maintained in good standing, but with some question. The question is indeed serious. The range of variation which seemed to separate this group from undoubted *Callyspongia* is found at Bermuda. My studies in the Bermudas convince me completely that *Patuloscula* must be dropped in synonymy to *Callyspongia*. The original separation by Carter

Fig. 26.



Camera lucida drawing, ×150, of a bit of the dermal structures of *Callyspongia arcesiosa*. The enclosed scale shows 100 microns by tens.

was for slight differences in external shape; these have long been known to be unreliable. In my 1936 paper I stress obtusely tuberculate surface, coarser mesh, occasional strongylote megascleres and occasional pseudotoxas as characterizing *Patuloscula*. Typical *Callyspongias* so frequently vary in these directions that they cannot serve as distinctions of generic rank.

On page 58 I discuss *Spongia plicifera* Lamarck and add (referring to it): " It would appear that *Patuloscula procumbens* Carter (1882, page 365), the type of *Patuloscula*, would also fall in synonymy here ". I now believe that such is not at all the case. The sponge which I describe from Tortugas as *Patuloscula plicifera* (Lamarck) is not Lamarck's *plicifera*, but (as I pointed out) is Carter's *procumbens*, and (now add) is a *Callyspongia*, not a *Patuloscula*—since the latter falls to the former. Lamarck's *plicifera* should be maintained as a separate species of *Callyspongia*, for its elaborately plicated surface.

Order *POECILOSCLERINA* Topsent.

Sponges of this order differ from those that have been already considered in that there are two or more kinds of spicules (megascleres) present. They differ from other orders that are yet to be considered in that (with a few curious exceptions) they never have radiate architecture, and neither do they have pronouncedly plumose structure. They are typically reticulate, with one type of megasclere and spicule arrangement at the surface, but with a second kind of megasclere and spicule arrangement of the endosome.

The first family here to be considered, the Adociidae, is placed in the Poecilosclerina with much question. It has a distinct dermal skeleton, but this is made of spicules which are very similar to those in the endosome; perhaps it belongs in the Haplosclerina. The last word on sponge classificaton has not yet been written.

Family ADOCIIDAE de Laubenfels.

Sponges of this family in many ways, especially as to their endosomes, resemble the sponges of the family Desmacidonidae, or even—in some cases—the Haliclonidae. There is this very significant difference however. The Adociidae, unlike the two families mentioned, have a special dermal skeleton, usually comprising tangent spicules. The Callyspongiidae do not have extensive subdermal cavities, thus their dermal layer may not easily be detached. Sponges of the family Adociidae do have extensive subdermal cavities, and in general may be distinguished by the "easily detachable dermis". This is one of the principal reasons for including them in Poecilosclerina, because this dermal trait is common within this order. It is also found in other orders, such as the Halichondrina, but not in the Haplosclerina.

The Adociidae are separated from all other Poecilosclerinas in that they are intermediate between that order and the Haplosclerina, as shown by the similarities between their dermal and endosomal skeletons.

Genus PELLINA Schmidt.

This genus, like *Adocia* (which is the type of the family), does not have microscleres, only a skeleton of oxeas in isodictyal arrangement. It is set off from *Adocia* by its shape; much or all of the sponge is given over to long, thin-walled tubes. This is true even when the sponge grows in such localities that most sponges assume a massive or an encrusting shape.

PELLINA COELA, sp. n. (See Pl. II, fig. 5.)

The syntype, which is a portion of the holotype, is deposited in the British Museum (Natural History), register number 1948.8.6.27. The residue of the holotype is preserved, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—July 8, 1947, and others.

Locality.—Walsingham Pond, Bermuda. There are unconfirmed reports that this species has been seen also in Harrington Sound.

Abundance.—Uncommon, only three certain records, one of them in 1946, the other two in 1947.

Shape.—Hollow tubes with thin walls. These tubes occasionally branch, so that a somewhat dendritic structure results. The form is illustrated by an enlarged photograph, Pl. II, fig. 5.

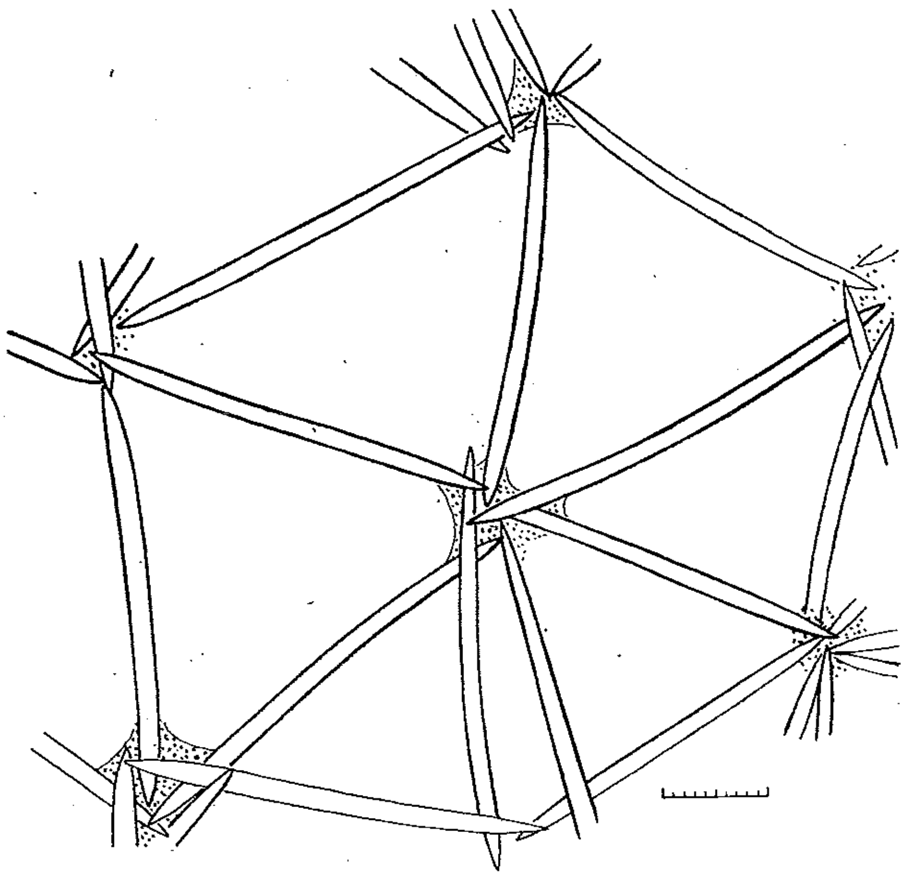
Size.—The whole sponge attains a total height of at least 10 cm. The tubes are 3 to 7 mm. in diameter, with walls less than 1 mm. thick.

Colour.—Nearly white; the faint tinges of lavender that appear here and there may be the real colour of the flesh, and the white appearance is probably a result of light waves being well reflected from the many dermal spicules.

Consistency.—Extremely fragile, but slightly flexible; thus it tears rather than breaks, as brittle objects break.

Surface.—Superficially smooth.

Fig. 27.



Camera lucida drawing, ×725, of a portion of the dermis of *Pellina coela*. Spongin is shown stippled. The enclosed scale shows 20 microns by twos.

Oscules.—All the tubes that are available for study end rather abruptly. These terminations may be accidental breaks, an idea which is suggested by the resemblance of the tubes to the fistules which arise from some sponges, such as *Polymastia*; these fistules are closed except for their myriads of small openings. The direct evidence, however, is that these terminal apertures are the oscules of *Pellina coela*; oscules with the same diameter as that of the cloaca, which is to say, 2 to 5 mm.

Pores.—These are represented only and simply by the polygonal, often triangular, meshes of the dermal reticulation. An approximate size of 50 microns could therefore be mentioned.

Ectosome anatomy.—An even-surfaced, tangential, isodicytal reticulation of spicules which are cemented with spongin at the nodes.

Endosome anatomy.—The cellular structures occur in what might be termed " islands ", often rather completely separated from each other. The flagellate chambers are spherical, 25 microns in diameter.

Skeleton.—The walls of the tubes that make up the body of *Pellina coela* are not as neatly reticulate as is the external, dermal envelope, but they do form a network. It is partly isodictyal, and there are also spicular tracts which form irregular meshes 100 to 400 microns in diameter. These tracts are 10 to 20 microns thick, and consist of spicules which are loosely cemented together by a small amount of spongin, about 4 to 7 spicules per cross-section.

The spicules are of one sort only. These are oxeas about 4 by 90 microns. Some are 3 by 100, but the variation is not great.

This species of *Pellina* has spicules that are far smaller than is true of most others in the genus : thicknesses of 15 to 25 microns are common, whereas the oxeas of *coela* are only 4 microns thick. The other species with comparatively thin spicules, such as *carbonaria* (Lamarck), are black in colour. *Coela* is also given over even more completely to hollow tubes than any other species in the genus.

Genus STRONGYLOPHORA Dendy.

Sponges of this genus, otherwise like *Adocia* in particular and the Adociidae in general, have strongyles as their principal megascleres in lieu of oxeas, and they also do have microscleres. The latter typically include raphides, and usually include sigmas. As is to be further discussed below, the following species is not certainly a *Strongylophora.*

STRONGYLOPHORA AMPHIOXA, sp. n.

The syntype, which is a portion of the holotype, is desposited in the British Museum (Natural History), and is represented by register number 1948.8.6.23. The residue of the holotype is preserved, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—June 30, 1947, and others.

Locality.—Harrington Sound.

Abundance.—Not common, but taken in 1946 as well as in 1947.

Shape.—Massive, rounded.

Size.—Fist-size, or (often) somewhat less.

Colour.—Both living and preserved specimens are dull, pale grey.

Consistency.—Firm, brittle, slightly compressible.

Surface.—Even, almost smooth.

Oscules.—In the type specimen there are two oscules, the larger had a diameter of 5 mm. ; each has a very smooth, sharp rim, flush—that is to say—the edges not at all raised. This was in a specimen 2 by 3 by 4 cm.

Pores.—Abundant, 30 microns in diameter.

Ecotosome anatomy.—There is a tangential dermal reticulation of tracts or fibres which are about 25 microns in diameter, and which contain little or no spongin. They consist of fascicular spicule-groupings, about eight spicules per cross-section. The meshes of this network are about 120 microns in diameter. A network, which is not isodictyal but rather confused, fills in each of these coarser meshes. The finer mesh is built up of strands of overlapping spicules.

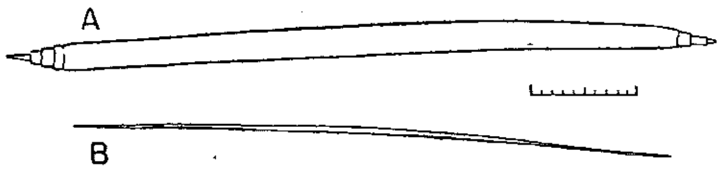
Endosome anatomy.—Microcavernous. It is difficult to decide which of the cavities are the flagellate chambers, because they vary in size so greatly.

Skeleton.—The spicules are arranged chiefly about the cavities or chambers, but otherwise are in considerable confusion. There are some vague ascending tracts, containing only three to five spicules per cross-section. Very few transverse or connective tracts exist—perhaps none. The ascending tracts branch occasionally, so that they are far more numerous immediately below the surface than they are elsewhere; in the outer regions they are only 150 microns apart.

The spicules may possibly be divided into megascleres and microscleres. The larger ones (see fig. 28 A) have such sizes as 6 by 140, 5 by 180 and 4 by 200 microns. The lack of correlation between length and thickness is remarkable. The smaller spicules (see fig. 28 B) are about as long, but are only a fraction of a micron in diameter.

Logically this species does not seem to be a *Strongylophora*. It has no sigmas, and the megascleres are not obviously strongyles. In fact, a good case could be made for the proposition that this is a new genus. In my judgement this is not warranted, and *amphioxa* may be classified as a *Strongylophora*. This opinion is based upon first-hand experience with related species in the West Indian regions.

Fig. 28.



Camera lucida drawing of the spicule types of *amphioxa*, ×666. The enclosed scale shows 20 microns by twos.

In 1934, page 14, I described *Strongylophora rampa* from waters near Puerto Rico, that is to say—in the West Indian region, significantly close to Bermuda. I believe that *amphioxa* is the Bermuda race or representative of *rampa*, but very extensively modified. The species *rampa* was much finer grained, with far smaller spicules, than any of the other species in *Strongylophora*; the species *amphioxa* also has very similar size and appearance of spicules, reticulation, dermal structures, and—in general—has all the other attributes of *rampa*, except that the spicule shape is different.

The megascleres of *amphioxa* come to sharp points at both ends; this is the description of an oxea. Yet closer study shows that the sharp point is not arrived at gradually, but by a series of stair-steps. It is well known that sponge spicules which are normally blunt-ended may step down by such a series of sharp drops, so that they superficially appear to be pointed. It is significant that the main portion of the *amphioxa* megascleres is a cylinder of uniform diameter, not tapering. It is quite possible that these spicules are essentially strongyles.

The smaller spicules of *amphioxa* might be considered to be merely immature or undeveloped megascleres, but my best surmise is that they are genuine raphides.

The species *amphioxa* has not yet been shown to have sigmas, and is this a serious difference, so that it may ultimately prove necessary to erect a new genus to receive it.

Pachypellina Burton (1934, page 18) appears at first as though it should receive *amphioxa*. It is diagnosed as having hastate oxeas (that is to say, oxeas with their central part of uniform diameter, not tapering until very near the ends), otherwise it is much like *Adocia*. The one spcies, however, is an extremely coarse-grained sponge, with spicules (24 by 492 microns) that are many times as large as are those in *amphioxa*, and there is an exceptionally dense dermal layer of spicules. It has been recorded only from the Antarctic region. Kirkpatrick, in 1907, page 290, described it as *Petrosia fistulata*, and this was then transferred to *Pachypellina* by Burton. This should be known as *Pachypellina dancoi*, however, as Burton, 1924, page 420, shows that it is conspecific with *Reniera dancoi* Topsent, 1901, page 1, also from the Antarctic.

Family COELOSPHAERIDAE Hentschel.

The sponges of this family have diactinal principal spicules, as did the other families of spiculiferous sponges which have already been discussed. Microscleres are often also present, even quite elaborate microscleres and combinations of microscleres, somewhat as in the ensuing order. The distinctive feature of the Coelosphaeridae is their structure. Each has a thick, tough, fibrous cortex that surrounds a central area that may contain nothing at all (except water) or may contain a flimsy endosome, as openwork and diaphanous as the cortex is dense and strong.

Genus Rhizochalina Schmidt.

This genus is set off from the others of its family by the negative circumstance that it does not possess any microscleres at all. Topsent has described three species for it from the Azores, Schmidt described two species for it from the West Indies, and Carter also added one, to be mentioned below. All are very closely related to one another.

Rhizochalina hondurasensis Carter (de Laubenfels).

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.28.

Date collected.—July 14, 1947.

Locality.—Harrington Sound, Bermuda.

Abundance.—One specimen.

Shape.—The specimen is actually flattened, but there is evidence that it once was sub-spherical. There is a large, central hollow, now collapsed.

Size.—The specimen measures 4 by 20 by 28 mm. The walls of the cortex are about 1 mm. thick.

Colour.—The living sponge was pale yellow, and it is nearly the same shade after preservation ; the alcohol also is tinted yellowish by the sponge.

Consistency.—Spongy, but rather easily torn.

Surface.—Smooth.

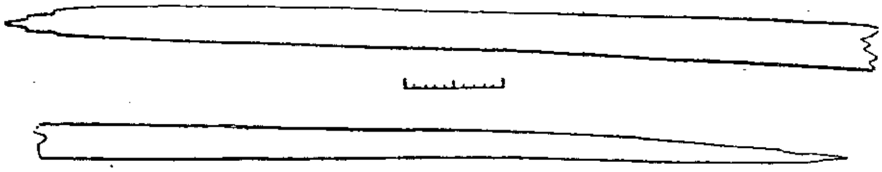
Oscules.—As is often true of the family Coelosphaeridae, no obvious vents can be found. The natural assumption is that some of the very small openings are exhalent as well as those that are inhalent.

Pores.—The surface is abundantly provided with openings from 50 to 150 microns in diameter. No morphological features were found to indicate which were exhalent and which were inhalent.

Ectosome anatomy.—A dermal region, 300 to (more often) 700 microns thick, is densely packed with spicules in confusion, and their interstices are also packed with organic substances, flesh and perhaps spongin.

Endosome anatomy.—A layer of pulp, 300 to (more often) 700 microns thick, lies between the rind and the central hollow. It is microcavernous, and is much like commonplace sponge endosome, except that it has rather more cavity and less flesh than usual.

Fig. 29.



Camera lucida drawing, ×666, of two different spicules of *Rhizochalina hondurasensis.* Only one end of each spicule is shown. One exhibits the step-down ending, the other the unbroken taper. The enclosed scale shows 20 microns by twos.

Skeleton.—The spicules are packed in the cortex in confusion, and scattered in the pulp—also in confusion except that they do not invade the cavities, but rather tend to outline them. There are also a few tracts, about 20 microns in diameter, chiefly rising toward the surface of the sponge, about 100 to 200 microns apart. They consist of spicules loosely held together, perhaps by spongin.

The spicules are oxeas. To be sure, they have sometimes a series of descending steps at one end, such as was described for *Strongylophora amphioxa ;* but the final segment of these spicules in *Rhizochalina hondurasensis* is an acutely pointed cone, and the cylindrical walls of the spicules taper before the steps, the while forming the steps. The oxeas of *hondurasensis* vary greatly in size ; a common size is 6 by 330 microns ; some reach 7 by 400 microns, others are much smaller.

Carter, 1882, page 122, described *Phloeodictyon hondurasensis* from the west portion of the Gulf of Mexico. His description nicely fits this Bermuda specimen. *Phloeodictyon* was transferred into synonymy with the earlier *Rhizochalina* by de Laubenfels, 1936, page 72.

Family CYAMONIDAE de Laubenfels.

Sponges of this family are sharply characterized by their possession of acanthose tetraxon or triaxon spicules. A few decades ago many students of sponges, particularly Dendy, made great use of a term " Tetraxonida ", often regarded as an order, characterized by possessing such spicules, and now divided into the orders Choristida and Carnosa, with a strong realization that the sponges of the order Epipolasida, which have no tetraxons at all, are nevertheless closely related. Meanwhile there has long been a tacit agreement that *Cyamon* and related genera (which do have tetraxons) are quite far, indeed, from being related to Choristida and Carnosa. The fact that there are spiny spicules in the Cyamonidae probably really does prove this point, because the orthodox old "Tetraxonida" never had the acanthose modification—except on their smaller spicules, the streptasters. The Cyamonidae constitute a well-marked family, but one might dispute a little as to which order should become its recipient.

Genus Cyamon Gray.

The sponges of this genus have the spiny polyactinal spicules of the family, but with them have some smooth monactinal spicules, especially styles. Other genera of the family do not have these megascleres. It may be observed that the systematists who used an order called "Tetractinellida" usually also employed another called "Monactinellida". Occasional monactinal spicules, such as styles, occur in the Choristida, and the Choristida are thoroughly typical of Tetractinellida, but this occurrence of styles in choristids has always been excused (almost certainly with complete accuracy) as being merely accidental. The occurrence of styles with tetraxons in *Cyamon* is, however, no accident, and has led to inclusion in the Monactinellida.

Cyamon vickersi (Bowerbank) Gray.

Bermuda occurrence of this species is, at the moment, represented only by a microscope slide in the author's possession.

Date collected.—July 16, 1947.

Locality.—Castle Harbour, Bermuda, north of the west end of the causeway.

Abundance.—Very rare.

Shape.—This species is usually amorphous.

Size.—This species is usually very small.

Colour.—Elsewhere this species is reported as being bright orange.

Consistency.—Elsewhere this species is described as being hard, scarcely elastic at all.

Surface.—Elsewhere this species is said to have a microtuberculate, slightly hispid surface.

Oscules.—Specimens of *Cyamon* seem consistently to be lipostomous, perhaps because of their small size.

Pores.—Microscopic and contractile.

Ectosome anatomy.—No special dermal structures have been reported, but their existence is conceivable.

Endosome anatomy.—Dense, much given over to skeleton.

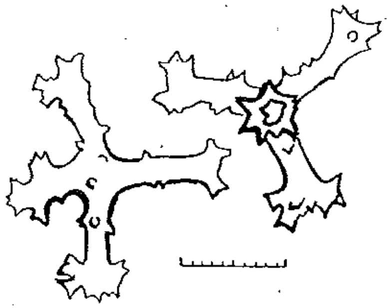
Skeleton.—A tightly packed mass of interlacing, spiny, tetraxon spicules, through which a few styles protrude, points towards, or even protruding from, the surface.

Bowerbank, in 1864, page 234, described a little sponge from the West Indies as *Dictyocylindrus vickersi*. It was not only small, but so preserved that colour and some other traits could not be made out, but its spiculation was both distinctive and remarkable.

In 1867, page 546, Gray erected for *vickersi* the new genus *Cyamon.* Other species of this genus have since been found in the Far East. In 1932 I found another specimen in the West Indies, north of Cuba, of what was obviously *vickersi* again, and this time was able to add data as to colour in life. This, too was a very small sponge. Members of the Cyamonidae seem seldom or never to attain a large size, are consistently as small or smaller than peas, or grains of corn.

On the 16th of July, 1947, in the Bermudas, I collected a specimen of *Dysidea fragilis,* already described in this paper. It contained, as is characteristic of that species, a number of obviously foreign spicules. Among them were two of the very distinctive acanthostrongylote tetractinellid megascleres of *Cyamon*

Fig. 30.



Camera lucida drawing, ×666, of the spicules of *Cyamon vickersi.* The enclosed scale shows 20 microns by twos.

vickersi, familiar to me from my study of the species in 1932. This is excellent evidence that the species occurs in the Bermudas. The other conceivable alternative is that some, as yet undescribed but related, species so occurs. It may be that when better specimens are found, a new name will prove to be necessary, but on the basis of present evidence this is not warranted.

More specimens of *Cyamon* should be sought. They are to be expected on the underside of heavy stones, or deep in cracks. They will probably be tiny, yellow or orange flecks of hard material, easily overlooked as well as difficult of access. Their rarity in collections seems rather from hiding and smallness than from actual absence—they must be present if *Dysidea* can obtain their spicules.

Family TEDANIIDAE Ridley and Dendy.

The sponges of this family have a special dermal skeleton which is built up of diactinal megascleres, whereas the skeleton of the interior is built of monactinal spicules. This description also applies to the family Myxillidae, which is an even larger family. Topsent, in 1928, regarded the two as so close that he put the Tedaniidae as merely a subfamily of the Myxillidae. A principal item of difference is that few or none of the megascleres of tedaniid sponges are spiny. This can be a very minor point. It acquires great significance only in connection with the identification of a third type of spicule, the first being principal, the second being dermal, and the last being echinating. The Tedaniidae clearly lack echinating spicules. The Myxillidae not only have acanthostyles ; these are either obviously echinating in placement, or—in *Myxilla* itself, where the megasclere crowding makes it difficult to recognize echinating placement—they morphologically resemble echinating spicules. In fact, a conceivable interpretation is that the majority of the endosomal spicules of *Myxilla* are echinating, and the difficulty in finding echinators is merely that of the traveller who could not see the forest because there were so many trees in the way.

Thus a suitable diagnosis of Tedaniidae would be: diactinal dermal, and monactinal main spicules, as in Myxillidae, but without echinating spicules.

Genus TEDANIA Gray.

The sponges of this genus are quite typical of the family as above described. The dermal spicules are tylotes, the endospicules are smooth styles. The genus is set off from others with the family especially by its complement of microscleres. These include microspined raphides and no others.

TEDANIA IGNIS (Duchassaing and Michelotti) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.29.

Date collected.—July 28, 1947, and many others.

Locality.—Harrington Sound, Walsingham Pond and the Bermuda coasts in general.

Abundance.—This species is extremely common.

Shape.—Encrusting to massive, often with elevated vents.

Size.—Head-sized specimens are common, fist-sized specimens even more so.

Colour.—Bright, flaming red. This, coupled with the fact that many people acquire a dermal inflammation of chemical origin as a result of handling *ignis*, results in a widespread local or colloquial name for this as as the " fire sponge ". It seems evident that 83 years ago, when Duchassaing and Michelotti named this species, the same colloquial term must have been current. The scientific name is, in this case, very appropriate.

The colour of *ignis* fades slowly in alcohol, finally, after weeks or months, practically to white. The alcohol becomes pinkish orange. The dry sponge is dirty white.

Consistency.—Soft, compressible, extremely easily torn. Newly collected specimens will fall apart if held at only one side.

Surface.—Smooth.

Oscules.—Often over 1 cm. in diameter. In the living sponge one may easily peer down into the shaded, dark interior of the sponge, through the oscular aperture, and see there three or four tributary canals opening into the oscular cloaca, as round, black holes. The oscule itself often has a raised collar, as tall or even slightly taller than the diameter of the oscule. These are not narrow walls, but conical elevations like volcanoes with huge craters.

Pores.—Abundant, 20 to 50 microns in diameter, or (often) completely closed.

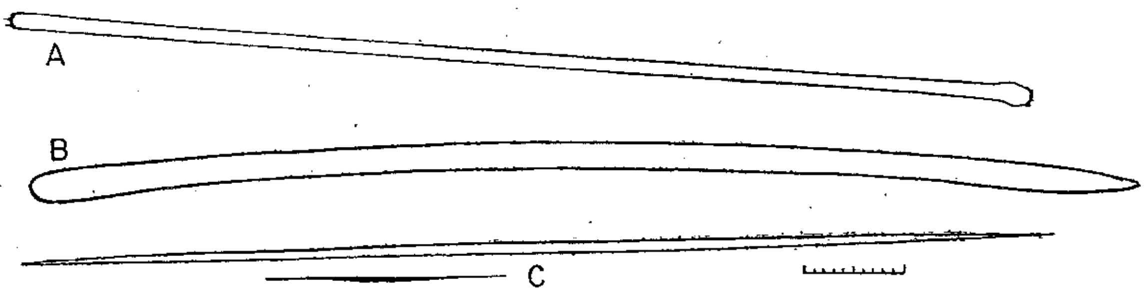
Ectosome anatomy.—There is a fleshy dermis, about 70 microns thick, but not easily measured or easily detached, because it blends into the tissue of the sponge's interior without a sharp separation. Within this ectosome the protoplasmic structures are dense and solid; there are exceedingly numerous cells of the sort with brightly coloured granules, and there are abundant tylote spicules. The latter are nearly all tangentially placed, but otherwise in confusion. In places even the horizontal-vertical pattern is also confused.

Endosome anatomy.—Cavernous, somewhat like bread. The flagellate chambers, which are located in the septa or walls about the gross cavities, are spherical and about 40 microns in diameter.

A specimen collected on the 8th of August, 1947, was peppered all through the interior with vivid, red, sub-spherical embryos, each about 500 microns in diameter.

Skeleton.—The dermal spicules are straight tylotes, ends only very slightly enlarged and the extreme tips very slightly microspined, see fig. 31 A. Their sizes range from 3 by 200 to 5 by 170 microns. The endosomal styles are smooth and often slightly curved, see fig. 31 B. Their sizes range from 5 by 170 to 6 by 210 microns. They are usually arranged in confusion, except as they may outline cavities. They do not as a rule protrude into canals. The microscleres are extremely abundant raphides, so faintly microspined that one might debate their smoothness. See fig. 31 C. They reach a size of at least 1·5 by 200 microns, but may be found in all sizes from that down to practical invisibility.

Fig. 31.



Camera lucida drawing, ×666, of the spicules of *Tedania ignis*. A: Dermal tylote; B: Endosomal style; C: Raphides (microscleres) of large and small size, as found. Intermediate sizes of raphides are even more abundant. The enclosed scale shows 20 microns by twos.

This species was described as *Thalysias ignis* by Duchassaing and Michelotti in 1864, page 83, from the Caribbean region. It is a superabundant species throughout the West Indies. Closely related sponges are common over much of the marine environment of the world.

Schmidt, 1862, page 74, described *Reniera nigrescens* from the Mediterranean, and this was made the type of the then new genus of *Tedania* by Gray, 1867, page 520. The spicules of *nigrescens* and *ignis* are very similar, and Burton and Rao, 1932, page 353, argue that the two are conspecific. The old-world *Tedania* of this sort, as implied in its name, is usually black or dark green. Burton holds that colour differences are trivial, pointing out that some old-world specimens are more or less reddish too. Certainly colour does vary, especially depending upon the amount of illumination which exists at the point of growth. Other great colour changes occur with pathological or senescent conditions. Yet one can allow for such factors; within comparable situations as to ecology and physiology, colour acquires significance. I believe that the differences between *Tedania nigrescens* and *Tedania ignis* are great enough to warrant retaining the distinctive, descriptive name of the West Indian species.

Names are convenient handles for human use. One could argue that lions and tigers are conspecific, because they certainly interbreed successfully. By some dictionary definitions that proves they are all the same species. Nevertheless it is well to call a lion *Felis leo* and a tiger *Felis tigris* for convenience in talking or writing about the two. *Tedania ignis* similarly requires its name.

TEDANIA TORA, sp. n.

The syntype, which is a portion of the holotype, is deposited in the British Museum (Natural History) register number 1948.8.6.30. The holotype is preserved, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—July 8, 1947, also August 8, 1947, and once in 1946 by Dr. Bergmann.

Abundance.—Three specimens known.

Shape.—Encrusting, occasionally with projecting lobes.

Size.—4 to 7 mm. thick. The protrusions may be 3 to 5 mm. in diameter, and as much as 20 to 25 mm. long.

Colour.—Orange-red.

Consistency.—Softly spongy, fragile, very easily torn.

Surface.—Smooth.

Oscules.—Small, contractile.

Ectosome anatomy.—There is a thin protoplasmic dermis about 10 microns thick. It contains special dermal tylote spicules, horizontally arranged.

Endosome anatomy.—Cavernous, somewhat bread-like, much as in *Tedania ignis*.

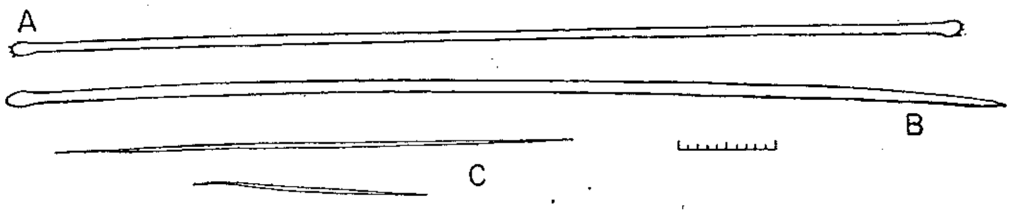
Skeleton.—The dermal spicules are tylotes with microspined terminations. See fig. 32 A. They are usually 2 by 180, but may reach 3 by 180 microns. The endosomal or principal spicules are not styles, but tylostyles ; see fig. 32 B. They are usually 3 by 180 microns, but may be as large as 4 by 200 microns. The microscleres are abundant raphides ; see fig. 32 C. They are usually 0·5 to 1 micron thick, and 120 to 140 microns long, and they are extremely common throughout the flesh. The spicules of the interior are very confused in arrangement, but are, in general, tangential to the surface of the gross internal cavities.

Each of the three specimens here termed *Tedania tora* was found in a locality where specimens of *Tedania ignis* were superabundant. I had had severe finger irritation from sponge contacts, and therefore made quite a study of the appearance of *ignis*, juvenile and mature, in order to avoid accidental contact with it. It is therefore significant that each of the specimens here named *tora* was confidently identified in the field as NOT being *Tedania* at all. It is admittedly difficult to put on paper some sponge differences that are, none the less, quite real. This situation causes a great deal of discouragement to anyone who is anxious to explain Porifera.

Yet there are several things that can be said about *tora*. Its colour is more yellowish that that of *ignis*. It has a lobular appearance quite unlike the volcano-covered cones and cavities of *ignis*. Its spicules are definitely smaller. Probably the one most significant difference of all is that the endosomal megascleres are tylostyles rather than simple styles.

Of all the many species named ascribed to *Tedania*, only two apply to sponges with tylostyles rather than styles for endodermal spicules. Both of these are species (or are they variants of the same species ?) that I described from California, briefly in 1930, more at length in 1932, page 85. In *Tedania toxicalis* these tylostyles are 2 by 100, to 7 by 200 microns, and the sponge was rich brownish red in life. In *Tedania topsenti* they are 11 by 250 microns, and the sponge was bright orange in life. These certainly seem emphatically different from each other, and from *Tedania tora*.

Fig. 32.



Camera lucida drawing, ×666, of the spicules of *Tedania tora*. The enclosed scale shows 20 microns by twos.

Another possibility must be kept in mind. We may grant that *tora* is distinctly different from the abundant *Tedanias* that surround it, but argue that it represents some pathological modification, like finding a few hunchbacks among a crowd of people, all the others being normal as to spine. This possibility cannot be denied, and should not be forgotten. Perhaps at some future time suitable additional data will be discovered. In the meantime, a handle or designation is useful, whereby the small-spiculed, tylostylote variety may be discriminated.

Most scientific names (properly) come from the Greek, but this is an exception ; *tora* is modified from the Latin *torus*, a small, rounded protrusion.

Genus Lissodendoryx Topsent.

Sponges of this genus have megascleres much like the megascleres of *Tedania*, except that once in a while some of the endosomal styles have a few spines on them. The significant difference concerns the microscleres and the structure. The latter is distinctly more reticulate than that of *Tedania*, and is sub-isodictyal, with many spicules per side of the polygonal meshes. The microscleres include arcuate isochelas and (usually) sigmas. Stress is laid on the fact that the chelas must be arcuate.

Lissodendoryx isodictyalis (Carter) Topsent.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.31.

Date collected.—July 12, 1947, and many others.

Locality.—Harrington Sound, Walsingham Pond, Hungry Bay, and the coasts of the Bermudas in general.

Abundance.—Very common, but rather inconspicuous.

Shape.—Amorphous to massive. This species in Bermuda, as elsewhere, regularly occurs in a great tangled mix-up of biological miscellany, interlaced with algae, ascidians, coelenterates, and whatever life is in the vicinity. The *Lissodendoryx* may be pierced by these others, but more often it inserts itself into crannies between and among them. While the sponge clearly prospers, it does not effectively eliminate the other living forms, and thus it may be described as one that " lives and lets live ". This is true of *Lissodendoryx* in general, in other localities, too. In fact, in the Bermudas it is possible to obtain larger specimens of just *Lissodendoryx* and not much else, than can be obtained elsewhere.

It is common to find a double-handful size mass of *Lissodendoryx* but upon close examination to discover that more than half the volume or weight consists of other things than the sponge, although the latter is continuous from side to side in all directions.

As is also true in other localities, Atlantic and Pacific, sponges of the genus *Lissodendoryx* in life have a strong odour of the sort termed " sulphurous ". This is very similar to the odour of sponges of the genus *Ircinia*, although the two genera are rather far apart in systematic position. A surmise is here made that the two have similar food habits.

Size.—Masses 10 cm. thick are common, and they spread laterally indefinitely.

Colour.—The basic colour seems to be a sort of ochre or brownish yellow, almost orange. The interior usually has this colour, and the exterior sometimes does so, too. Most specimens of *Lissodendoryx*, however, appear blue, blue-green, or clear green, probably due to microscopic symbionts which reside in the ecotosome.

Consistency.—Fragile, easily torn, but somewhat spongy.

Surface.—Undulating, with low, irregular lumps, occasionally there are patches of several square centimetres that are nearly smooth.

Oscules.—1 to 6 mm. in diameter, rather uncommon. There must be numerous additional, very small, readily closeable vents that are overlooked. The obvious oscules are closed, as in many sponges, not by squeezing together the cloacal walls but by a thin, protoplasmic membrane which pulls inward from all sides.

Pores.—Abundant, contractile ; certainly they can be opened to 30 microns in diameter, perhaps to 50.

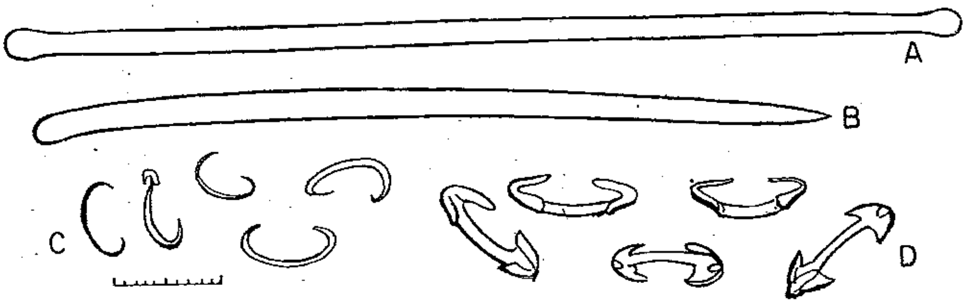
Ectosome anatomy.—A definite but thin dermis or protoplasmic membrane is present. It is rather conspicuous where it forms a roof of ceiling over the sub-dermal cavities. These reach a diameter greater than 1 mm., and meander about like maps of river systems.

Endosome anatomy.—Cavernous, bread-like.

Skeleton.—There are special ectosomal spicules. These are smooth tylotes (see fig. 33 A), 2 by 180 to 4 by 180 microns. They are usually placed within the thin dermis, and hence are tangent to the surface. The endosomal megascleres are smooth styles (see fig. 33 B), 3 by 150 to 5 by 150 microns. The solid masses of tissue (ground substance and cells) which surround the minute cavities of this sponge are filled with these styles in sub-isodictyal reticulation. Often clusters or rows of such spicules outline rooms, " log-cabin " style. For microscleres there are numerous sigmas (see fig. 33 C), 12 to 20, but oftenest 17 microns in chord measurement. There are even more numerous arcuate isochelas (see fig. 33 D) about 22 microns long.

This species is abundant throughout the entire West Indian region, and on the Atlantic Coast of North America up to North Carolina (Beaufort). It was first described by Carter, 1882, page 285, as *Halichondria isodictyalis*. In 1889, page 49, Topsent described it, also from the West Indies, as *Tedania leptoderma*, and in 1894

Fig. 33.



Camera lucida drawing, ×666, of the spicules of *Lissodendoryx isodictyalis*. The enclosed scale shows 20 microns by twos.

Topsent made this the type of his genus *Lissodendoryx*. Finally, in 1925, Topsent noticed the similarity, and brought the two species appropriately into synonymy. H. V. Wilson recorded this from North Carolina as *Lissodendoryx carolinensis*, but de Laubenfels, 1947, page 35, points out the synonymy. In my various summers in and about the Dry Tortugas, I found this a regular and locally abundant West Indian species.

Family PSAMMASCIDAE de Laubenfels.

This family comprises sponges that borrow their skeletons quite extensively. Most of them are filled with great masses of sand, of whatever chemical sort happens to occur in the vicinity, but fragments of foreign spicules, bits of skeleton of animals other than Porifera, and even plant material may be borrowed. Vestiges of the sponge's proper skeleton also remain, in the form of proper spicules.

While it is true that such a situation may be arrived at independently by species not otherwise closely related, it is by no means certain that the family is polyphyletic. A number of indications of genetic relationship exist—the rather slimy ectosome, and abundance of sigmoid microscleres for example.

Genus Xytopsues de Laubenfels.

Sponges of this genus are regularly loaded with foreign material—often sand, but—as in the Bermuda specimens—they may contain other extraneous substances. There are thin, small but proper diactinal (strongylote) megascleres, sigmas and arcuate isochelas for microscleres.

Xytopsues griseus (Schmidt) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.22.

Date collected.—July 28, 1947, and many others.

Locality.—Harrington Sound, Bermuda.

Abundance.—Moderately common.

Shape.—Amorphous massive, rounded.

Size.—Fist-size specimens are common, some reach almost the size of a human head.

Colour.—Field notes term this species " polychrome ". At a slight distance it appears brown, but closer examination reveals that it is vaguely mottled, blended, with—as it were, a little bit of everything, all mixed up. One finds hints of dull pink and dull green, of dull lavender and very dull yellow, all simultaneously present here and there. None of these tints are definite, clear-cut colours, but merely appearances. The sponge fades to pale drab in alcohol, but colours the fluid green, probably due to chlorophyll.

Consistency.—Slimy, softly spongy, easily torn. The slime is an abundant colloidal extrusion, not merely the tactile sensation imparted by a smooth slippery surface.

Surface.—Compound tuberculate. It is covered with coarse lumps, about the size of peas, which are in turn finely lumpy. Sub-dermal canals that are more than 1 mm. in diameter meander about conspicuously on the surface, and over each is a smooth, thin, translucent skin or membrane.

Oscules.—About 1 mm. in diameter, but very changeable in life. They are openings through the above-mentioned dermal membrane, over the surface canals, and they are readily closed or opened.

Pores.—Microscopic, contractile.

Ectosome anatomy.—There is a definite dermis, especially conspicuous over the surface canals, but it does not contain any special dermal skeleton. It is about 10 microns thick, and does contain a few spicules. Because of its thinness these spicules are chiefly in the tangential position.

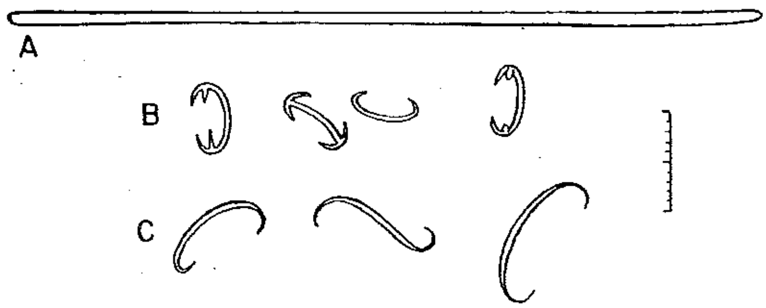
Endosome anatomy.—Some specimens of this sort are especially full of symbiont vegetables as compared to other sponges, common as this trait is among Porifera. The inclusions of *griseus* as found in Bermuda are especially coarse, easily noticed vegetables. The specimen now being considered is more than half algae, less than half sponge by volume or by weight ; this is a conservative statement—three-fourths vegetable may be nearer to final accuracy. The principal plant seems to be the same one which has been already described as being so abundantly present in *Dysidea fragilis*, and is probably of the genus *Jania*. There are long algal strands, green, 65 microns thick, divided into nodes that are a little less than 300 microns apart, hence about four times as long as thick. The strands are longitudinously striated, and they often branch at the nodes. The gross outline of the mass is that of the sponge, however. The whole symbiosis occurs inside the sponge's skin, served by the sponge's pores and oscules, its canals and chambers. A typical Desmacidonid skeleton permeates the interstices between the algal filaments, or perhaps one should put it the other way.

Skeleton.—The megascleres (fig. 34 A) are straight, smooth strongyles, 1 to 3 microns in diameter, oftenest 2·5 microns. Their length varies from 150 to 180 microns. There are also abundant microscleres : isochelas (fig. 34 B), 16 to 18 microns long, that are certainly to be termed unguiferate. In general, unguiferate chelas are anchorate rather than arcuate, and arcuate chelas are seldom unguiferate. Yet these chelas of *griseus* are probably best classified as arcuate. The general usage during recent years tends to reserve the word anchorate for chelas that have (at each end) four obvious tines, 90° from each other; that is to say—there is a recognizable clad or tine parallel to the shaft. Clear-cut arcuate chelas show only three clads or tines at each end. By this criterion these microscleres, as they occur in *griseus*, are arcuate.

There are also present in *griseus* numerous sigmas (fig. 34 C) which are 20 to 30 microns in chord length.

There is a discussion of *Phoriospongia osburnensis* in de Laubenfels, 1947, page 35. This name was erected by George and Wilson, 1919, page 154, and in the location cited it is referred in synonymy to that which was first described as *Desmacidon australis* by Dendy, 1896, page 19. Study of the species *griseus* at Bermuda and

Fig. 34.



Camera lucida drawing, ×666, of the spicules of *Xytopsues griseus*. The enclosed scale shows 20 microns by twos.

further review of the literature now convince me that this synonymization was not correct—although related, the species mentioned are probably distinct. Instead *osburnensis* should be dropped in synonymy to this West Indian species, which was first described by Schmidt, 1870, page 55, as *Desmacidon griseum*. The species *osburnensis* was made the type of the genus *Xytopsues*, thus this genotype should now be known as *Xytopsues griseus*; but its location in the family Desmacidonidae is not suitable; it should be transferred to the family Psammascidae.

Schmidt, 1870, page 55, set up a name *Desmacidon dianae* for a West Indian sponge. He gave it only a few words of description, and it is essentially unrecognizable. I propose to leave it, pro tem, as a synonym of *Xytopsues griseus* (named on the same page), because any other allocation is open to even greater question, and because my best opinion is that Schmidt's specimens (so named) were actually conspecific. Schmidt seemed to consider the chief difference to be the occurrence in *dianae* of peculiar lumpy toxiform spicules. It is my surmise that these were not proper to the sponge, but were inclusions, perhaps not even poriferan in origin, but from animals of some other phylum.

Mention was made by de Laubenfels, 1947, page 35, of the sponge that was first described as *Desmacidon australis* by Dendy. This was made the type of the genus *Burtonispongia* by de Laubenfels, 1936, page 52. The following species were there referred to this new genus, but a further study of them now indicates that there should be the revised allocations which are indicated at the right of the list.

Desmacidon australis Dendy, 1896, page 19. Type of *Burtonispongia.*

Desmacidon tunicata Schmidt, 1870, page 55. Hereby transferred to *Coelosphaera.*

Desmacidon dianae Schmidt, 1870, page 55. Here transferred to *Xytopsues.*

Desmacidon griseum Schmidt, 1870, page 55. Here transferred to *Xytopsues.*

Desmacidon peltatus Topsent, 1904, page 204. Here transferred to *Naauna.*

Desmacidon platei Thiele, 1905, page 436. Here transferred to *Naauna.*

Fibularia raphidifera Topsent, 1889, page 16. Here transferred to *Fibulia.*

Halichondria cylindracea Bowerbank, 1882, page 96. Here transferred to *Anomomyxilla.*

Halichondria stelliderma Carter, 1886, page 451. Transferred to *Strongylacidon*, per Burton, 1934, page 554.

Dysidea chaliniformis Carter, 1885, page 217, to *Psammodoryx*, per Burton, 1934, page 554.

Thus the genus *Burtonispongia* now remains monospecific, characterized by spiculation of strongyles, sigmas and anchorate isochelas, with much foreign material added. Because anchorate and arcuate chelas blend, those of *griseum*—for example—have the unguiferate modification which suggests anchorate, therefore further study of Australian material may show that *Burtonispongia australis* could be said to have arcuate instead of anchorate chelas. In this case the genus *Burtonispongia* might have to fall in synonymy to *Xytopsues.*

NAAUNA, gen. nov.

This genus does not occur in Bermuda.

Mention was made above of two species which were first described in the genus *Desmacidon*, that is to say, *peltatus* Topsent, 1904, page 204, and *platei* Thiele, 1905, page 436. They appear to be congeneric with each other, but not suitable for placement in any genus that is already established. The new genus *Naauna* is therefore here established to receive them, and the type is designated as the species *peltatus* of Topsent. This genus belongs in the family Desmacidonidae, and is characterized by the possession of strongylote megascleres and microscleres which are isochelas of the palmate type, although in both species they verge toward the arcuate form. The type species also has raphides, but *platei* does not, and the generic diagnosis should not require this latter spicule sort. The name *Naauna* is an arbitrary arrangement of letters, not having any significance that is known to the author.

Family MICROCIONIDAE Hentschel.

The sponges of this family have monactinal megascleres of the endosome, as do the members of the Tedaniidae, and they likewise have special dermal spicules, but these are monactinal in the Microcionidae. The architecture is reticulate in both families, but it is more likely to exhibit tracts or even fibres in the species of the Microcionidae, and the latter also have obviously echinating spicules protruding from their fibres, as the Tedaniidae do not.

Genus Eurypon Gray.

Sponges of this genus are encrusting, in such a way that it is conceivable that this is a permanent habitus, not merely a juvenile form or environmental response. In lieu of ascending fibres or tracts, in *Eurypon* large solitary spicules stand erect upon the substrate, and the sponge seems never to become a crust any thicker than these spicules are tall. These spicules take the place of ascending tracts, and they are echinated by acanthostyles as fibres often are echinated. There are, in addition, special dermal monaxons in *Eurypon*.

Most of the genera of the Microcionidae possess microscleres ; *Eurypon* is remarkable in that it does not. This also is true of *Acantheurypon*, whose spiculation is much like that of *Eurypon*, but the architecture is different. In *Acantheurypon*, instead of the long, solitary spicules, there are ascending tracts, echinated in the usual way. *Acantheurypon* is seldom (or briefly) encrusting, and shows a decided tendency to grow up to be tall, even ramose in shape.

The genus *Bethia* has no microscleres, but has radiate structure, so that its placement in the family Microcionidae is open to grave question. The genus *Paracliona* inhabits *Cliona* burrows, hence has peculiar structure, and also is of dubious family placement. All the other genera of Microcionidae have distinctive microscleres.

Eurypon clavata (Bowerbank) Gray.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.32.

Date collected.—June 30, 1947.

Locality.—Harrington Sound, Bermuda.

Abundance.—One specimen. Doubtless careful investigation of many thin (therefore nearly invisible) encrustations would yield more specimens of this sort, and probably would yield additional similar species for the Bermuda fauna.

Shape.—A very thin encrustation.

Size.—Less than 1 mm. thick. The patch found in 1947 was about as large as a shilling.

Colour.—In life it was orange. In spirit it has become a pale drab.

Consistency.—Softly fragile.

Surface.—Hispid, due to the erect spicules which were discussed in the generic description.

Oscules.—Microscopic and contractile. It is typical of these thin encrusting forms that the oscules cannot be found.

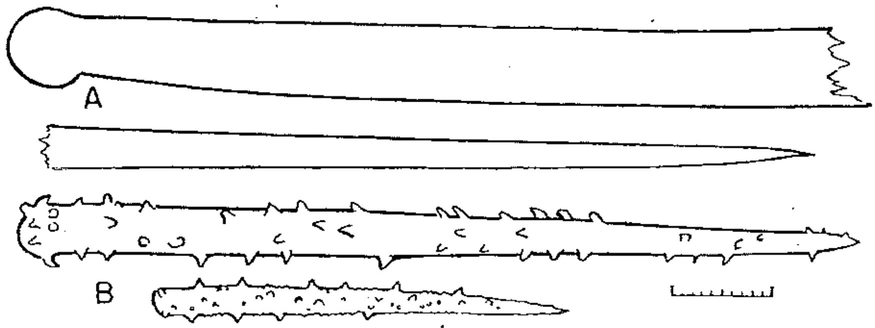
Pores.—Microscopic and contractile.

Ectosome anatomy.—No specialization.

Endosome anatomy.—Microcavernous and fleshy. There may have been a basal plate of spongin.

Skeleton.—The long, smooth spicules stand erect upon the substratum, points upwards (see fig. 35 A). They are long, smooth tylostyles, 15 by 1,000 to 16 by 2,000 microns in measurement. The shorter, spiny spicules (see fig. 35 B) echinate these longer ones as though the erect ones were fibres. There are also many of the acanthostyles merely loosely scattered within the fleshy walls that surround the cavities of the sponge. The acanthostyles vary in size quite a bit, at least from 5 by 70 to 11 by 205 microns. As is the rule among spiny megascleres, the larger the spicule, the fewer the spines ! Most of the larger spines on the larger megascleres are curved like rose-thorns, point toward the spicule's blunt end, but near this rounded end some of the thorn-like curvatures are directed instead toward the spicule's pointed end.

Fig. 35.



Camera lucida drawing, ×666, of the spicules of *Eurypon clavata*. A : shows the head end of one of the long, smooth, erect tylostyles, and the pointed end of another one of the same category of spicules ; the extremely long mid-portion is not shown ; it is simply cylindrical. B : illustrates two representative acanthostyles. The enclosed scale shows 20 microns by twos.

This species was described by Bowerbank, 1866, page 143, as *Hymeraphia clavata*. Gray, 1867, page 521, made it the type of the genus *Eurypon*. It is common in European marine waters, and probably about the coasts of the North Atlantic in general, but as already explained, it is quite likely to be overlooked.

Numerous species of *Eurypon* exist on paper, differing among themselves chiefly by slight differences in spicule size—much of this may lie within the range of variation of a very few species. The more vaguely one of them is described, the more it appears to be conspecific with this Bermuda specimen, or rather—vice versa. Many of them may be conspecific with *clavata*, the oldest species of the genus. In particular, it is here remarked that the two species first described as *Hymeraphia coronula* Bowerbank, 1874, page 246, and *Hymeraphia simplex* Bowerbank, 1874, page 253, should be transferred in synonymy to *clavata*.

Genus Tricheurypon Topsent.

Sponges of this genus are obviously related to those of the preceding genus, as is indicated in the name. But they have raphides as microscleres, where the species of *Eurypon* have no microscleres. Specimens of *Eurypon* are reported in the literature much more frequently than are specimens of *Tricheurypon ;* in fact, the latter must be regarded as a very rare genus. As a result of the paucity of specimens, the range of variation is not well known.

TRICHEURYPON VIRIDIS Topsent.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.33.

Date collected.—July 8, 1947.

Locality.—Walsingham Pond, Bermuda.

Abundance.—One specimen.

Shape.—This appears to be a digitate sponge, expanded in a sort of pedestal at the base. There is a central cavity which runs the entire length of the specimen, but it gives no indication of being cloacal—rather it seems to be a residue, where perhaps some foreign object had been located. The interpretation is here offered that the sponge now being described is actually an encrusting type, not at all disposed to be digitate; it is further predicated that it grew on the surface of some other sessile plant or animal which did have an elongate, cylindrical shape, and that this other plant or animal has since died and decayed. In fact, the distal third of the *Tricheurypon* was dead and macerated at the time of collection, perhaps as a result of the dying and decaying of its substrate, a death perhaps brought on by the circumstance that the sponge had finally completely covered and smothered it.

Size.—The column of sponge is 45 mm. high, of which the upper 15 mm. were already dead and macerated when it was collected. Most of the column is 8 mm. in diameter, but at the base it flares out to 20 mm. The central cavity is 3 mm. in diameter. Another, and probably more significant description of the size of this species is to say that it is a crust a trifle more than 2 mm. thick.

Colour.—The living sponge was a rich blue, and this has faded only a little in alcohol. Other Bermuda sponges, especially some specimens of *Geodia* and many specimens of *Terpios*, have a blue outer layer that similarly resists both alcohol and water. In this *Tricheurypon* the blue colour extends not only to the ectosome, however, but also to the endosome.

Consistency.—Spongy, soft, very easily torn.

Surface.—Tuberculate, with tubercles less than 1 mm. apart, and only about 400 microns high.

Oscules.—As characteristic of many thin, encrusting sponges, no oscules are certainly to be made out. To be sure, there are two holes, about 1 mm. in diameter, near (but not at) the distal end of the sponge. They appear, however, to be torn places or punctures, perhaps the locations of branches of the object on which the sponge grew, or merely accidental wounds.

Pores.—Small, contractile, about 35 microns in diameter.

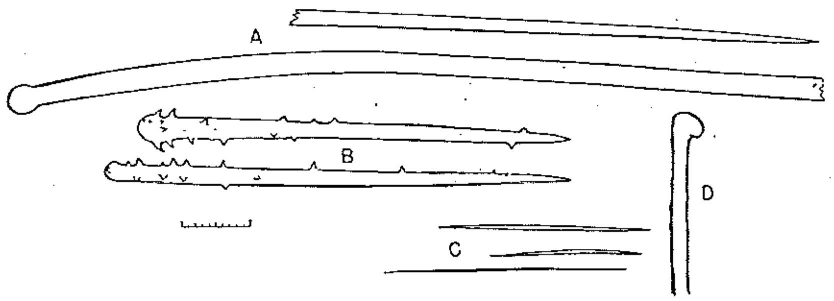
Ectosome anatomy.—No dermis is evident.

Endosome anatomy.—Cavernous, bread-like, the cavities remarkably spherical.

Skeleton.—There are abundant, long, smooth tylostyles (see fig. 36 A) often 7 by 800 microns. They are frequently bent near the head end, which probably comes as a result of the fact that the sponge grew on a flexible rather than on a rigid substratum. Another outcome is that these spicules, which would be expected to stand erect on the substratum, are irregularly placed in this specimen—some are erect with regard to the solid attachment at the base of the column, others erect with regard to the central cavity, and thus they are in confused disorder with regard to each other. Among these, probably to be regarded as echinating them, are abundant acanthostyles (see fig. 36 B) 3 by 36, 5 by 135, 6 by 120 microns, and similar sizes. Often these spicules lie tangent to the cavities of the sponge, obviously avoiding piercing the cavity. The microscleres are commonplace raphides (see fig. 36 C) 1 by 60, 1/2 by 75, 1/3 by 20 microns, and similar sizes.

This species was described as *Hymeraphia viridis* by Topsent, 1889, page 14, a West Indian species. In 1928, page 295, Topsent erected the genus *Tricheurypon* to receive it.

Fig. 36.



Camera lucida drawing, ×444, of the spicules of *Trichurypon viridis*. A: shows the head portion and also the pointed portion of one of the long tylostyles, but does not show its central portion. The spicule shown at D is a curious abnormality, not at all characteristic of this species in general, but recorded to illustrate what spicule malformations may occur in sponges. The enclosed scale shows 20 microns by twos.

The original material was dry, and this illustrates graphically the danger in giving colour names unless based upon the living material. Here we have a bright blue sponge named *viridis* because its dried remains assume a greenish hue. Attention has already been called to the fact that the well-named *Haliclona viridis* is green when alive, but may be violet in alcohol, whereas the several violet *Haliclonas* all fade to drab. The appearance of died or spirit specimens is only occasionally the same as the sponge's real colour when alive.

Family OPHLITASPONGIIDAE de Laubenfels.

Sponges of this family, like those of the Microcionidae, have monactinellid spicules as both ectosomal and endosomal spicules; the two spicule sorts are often but little, if any, different from each other. Furthermore, the echinating spicules are smooth, instead of spiny, as in other families of the Poecilosclerina. Thus, although very close to the Microcionidae—so close that specimens may be very difficult to allocate as between the genera *Microciona* and *Ophlitaspongia*—the Ophlitaspongiidae are none the less transitional, in the direction of the orders Halichondrina and even Hadromerina. The smooth echinators, for their very smoothness tend in the direction of the plumose architecture which characterizes *Axinella*, and—if carried one step further—the radiate structure of the Hadromerina. In the latter, tylostyles are the rule, such spicules are much commoner among the Ophlitaspongiidae than they are in other families of Poecilosclerina.

Genus Desmacella Schmidt.

Sponges of this genus have the very simple spiculation of tylostyles and sigmas. The architecture is semi-plumose, with smooth tylostyles echinating as well as coring the tracts of the skeleton. This is a common genus in the West Indies, with four or five species in the region, and many individuals.

Desmacella jania Verrill.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.34. If, as appears to be certain, the holotype has been hopelessly lost, this British Museum specimen should be taken as the neotype of the species *jania*. The residue of this particular type specimen—the British Museum specimen being a portion—is preserved (at least temporarily) in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—August 8, 1947.

Locality.—Walsingham Pond, Bermuda, on submerged mangrove roots.

Abundance.—Very common within the restricted area specified—it was found in 1947 only in Walsingham Pond, and only on mangrove roots.

Shape.—Encrusting, somewhat lobular.

Size.—3 to 11 mm. thick, but growing laterally indefinitely; it grows clear around mangrove roots which are 4 cm. thick, and often grows the length of the root until further progress would bring it out of water, or until it collides with another sponge. It is also associated with Diademnid Ascidians. Some continuous growths of *Desmacella jania* were found with a total length, on the root, of more than 70 cm.

Colour.—The living sponge is basically lavender, but there are curiously contrasting rose-pink areas or mottlings. An effort was made to ascertain whether or not the pink areas were different from the lavender areas in any other respect than colour. The regions of extensive sub-dermal canals seemed more often to be pink, less often lavender, and the regions with few sub-dermal canals seemed more often to be lavender, but there were exceptions to both. The suggestion is here offered that the pink areas were characterized by cells which were getting ready to take their places in embryos—that is to say, that the pink colour characterized reproductive tissue.

All over this species appear easily observed meandering sub-dermal canals, just below the surface, and separated from it only by a thin dermal membrane. These canals form patterns like the maps of river systems. Along each stream, and blending into the lavender tissue on each side, the colour is the contrasting pink. The sub-dermal channels are consistently pink, and here and there occur pink areas, 2 or 3 cm. in diameter, not directly associated with the channels.

The preserved sponge and the alcohol in which it is immersed have both become a vivid brown colour, but this is chiefly the result of bits of mangrove root which were intimately associated with the sponge—it is more mangrove pigment than Poriferan.

Consistency.—Spongy, but fragile.

Surface.—Optically smooth.

Oscules.—Small and contractile. In the field they were visible and about 1 mm. in diameter, but in preserved material they are closed, so effectively that they cannot be found.

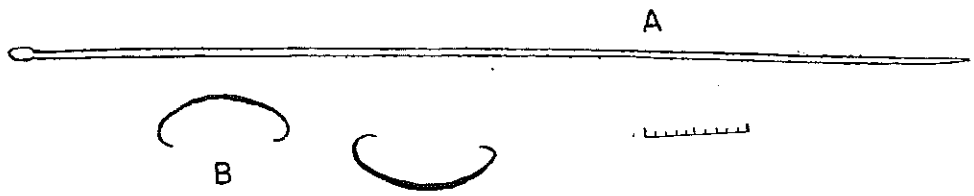
Pores.—Microscopic and very contractile. In preserved material considerable portions of the dermis are so imperforate that not even the pore locations are evident.

Ectosome anatomy.—There is a definite protoplasmic dermis, between 10 and 20 microns thick, which contains spicules tangentially placed.

Endosome anatomy.—Compact, fleshy.

Skeleton.—The megascleres are tylostyles (see fig. 37 A) with long heads. The shaft is 2 microns, or even less than 2 microns thick ; lengths are usually 180 to 190 microns. Some of these megascleres are loosely strewn in the flesh, but chiefly they are organized into definite tracts which are about 20 microns in diameter, and which have about 20 spicules per cross-section. These tracts weave about in a sinuous, undulating manner, but seldom or never anastomose. When the tract is straight, the spicules are very straight indeed, but when the strand in which they occur is bent, at that point they are curved. The microscleres are sigmas (see fig. 37 B) that are remarkably free from contortion. They are also rather uniform as to size, 26 microns chord measurement.

Fig. 37.



Camera lucida drawing, ×666, of the spicules of *Desmacella jania*. The enclosed scale shows 20 microns by twos.

This species was described by Verrill, 1907, page 338, as *Desmacella jania*. His specimen was extensively filled with an alga of the genus *Jania*, but he records a spiculation of tylostyles and sigmas ; this is not only typical for *Desmacella*, but no other Bermuda sponge has this spiculation, hence the identification is made with considerable confidence.

Verrill thought that the outstanding peculiarity was the symbiosis. In 1947 it was clear that several species of sponge might live with *Jania*, probably each partner helping the other. It is conceivable that the alga, which is reported to shun bright light, may be victimizing the sponges in which it grows, but it is difficult to imagine how it could do so ; it appears rather that the sponge (which regularly completely encases the plant) was growing over the Thallophyte and making use of it. The 1947 specimens of *Desmacella* were not in any relationship to *Jania* at all.

It is here suggested that the most distinctive feature of *Desmacella jania*, as compared to others within the genus, is the delicacy and small size of the spicules. Other West Indian *Desmacellas*, such as *pumilo*, have spicules as large as 17 by 1400 microns where the Bermuda species has megascleres only up to 2 by 190.

Family AMPHILECTIDAE de Laubenfels.

Sponges of this family are more typical of the order in which they are now put, the Poecilosclerina, than are the sponges of the family Ophlitaspongiidae. This is due to the fact that they are reticulate, not plumose, and they often do have spiny spicules. On the other hand, they are less typical of the order Poecilosclerina, and more like the sponges of other orders, in that they have no echinating spicules. Thus the conclusion is in order that the Amphilectidae, as well as the Ophlitaspongiidae, are transitional in nature and therefore intrinsically puzzling as to classification.

The Amphilectidae are fibro-reticulate in a way that is reminiscent of the sponges of the order Haplosclerina in general, and the family Haliclonidae in particular. The lack of conspicuous ectosomal specialization is a similar comparison, but unlike those of the Haplosclerina the spicules of Amphilectidae are consistently monactinellid, and they are often spiny.

Genus BIEMNA Gray.

Sponges of this genus are typical for the family Amphilectidae, in that they are more or less fibro-reticulate, their fibres are not echinated, and they possess monactinellid megascleres. The regular spiculation is styles, with microscleres that comprise both sigmas and raphides. It appears that the genus *Biemna* has not hitherto been recorded from the West Indian region.

BIEMNA MICROSTYLA, sp. n.

The syntype, which is a portion of the holotype, is deposited in the British Museum (Natural History), register number 1948.8.6.35. The residue of the holotype is preserved, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—August 8, 1947.

Locality.—Walsingham Pond, Bermuda.

Abundance.—Common in the very restricted ecological placement of occurring on mangrove roots, under water. No specimens were found in any other situation, nor away from Walsingham Pond.

Shape.—Encrusting to amorphous.

Size.—14 to 25 mm. thick. Laterally the growths often encircled the mangrove roots (which were 3 or 4 cm. in diameter) and extended lengthwise of the roots for at least 11 cm. Further progress was usually stopped either by the surface of the water, or by collision with another sponge.

Colour.—Dull yellow to yellow-orange. This fades a little in alcohol, and the fluid is stained yellow.

Consistency.—Spongy, but easily torn, somewhat slimy to the touch.

Surface.—Uneven ; in places tuberculate.

Oscules.—Scattered, often more than 6 cm. apart ; diameters 4 to 6 mm. Each is usually at the summit of an elevation which is about 10 mm. in diameter and 10 mm. high.

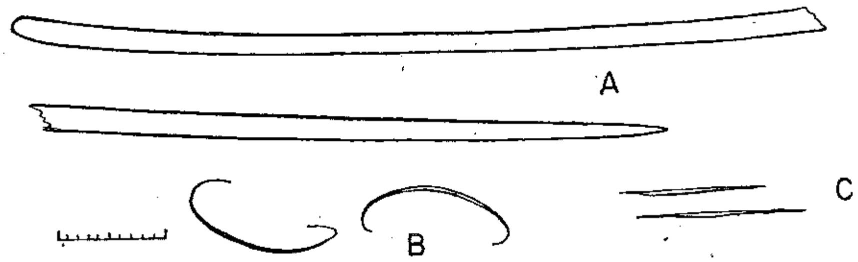
Pores.—Small and very contractile. The live sponges were covered with microscopic pits, but these promptly closed upon death of the sponge.

Ectosome anatomy.—There is a rather astonishing lack of dermal specialization, which is distinctly atypical for the order Poecilosclerina, except for this family (Amphilectidae) in which such a lack is commonplace.

Endosome anatomy.—Microcavernous, somewhat bread-like.

Skeleton.—The spicules are arranged in vaguely plumose tracts and in confusion around the many sub-spherical cavities. There is little or nothing to be called a reticulation at all. The megascleres (see fig. 38 A) are styles, with no tylostylote modification. The sizes are chiefly 4 by 240 to 4·5 by 280 microns. There are two sorts of microscleres. First, there are commonplace sigmas (see fig. 38 B), 5 to (commonly) 30 microns in chord measurement. Second, there are raphides (see fig. 38 C) about 1/3 by 40 to 1/2 by 90 microns.

Fig. 38.



Camera lucida drawing, ×666, of the spicules of *Biemna microstyla*. A: illustrates an entire style, as typical of this species, in two instalments, the head end above, and all the rest of the megasclere below. The enclosed scale shows 20 microns by twos.

This species poses some interesting problems as to genetic allocation. It is quite conceivable that a new genus should be erected for it. It agrees with *Desmacella* in structure so closely that I put it, at first, in that genus, but *Desmacellas* have tylostyles and lack raphides. The spiculation is exactly that of a *Biemna* and nothing else. On the other hand, with one exception, all the other *Biemnas* from *varianta* (the type) on down; possess huge megascleres, upwards of 30 by 1800 microns in measurement, and are other than plumose.

That other sponge spiculation which is closest to that of *Biemna microstyla* is *Biemna microxea* Hentschel, 1911, page 316, from south-western Australia; but *microxea* has two sorts of raphides, a thin kind 70 microns long, and a short, thick sort 22 microns long, and its sigmas are only 15 microns in chord measurement. Furthermore, it has the reticulate structure typical of *Biemna*. It would not be at all astonishing if some future student of sponges were to erect a new genus for such sponges as *microstyla* from Bermuda.

Order *HALICHONDRINA* Vosmaer.

This order comprises odds and ends of sponge groups which are very difficult to allocate, and therefore no simple diagnosis of the order is possible It may be that this order will be deleted from future classifications. It is named for its family Halichondriidae, but the sponges of this particular family bear close resemblance to those of the family Adociidae, which is in the order Poecilosclerina.

The family that is most distinctive of the Halichondrina is Axinellidae; it has been assumed that the other Halichondriidae have been derived by loss or simplification from the Axinellidae, but this is questionable. The sponges of the family Axinellidae are pronouncedly plumose, the most plumose of all sponges, and thus they represent a continuation of the trend which was observed in the Ophlitaspongiidae of the order Poecilosclerina.

Other than the family Axinellidae, the families that are put into the order Halichondrina often comprise the Hymeniacidonidae, which tend to resemble Desmacidonidae, and also the Semisuberitidae, which are exceedingly difficult to allocate systematically.

Family AXINELLIDAE Ridley and Dendy.

Sponges of this family clearly stand between those which are most typical of the Poecilosclerina and those which are equally typical of the Hadromerina. The Axinellidae are characterized by having plumose columns of spicules; often it seems that these structures are built of only echinating spicules, no spicules to be regarded as coring. Microscleres are rarely present. Some sponges which have been assigned here, however, are probably just lipochelous *Ophlitaspongias*. Axinellid type sponges which have microscleres are likely to be placed in the family Ophlitaspongiidae.

Genus HOMAXINELLA Topsent.

This genus was proposed in 1916 for sponges otherwise much like those of the typical genus, *Axinella;* but, whereas that genus has both monactinal and diactinal spicules, in *Homaxinella* only monactinal spicules occur. The genus is very close to the earlier *Stylissa* of Hallmann (1914), but *Stylissa* was erected for sponges of a distinctive vase or cup shape, with much spongin present. *Homaxinella* species are typically ramose. Otherwise both are typical of the family, with plumose columns and surfaces that are hispid because they are beset with erect megascleres.

HOMAXINELLA RUDIS (Verrill) de Laubenfels. (See Pl. I, fig. 4.)

Specimens of *rudis* are represented by British Museum (Natural History) register number 1948.8.6.36. It appears that Verrill's original specimens are hopelessly lost, therefore this British Museum specimen is hereby designated as neotype of the species *rudis*. A syntype is deposited, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—June 30, 1947, and many others.

Locality.—Harrington Sound, Bermuda.

Abundance.—Extremely common in Harrington Sound, and one small specimen was taken, August 8, 1947, in Walsingham Pond.

Shape.—This sponge has been known locally as the " red trees ". It is ramose, with branchings that are much like those of some deciduous trees; its small secondary processes or branchlets give the effect of twigs or clumps of leaves.

Size.—Specimens certainly occur as tall as 30 cm., but most are under 30 cm. high. The diameter of the trunk, and of the branches, is quite consistently 1 cm., with due allowance for the secondary protrusions.

Colour.—Bright, clear red. In alcohol this dissolves out almost immediately, turning the fluid bright orange-red, and leaving the sponge a brownish white. Some dry specimens of *rudis* retain the red colour, but others lose it. This latter circumstance is brought about by washing the specimen at time when it is not yet hardened, or by squeezing it—even handling it roughly. Some types of bacterial action may bleach a sponge.

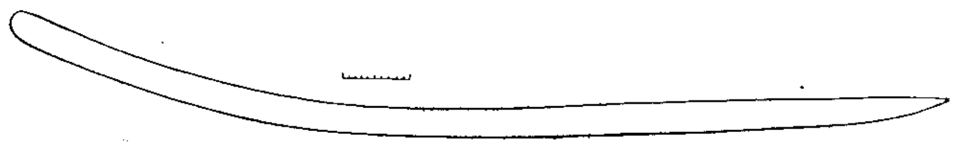
Consistency.—Slightly spongy, but easily torn or broken. This species does not give off any great quantity of slime when it dies or is injured.

Surface.—Multiple compound. There are little lumps all over this species, each lump about 2 mm. in diameter and 2 mm. high. These protrusions in turn are bristling with fibre ends, so that there is great resemblance to *Higginsia* and to *Pseudaxinella rosacea.*

Oscules.—The inhalent and exhalent apertures are not readily distinguishable.

Pores.—The entire surface is liberally provided with apertures of very irregular cross-section, but each about 1 mm. in diameter. They are some 3 mm. apart, centre to centre. Doubtless some of these apertures are inhalent and others are exhalent, or portions of each may be thus specialized.

Fig. 39.



Camera lucida drawing, ×444, of the spicule that occurs in *Homaxinella rudis.* The enclosed scale shows 20 microns by twos.

Ectosome anatomy.—The peculiar compound surface, like the top of a forest of leafless trees, has no ordinary dermis at all.

Endosome anatomy.—The soft parts are diluted by numerous gross canals and cavities, and are further relegated to the interstices of the extensive skeleton.

Skeleton.—There are many fibres, and enough connections exist between them, so that this may be spoken of as reticulate, but it is not typically reticulate. The fibres run lengthwise of the trunk or branches, and then curve out toward the surface. They contain one of the spongin compounds, or mixtures of compounds. They are both cored and profusely echinated in a plumose fashion by spicules all of the one sort. These are styles, as illustrated in fig. 39, usually 9 by 280 to 11 by 320 microns.

Verrill described this in 1907, page 297, or page 341, as *Axinella rudis*, the genus *Homaxinella* not having as yet been established. In the same article, on the preceding page, he described *Axinella appressa.* The abundant Bermuda species here described fits the descriptions of both *rudis* and *appressa.* Neither term has priority, and *appressa* is here dropped in synonymy as least appropriate. Verrill drew a distinction in that the one retained its red colour when dried, whereas the other did not. Experimentation in the summer of 1947 showed clearly that this was a matter of treatment. The same specimen could be broken in half, and one portion so handled that it complied with one of Verrill's terms, and the other half so handled that it complied instead with the other. Neither of Verrill's descriptions is really adequate, but there are no other Bermuda sponges to fit, and this one does, therefore the identification is made quite confidently.

The genus *Homaxinella* includes the following, which are listed with the genus in which each was originally named. All, except *informis*, were transferred to *Homaxinella* by Topsent, chiefly in 1916, page 166, where he established the genus for *supratumescens* as type.

1. *Acinella aborescens* Ridley and Dendy, 1886, page 479. Australian.
2. *Axinella axifera* Hentschel, 1912, page 404 (?). Australian.
3. *Axinella balfourensis* Ridley and Dendy, 1886, page 480. Indian Ocean.
4. *Alcyonium ensiferum* Lamarck, 1815, page 163. Australian.
5. *Homaxinella informis* Burton, 1930, page 507. Arctic.
6. *Axinella supratumescens* Topsent, 1907, page 74. Antarctic.
7. *Axinella tenuidigitata* Dendy, 1905, page 189. Indian Ocean.

Of these, numbers 1 and 7 have spicules about three times as thick, nine times the mass of the spicules of *rudis*. From the others, *rudis* is separated by the peculiar compound surface, which resembles the surface of *Higginsia*. It must be noted, however, that some of the other species are not accompanied by detailed descriptions of their dermal architecture.

Genus PSEUDAXINELLA Schmidt.

Sponges which are typical of the family Axinellidae, and in particular sponges which could go in the genus *Axinella* itself, regularly have a distinctive central portion, or axial specialization. The genus *Pseudaxinella* was erected for sponges otherwise like *Axinella*, but lacking this particular item. They have the plumose structure, erect dermal spicules, and the combination of monactinal and diactinal spicules, all as in *Axinella*.

PSEUDAXINELLA ROSACEA (Verrill) de Laubenfels.

Specimens of *rosacea* are represented by British Museum (Natural History) register number 1948.8.6.37. It appears that Verrill's original specimens are hopelessly lost, therefore this British Museum specimen is hereby designated as neotype of the species *rosacea*. A syntype is deposited, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—June 30, 1937, and many others.

Locality.—Harrington Sound, also Walsingham Pond, Bermuda.

Abundance.—Very common in the two localities specified, more common in the Pond than in the Sound.

Shape.—Semi-encrusting, in layers which are often more than 5 cm. thick. Each crust is a densely packed mass of columns, much as in *Acarnus*, but no ramose tendency is present, even when environmental conditions most favour such a form.

Size.—The thickness has already been cited. In Walsingham Pond some of the encrustations attain a diameter greater than 70 cm., but the majority are less than 30 cm. in diameter.

Colour.—The living sponge is scarlet, and this colour is maintained to an exceptionally great extent in alcohol. It does fade, but only slowly, over a period of months. The fluid is tinged deep reddish orange. Dry specimens of *rosacea* remain red, although duller than in life. This hue persists through many types of abuse, but actual maceration will leave a bare skeleton that is practically white.

Consistency.—Somewhat spongy. This species is far more easily torn or cut than bath sponges are, yet the appearance of fibres and texture curiously suggests *Spongia*. An outstanding characteristic of *rosacea* is its slime production. The living sponge will give off a mucilaginous colloid if it is roughly handled. The dying sponge emits relatively immense quantities of this soft colloidal stuff, a total mass considerably exceeding the volume of the sponge itself. This slime, when examined under the microscope, is seen to contain scattered cells, but the bulk of it is a watery sol, non-cellular, but probably akin to protoplasm in many chemical respects.

Surface.—Multiple compound. There are ascending columns, 1 to 2 mm. in diameter, perpendicular to the substrate and parallel to one another. They end (above) with pointed projections ; but each of these in turn is bristling with fibre ends. The summits of the conules end at a rather uniform level, so that superficially the surface is rather plush-like. With a lens it appears rather like peering down at a coniferous forest. This surface is exceedingly like the surface of *Homaxinella rudis*, and both are in this respect extremely like *Higginsia coralloides*.

Oscules.—Rather conspicuous, about 4 to 7 mm. in diameter, and often with raised rims, 3 to 5 mm. high. In some specimens they are flush or level. The number of oscules is rather large, the distance from centre to centre being only 2 or 3 cm.

Pores.—The entire surface is beset with conspicuous openings of irregular, jagged outline ; these are the interstices between the ascending columns. Being rather obviously inhalent, they may be spoken of as the pores.

Ectosome anatomy.—The peculiar surface, already described, tends to preclude anything in the way of a cortex or dermis.

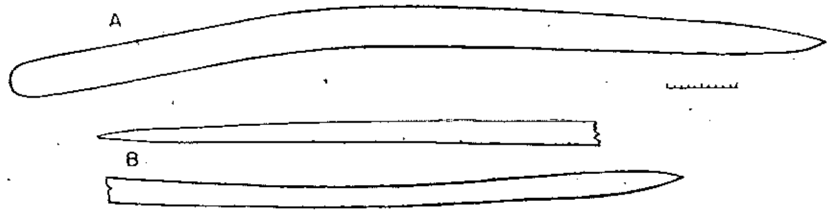
Endosome anatomy.—The soft parts are more or less coated onto the tree-like ascending columns, or are interstitially located with regard to them.

Skeleton.—The sponge, as already noted, is crowded with ascending columns, 1 to 3 mm. apart. Each of these is cored with oxeas, and each bristles (or is echinated) with styles, points outward, and usually upward. Spicules of both sorts may be found scattered in the flesh between the columns. The columns definitely contain a spongin compound. The spicules are of two sorts. There are styles, usually curved (see fig. 40 A), 8 by 300 to 10 by 400 microns. Some are shorter and thicker, 11 by 235 microns. Then there are the coring oxeas (see fig. 40 B), 7 by 300 to 8 by 320 microns.

Verrill described *Axinella rosacea,* in 1907, page 297 or 341, in connection with his account of Bermuda sponges, but did not quote Bermuda specimens, he merely cited it for the West Indian region in general. One might well argue that this Bermuda species is not his *rosacea,* but I hesitate to call it a new species. Verrill's description is sufficiently vague that it can include this sponge, and there is quite a considerable likelihood that this is a correct identification.

In the West Indian region a fairly common sponge is *Higginsia coralloides* Higgin, 1877, page 291. It is described as being the same bright red as *Homaxinella rudis* and *Pseudaxinella rosacea.* I am familiar with preserved specimens of *Higginsia* ; they have the peculiar twice-compound structure of the two Bermuda sponges. Therefore I started with the assumption that both these red sponges were *Higginsia.* But *Higginsia* has not only both styles and oxeas, as in *rosacea* but unlike *rudis,* and has a ramose form as in *rudis,* but unlike *rosacea,* but it also has microscleres of a definite sort: acanthomicroxeas. Specimens of *rudis* were searched exhaustively for the oxeas and the microscleres ; several cubic centimetres of spicules were boiled out with nitric acid from a whole range of specimens, and

Fig. 40.



Camera lucida drawing, ×444, of the spicules of *Pseudaxinella rosacea.* B : one entire oxea is shown, but in two sections. The enclosed scale shows 20 microns by twos.

hours of study were given to millions of spicules by microscope—but not a single microsclere, and not a single oxea appeared. Similarly *rosacea* was searched for the microscleres, almost as exhaustively, and equally in vain—and while *rosacea* has two of the three spicule sorts that are typical of *Higginsia,* it does not have the ramose form. Briefly it was thought that *rudis* and *rosacea* might be conspecific, but studies showed their cells to be quite different. Their pigments behave differently in alcohol, and in regard to oxidation. The immense slime production of *rosacea* has no parallel in *rudis.* Both *rudis* and *rosacea,* however, are distinct from other species in their respective genera by their *Higginsia*-like surface structures.

Family HYMENIACIDONIDAE de Laubenfels.

The sponges of this family have a spiculation which is much like that of the Axinellidae, and they were formerly included within that family. They were then separated because, unlike *Axinella,* they have a fleshy dermis. The significance of this latter characteristic is here further emphasized. As a result of this organic dermis the Hymeniacidonidae resemble keratose sponges, or better yet, they greatly resemble those sponges of the Desmacidonidae (exemplified by *Iotrochota*) which have conulose, fleshy ectosomes. The Hymeniacidonidae may not only be removed from the family Axinellidae—they may in the future even be taken from the order Halichondrina. They may be put with the above-mentioned fraction of the present family Desmacidonidae, as a family with a new content, although it may still be called Hymeniacidonidae. No decision is here rendered as to what order should then receive this family, nor is its extent as yet determined.

Genus Hymeniacidon Bowerbank.

The sponges of this genus have a spiculation of only styles. These are arranged in a somewhat plumose pattern, in tracts and surface brushes, but—as characteristic of the family—there is a distinct protoplasmic dermis. Such a sponge looks very different from the *Higginsia* type. It is characteristic of *Hymeniacidon* to have spicules of greatly varying sizes.

Hymeniacidon heliophila (Parker) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.38.

Date collected.—July 8, 1947.

Locality.—Walsingham Pond, Bermuda.

Abundance.—Rare in Bermuda.

Shape.—The Bermuda specimens consist of four, elongate, conical processes, typical of the species.

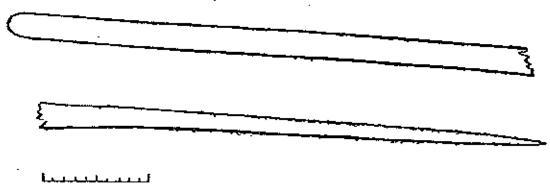
Size.—These processes ranged from 25 to 35 mm. in length; in diameter they taper from 5 mm. at the base to 1 mm. at the apex.

Colour.—The living sponge was orange; this colour has faded in alcohol to a pale drab.

Consistency.—Soft and flesh-like.

Surface.—Tuberculate to conulose, with protrusions only about 300 microns high, and almost 1 mm. apart.

Fig. 41.



Camera lucida drawing, ×666, of a representative spicule of *Hymeniacidon heliophila* from Bermuda. The figure illustrates the head end and the pointed end of the same spicule, but does not picture the long mid-portion of the spicule. The enclosed scale shows 20 microns by twos.

Oscules.—Not evident.

Pores.—Not evident.

Ectosome anatomy.—There is a skin or protoplasmic dermis over the entire surface. This is now imperforate, but doubtless contains the pores, which are known to be closeable. It is less than 40 microns thick.

Endosome anatomy.—Microcavernous, almost bread-like. Many of the cavities are some 150 microns in diameter.

Skeleton.—There are vague plumose tracts, but they have so indefinite an outline that measurement of diameter would be futile. The bulk of the spicules are merely strewn in confusion, but they are confined to the partitions which lie between the cavities which are abundantly present. The spicules are styles, as figured, of great variation in size within the same specimen. Most of them would probably come between 4 by 340 and 6 by 680 microns, but some are at least as small as 1 by 210 microns.

This was described as *Stylotella heliophila* by Parker, 1910, page 2. It is abundant along the east coast of North America, from Florida to Virginia, and de Laubenfels, 1936, page 138, records it from the Dry Tortugas, north of Cuba, thus placing it in the West Indian fauna.

Order *HADROMERINA* Topsent.

This is a rather well-marked order, in distinct contrast to the preceding two orders, which may require extensive revision (especially the Halichondrina may need to be split). The Hadromerina, with only a few exceptions, have radiate architecture, and therefore are, in this respect, somewhat like the two following orders, the Epipolasida and Choristida. Many of the Hadromerina have astrose microscleres, and in this, too, they resemble the ensuing orders. In general, the few that are not conspicuously radiate have the astrose microscleres or vice versa. But none of the Hadromerina have the tetraxon spicules of the Choristida and Carnosa, and many of them have a principal spiculation of tylostyles; in this latter respect they show decided relationship to the Poecilosclerina and considerable divergence from the remaining orders of Demospongiae. In fact, there are some genera—especially *Artemisina*—which are exceedingly difficult to allocate as between Poecilosclerina and Hadromerina.

Family CHOANITIDAE de Laubenfels.

Sponges of this family are quite typical of the order Hadromerina. The spicules are chiefly tylostyles, more or less radiately arranged, the body is compact, and the surface is armoured by dense masses of monactinal spicules, points outward. Furthermore, the Choanitidae have spirasters as microscleres.

Genus SPHECIOSPONGIA Marshall.

Sponges of this genus are first of all characterized by having dermal spicules as large as those of the interior, and second, by having peculiar surface openings. In addition to obvious and rather typical pores, and obvious, rather typical oscules, there are usually present openings of intermediate size, difficult to classify as between pores and oscules. At the Dry Tortugas I tested them under water, using the diving-helmet, by holding a glass tube over the opening. Suspended particles in this tube moved neither in nor out. I found one specimen with none of the obvious oscules. In Bermuda I found several specimens with few or none of the ambiguous openings—such specimens would be very difficult to place, systematically, but for their occurrence with numerous surrounding specimens that were obviously conspecific and typical. This serves to call attention to the danger and difficulty of identifications based upon a single specimen—a difficulty of supreme importance to the museum worker.

Another very distinctive trait of the genus *Spheciospongia* is its rapid growth and large size. The matter of rapid growth would be beyond the reach of the purely museum specialist, and is difficult to be sure of even for the field worker—but areas have been denuded of *Spheciospongia* (" loggerheads ") near Key West, Florida, and the sponges used for fertilizer. A few years later each area was again full of enormous specimens. Those of this genus in the vicinity of Cuba and Florida are the largest sponges of the world. The largest sponges that I have been able to find on the Pacific Coast of North America belong to this genus (*Spheciospongia confederata* de Laubenfels) and the Bermuda *Spheciospongias* are the largest sponges there.

SPHECIOSPONGIA OTHELLA, sp. n. (See Pl. II, fig. 6.)

The syntype is deposited in the British Museum (Natural History), register number 1948.8.6.39. Other Bermuda type material is deposited, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—July 28, 1947, and many others.

Locality.—Harrington Sound, Walsingham Pond, and the coasts of the Bermudas in general.

Abundance.—Extremely common.

Shape.—Massive, often with a rather circular base; its vertical form is profoundly modified by its oscular structure, to be described below.

Size.—Individuals were studied in the field, with diving-helmet, that were considerably over 70 cm. high and 70 cm. in diameter, computed mass nearly 200 kilograms, well over 400 pounds, wet weight. The dry weight is only about 20 to 25 per cent. of this.

It is much more difficult to find small specimens of this sponge than to find large ones, and to study the growth forms—the indications of rapid growth are many. The smallest specimen of *Spheciospongia* found in the summer of 1947 was on August 4, 1947, at Cock Rock, on the north shore of the Bermudas. It was 12 mm. in diameter, 30 mm. high and had eleven obvious openings each 2 mm. in diameter, as well as a number of microscopic but obvious pores.

Colour.—The living sponge is chiefly black, but there are occasional small patches of lemon yellow, especially in the oscular linings. These patches are streaked, and do not have sharp boundaries, but instead blend through greenish into black. It is often about 2 or 3 mm. from the clear, bright yellow to the nearly inky black. Some yellow patches are as large as 1 by 7 cm. There are also yellowish patches scattered here and there throughout the interior of the sponge, visible only if it is cut to pieces. The blackish colour fades only slightly in alcohol, and the fluid is only a little discoloured; evidently the melanic pigment is relatively insoluble. Dry specimens sometimes appear grey, as a result of the reflection of light from the many spicules at the extreme surface.

Consistency.—Flesh-like, not hard and woody.

Surface.—Undulating, but otherwise smooth.

Oscules.—Many are 1 cm. in diameter, as typical for the genus, but most Bermuda *Spheciospongias* have some much larger, even enormous vents. I found in Walsingham Pond in July 1947 one which had a vent so large that I could put the anterior portion of my foot into it—it was at least 8 cm. in diameter, perhaps 10 cm. When I did put my toes into it, it began instantly to close, and in approximately 30 seconds closed to a long slit, much as a wide-open human mouth might be closed. When one puts a finger into one of the smaller oscules, the sponge flesh closes on it like a fairly muscular human hand-grasp. The realization that the sponge is a living animal then comes in a manner which may be called uncanny.

The oscular currents are very vigorous, much more so than I found to be the case with either the Florida or the California *Spheciospongias*. A specimen of *othella*, about twice the size of a human head, was placed in a tub of seawater. The surface of the water in the container thereupon was rendered convex, a bulge approximately 10 mm. in height occurred directly over a cluster of large oscules. This " head " was maintained for about an hour, at the end of which time the sponge was removed for preservation. This specimen was first hardened in formalin, then dried and left at the Bermuda Biological Station for research. It is illustrated in Pl. II, fig. 6.

The oscules of *othella* are also distinguished by their raised collars. Even in fairly strong currents, where sponges in general have no oscular collars, this species usually has a raised rim about the vent, a rim at least 1 cm. high. In relatively calm water, oscular chimneys were found as high as 5 cm., and a little over 1 cm. in diameter; their walls were 1 mm. thick. This also is illustrated in Pl. II, fig. 6. The grouping of oscules that characterizes the upper surface of *Spheciospongia vesparia* is not here in evidence; instead the vents are well scattered over the sponge surface, say 3 to 10 cm. apart.

Pores.—Not only the oscules, but also the pores are susceptible to very rapid closing. In preserved specimens they are all consistently closed. As in other *Spheciospongias*, however, there occur the curious intermediate openings, about 1 mm. in diameter, more than ten times as large as the openings that are certainly pores, only a tenth as large as the smaller oscules. In Bermuda, as near Cuba, no current could be detected going in or coming out of these apertures. In only a few Bermuda specimens were they grouped in sieves, as they commonly are in the Florida and California species.

Ectosome anatomy.—The fleshy, very contractile dermis is between 50 and 100 microns thick, and is well filled with cells which are packed with pigment granules. Unlike most members of the order Hadromerina, the dermis of this species contains many tangential spicules, not the phalanx of erect spicules, pointed outwards, which might be expected. Of course, a dermis packed densely with spicules could scarcely be as muscular (or rather, as contractile) as is this outstandingly contractile, muscular ectosome of *othella*.

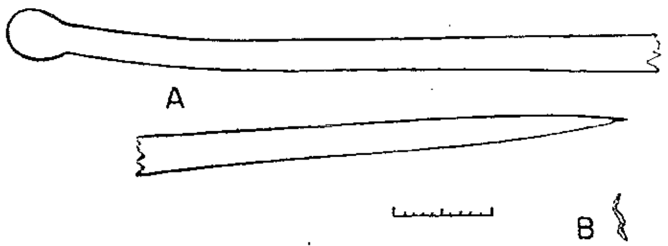
Endosome anatomy.—Cavernous, almost bread-like. There are sub-spherical cavities of all sizes from 10 microns up to at least 10 mm., and a little larger if one includes the oscular cloacas.

Skeleton.—The spicules are mostly fitted into the areas between the cavities, but a few meandering fascicular tracts occur. These are upwards of 150 microns in diameter and contain about 100 spicules per cross-section. They also contain considerable organic material, but no pigment cells. The spicules are of two sorts. The megascleres are tylostyles (see fig. 42 A), 6 by 280 to 9 by 300 microns. The microscleres are spirasters (see fig. 42 B), 0·5 by 10 microns. They are rare, and so very small that it is extremely difficult to find them.

Lamarck, 1814, page 78, described *Alcyonium vesparium*, which was made type of the genus *Spheciospongia* by Marshall, 1892, page 32. This, the largest sponge in the world, is abundant throughout the West Indian region (it is locally called "Loggerhead" sponge) and on up the Atlantic Coast of North America, at least to North Carolina (see de Laubenfels, 1947, page 34). A second species for the genus was found on the Pacific Coast of North America, where it is the most massive sponge that occurs; this was named *Spheciospongia confederata* by de Laubenfels, 1930, page 26. The Bermudan *othella* is the third for the genus.

The species *othella* is distinctive in colour, being black with lemon-yellow patches. *Vesparia* is very dark as to exterior, but it is a purplish black, and the dried sponge is brown; the interior is drab, whereas the endosome of *othella* is as

Fig. 42.



Camera lucida drawing, ×666, of the spicules of *Spheciospongia othella*. A: represents an entire megasclere in two portions. B: illustrates the spiraster. The enclosed scale shows 20 microns by twos.

dark (or nearly so) as the exterior. *Conferata* is lead-grey outside and ochre inside, turning brown when dying. *Othella* is perhaps most distinctive for its frequently enormous vents. These are less than 1 cm. in the other species, with little or no oscular collars; *othella* has a fleshier consistency, where the other two are stiffer, more wood-like. This is associated with the exceptionally great muscular power of the Bermuda species. *Vesparia* has megascleres 9 by 445 to 10 by 600 microns; this is much larger than the size of the megascleres of *othella*. The microscleres of *vesparia* are also larger, being 12 to 15 microns long, and 2 to 4 microns thick.

Verrill, 1907, page 342 (or 298), identified this sponge as *Heterocliona*, gen. nov., *cribraria* Schmidt. Verrill's genus, of course, falls in synonymy to *Spheciospongia*. *Papillina cribraria* Schmidt is a synonym of *vesparia*.

Genus Spirastrella Schmidt.

Sponges of this genus have a spiculation of tylostyles and spirasters, which reads much like the spiculation of *Spheciospongia*. But *Spirastrella* species are usually thin crusts, rather than large, coarse specimens. Their spirasters are also very large and coarse, whereas those of the preceding genus are small and fine.

Spirastrella coccinea (Duchassaing and Michelotti) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.40.

Date collected.—August 9, 1947, and many others.

Locality.—Whalebone Bay, also Harrington Sound and the coasts of Bermuda in general. It occurs as a crust on rocks, shells, and such relatively solid objects, but is regularly confined to under-surfaces and other places where it is effectively hidden.

Abundance.—There are probably more numerous separate individuals or colonies of this species than there are of any other species of Porifera in Bermudan waters. Yet the aggregate total volume of all the *Spirastrellas* is probably less than one of the smaller specimens of *Spheciospongia.* Specimens as small and thin as postage stamps are the rule.

Shape.—Encrusting.

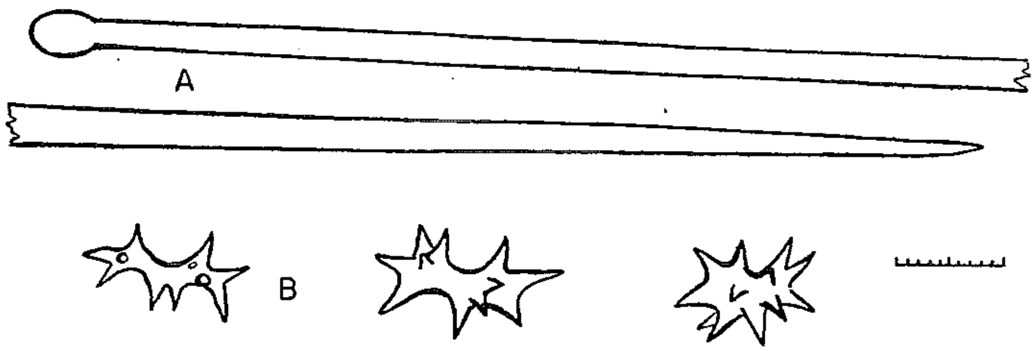
Size.—Usually under 1 mm. thick, and extending laterally less than 3 cm., even less than 1 cm. A very few specimens cover areas as large as the palm of the hand.

Colour.—Dull red, varying to dark reddish brown.

Consistency.—Mediocre.

Surface.—Smooth.

Fig. 43.



Camera lucida drawing, ×666, of the spicules of *Spirastrella coccinea.* A: illustrates an entire megasclere (tylostyle) but in two instalments. B: illustrates typical spiraster shapes and sizes. The enclosed scale shows 20 microns by twos.

Oscules.—Microscopic and contractile.

Pores.—Microscopic and contractile. This is to say that specimens are regularly lipostomous.

Ectosome anatomy.—No specialization can be discerned, nor should it be expected in view of the extreme thinness of this species.

Endosome anatomy.—Dense.

Skeleton.—The megascleres are tylostyles (see fig. 43 A) usually 7 by 380 microns. They are strewn in confusion, or perhaps more have points toward the surface of the sponge than those which point in any other direction. The microscleres are spirasters (see fig. 43 B) about 33 microns long. These are conspicuous, so abundant that they practically interlock.

This was described as *Thalysias coccinea* by Duchassaing and Michelotti, 1864, page 89, from the Caribbean region. It is very common throughout the West Indies. It is clearly the sponge which Verrill, 1907, page 300 (or 344), described as *Spirastrella mollis,* sp. n.

SPIRASTRELLA DIORYSSA, sp. n.

The syntype, which is a portion of the holotype, is represented by British Museum (Natural History) register number 1948.8.6.41. The residue of the holotype is deposited, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—August 15, 1947.

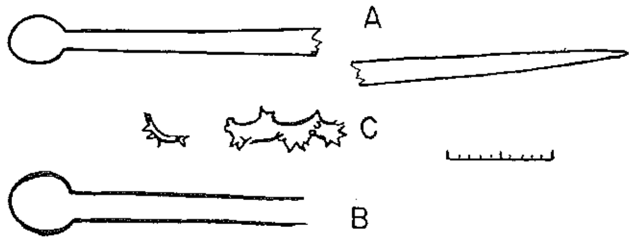
Locality.—Lobster pond at Biological Station, St. George's West, Bermuda.

Abundance.—Rather uncommon.

Shape.—Encrusting, but with convexities 1 mm. high, 8 to 10 mm. wide. It also penetrates into cavities of the limestone on which it grows, to a depth of at least 3 cm.

Size.—Larger specimens are still not as much as 10 cm. in diameter. The thickness may reach 3 mm. at the low protrusions, but is usually under 1 mm.

Fig. 44.



Camera lucida drawing, ×666, of the spicules of *Spirastrella dioryssa.* A and B illustrate two representative heads and one pointed end of the megascleres; no mid-portions are shown, therefore not the whole spicule is illustrated. The figures at C illustrate the two sorts of spiraster. The enclosed scale shows 20 microns by twos.

Colour.—The living sponge is brilliant orange. This fades somewhat in alcohol.

Consistency.—Mediocre.

Surface.—Smooth.

Oscules.—Minute and contractile.

Pores.—Microscopic and contractile.

Ectosome anatomy.—There is a dermal crust of spirasters.

Endosome anatomy.—Dense, almost imperforate.

Skeleton.—The megascleres are tylostyles (see fig. 4 A), 4 by 265 to 5 by 325 microns. These are remarkable spicules, because the heads have more than twice the diameter of the shaft, even in the mature megascleres. In most sponges that have tylostyles this proportion is seldom realized, and these only in juvenile spicules. In *Spirastrella dioryssa* the spicule heads are spherical and 12 microns in diameter. The microscleres are spirasters (see fig. 44 C) of two sorts. There are larger ones 24 microns long and smaller ones 12 microns long.

Spirastrella species with two size ranges of microscleres are rare. Ridley and Dendy described one from Australia, 1886, page 490, as *S. massa.* Its megascleres lacked the extra large heads of the spicules of *dioryssa,* were 6 by 450 microns, which is notably larger. Its microscleres were 44 and 9 microns, respectively, as contrasted with the 24 and 12 of *dioryssa.*

Actually, the chief problem which we here encounter is one of generic, or even family allocation. The family Clionidae is established for sponges that excavate galleries into limestone, and reside therein. Their megascleres are usually tylostyles, and they often have spirasters as microscleres.

This Bermuda sponge, *Spirastrella* (?) *dioryssa* (from the Greek " to dig through "), certainly lives inside limestone. The basic formation in Bermuda is an aeolian limestone, built out of compacted and cemented grains of what was once wind-blown coral sand. Such rock has natural interstices which are actually hollow (air or water filled). Potential hollows are yet more abundant. The solvent action of carbonic acid-containing rainwater can readily enlarge these potentialities, and as a result there are many caves in Bermuda, some as large as railway stations. Perhaps the rock on which my specimens of *dioryssa* grew had been already eroded by inanimate means. Perhaps the sponge merely penetrated pre-existing spaces. Even if this is the most that can be said, it is still phenomenal. Few sponges can set up such a transportation system—canals and whatever—so that they can successfully live several centimetres below the surface, in rock cavities scarcely 1 mm. in diameter, yet this sponge does so !

If *dioryssa* made its own way, that is to say, if it is truly " boring ", then it is a *Cliona*, not a *Spirastrella* at all. No *Cliona* yet described has these large spirasters, however, nor tylostyles with such large heads. So the Bermuda sponge is a new species, no matter which genus receives it. Obviously more information about *dioryssa* is greatly to be desired.

Subfamily *Timeinae* Topsent.

The sponges of this subfamily are typical of the family Choanitidae, in that they have, as a rule, tylostyles as megascleres, together with astrose microscleres and more or less radiate architecture. They are set off by the fact that their microscleres are neither elongate spirasters nor streptasters, as in the principal portion of the family, but instead are euasters. That is to say, these microscleres have a one-dimensional axis or focal point from which many rays extend.

Genus Halicometes Topsent.

Sponges of this genus are quite typical of the family and subfamily, but peculiar in that plain styles are sometimes included in the megasclere spiculation, while the microscleres include at least two kinds of euasters. There is also a profound tendency toward elaborate shape in the species of *Halicometes*.

Halicometes stellata (Schmidt) Topsent.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.42.

Date collected.—July 2, 1947.

Locality.—North shore of Bermuda, St. George's Parish.

Abundance.—One small specimen was found under a stone, just below tide-marks.

Shape.—Amorphous.

Size.—Not quite 1 mm. thick and covering an area of 5 by 5 mm.

Colour.—Drab in life and in preservation.

Consistency.—Mediocre.

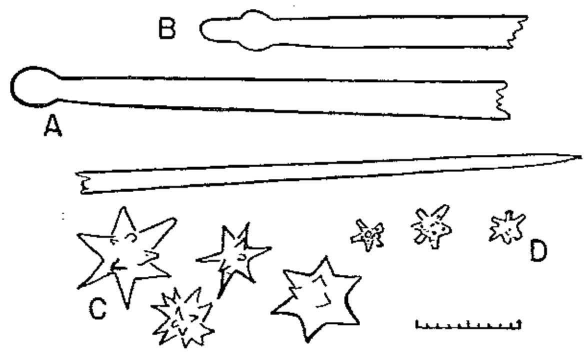
Surface.—Even.

Ectosome anatomy.—No specialization is evident.

Endosome anatomy.—Compact.

Skeleton.—The spicules show no trace of orderly arrangement, probably because the specimen has never grown in the manner of which it is capable were it to grow in deeper water. The megascleres are tylostyles (see fig. 45 A) about 7 by 600 microns, the head 8 microns in diameter, 9 microns long. Some have the tylote enlargement not quite at the end (see fig. 45 B). The microscleres are of at least two sorts, both extremely abundant. There are oxyspherasters (see fig. 45 C), 12 to 18 microns in diameter, and microspined chiasters (see fig. 45D), 8 to 9 microns in diameter.

Fig. 45.



Camera lucida drawing, ×666, of the spicules of *Halicometes stellata*. A : the head end of a normal megasclere. B : the head end of an abnormal megasclere—also the pointed end of a megasclere is figured. Not the whole of any tylostyle is shown, just the terminations, mid-portion omitted. C : the range of variation of the oxyspherasters is shown. D : the chiasters. The enclosed scale shows 20 microns by twos.

Schmidt, in 1870, page 49, described a West Indian sponge as *Cometella stellata*. It was characterized by peculiar shape, a lobate head and a long, comet-like tail. Its spicules were described as tylostyles, oxyeuasters, and what seem to be microspined chiasters. Schmidt's descriptions were, as so often the case, tantalizingly brief. This was put in *Halicometes* (was it for Halley's comet ?) in 1898, page 112, by Topsent. The Bermuda sponge now under discussion fits well enough to the brief description. Almost certainly it fails to show its characteristic form only because it is so small and undeveloped.

Family SUBERITIDAE Schmidt.

Sponges of this family are typical of the order Hadromerina ; they have a principal spiculation of tylostyles, radially arranged—or at least those of the outer layers are arranged in dense stands, points toward the surface. There are, however, no microscleres at all. Yet in Suberitid sponges one often finds ascending tracts of a semi-plumose structure, so that one notes significant resemblance to the Axinellidae and other Halichondrine sponges. Some Suberitids are very abundant.

Genus Aaptos Grey.

Sponges of this genus look like *Suberites* in particular, as well as resembling Suberitidae in general. They have very similar architecture, sub-radiate, with a dermal layer of densely crowded, erect monaxon spicules, points outward. These dermal spicules are even, as in *Suberites*, a small size range than are the megascleres of the interior. Yet *Aaptos* is quite peculiar, almost to be left out of the family, because its spicules are not tylostyles but styles. As a matter of fact, instead of having an enlargement at the blunt end of the monactinal spicule, in *Aaptos* the heads, and a portion of the shaft of the spicule near the head, are a little thinner than the main portion of the shaft.

Aaptos bergmanni, sp. n.

The syntype of this species is represented by British Museum (Natural History) register number 1948.8.6.43. The rest of the holotype is deposited, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda. The species is named in honour of the distinguished scientist, Professor Werner Bergmann of Yale University.

Date collected.—July 28, 1947, and many others.

Localities.—Harrington Sound, Walsingham Pond, and a few other places in the Bermudas.

Abundance.—This species is extremely abundant in some portions of Harrington Sound. The few specimens which were found in Walsingham Pond were small. Small specimens are likely to be overlooked, and large ones too—for that matter—because they so nicely simulate the appearance of the country rock.

Shape.—Massive, often sub-spherical, or an irregular aggregation of roughly sub-spherical components.

Size.—Specimens 10 to 16 cm. high and 9 to 14 cm. in diameter are common.

Colour.—The interior is consistently a rich yellow, about the appearance of cheese. In some specimens the exterior is also of the same beautiful golden hue, but this is exceptional. As a rule the exterior is dark and dull brown—even dark brown; not uniform, but darker the more the sponge has been exposed to the light. In alcohol the interior bleaches to a pale whitish yellow, and the darker brown portion reveals purplish tinges. It is quite likely that the brown colour is the result of superimposing a lavender or violet pigment over the carotenoids. The alcohol is tinted green, akin to the colour of chlorophyll, which is likely also to be present, rendering the carotenoid more yellow than red. Dried specimens turn almost black.

Consistency.—This sponge represents to a great extent the texture as well as the appearance of cheese; it cuts and feels like cheese.

Surface.—Even, or minutely roughened.

Oscules.—Very small and contractile. Canals can be traced through the body, right up to the surface, there over 1 mm. in diameter, and they must have terminated at oscules at least that large; but the endings are always tightly closed, due to handling of the specimen, even before the closure that is due to dying.

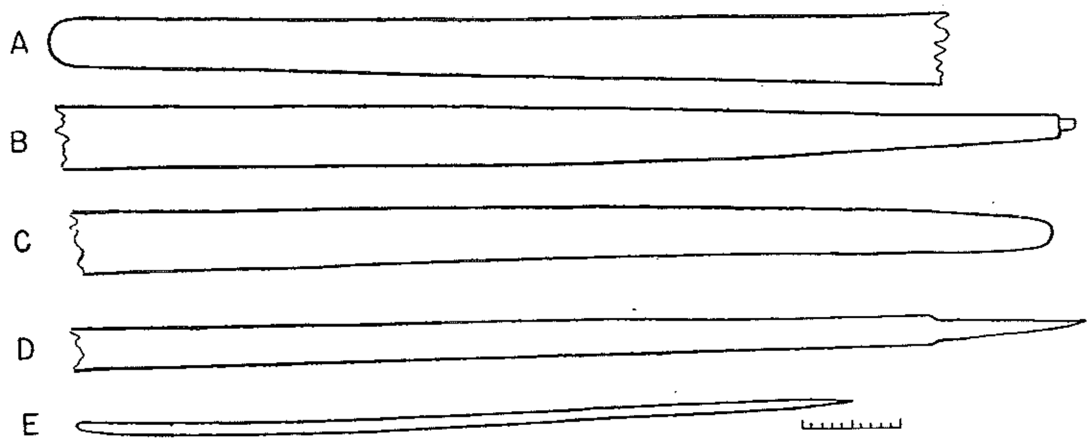
Pores.—Microscopic and very contractile.

Ectosome anatomy.—There is a skin, some 500 microns thick, characterized chiefly by its rich content of pigment cells and uniformly dense structure. It furthermore contains a palisade layer—a stand of smaller megascleres, all perpendicular to the surface, points out, but not protruding beyond the protoplasmic or organic surface.

Endosome anatomy.—The flesh is very compact. The few optically evident canals which ramify through it are round in cross-section, and their appearance in a cut surface bears out nicely the resemblance to an appetizing diet of delicious cheese. There is an unusually high ratio of flesh to spicule by volume.

Skeleton.—The spicules of *Aaptos bergmanni* are styles as described in the generic discussion. The smaller ones (see fig. 46 E) as typical of the ectosome, already discussed, are often about 2·5 by 150 microns. The Suberitidae are known to be related to the Tethyidae ; these latter often have megascleres, the type known as strongyloxea. Some of the spicules of *bergmanni* are strongyloxeas. One end (see fig. 46 A) is always rounded, but only after it has already tapered somewhat

Fig. 46.



Camera lucida drawing, ×666, of spicules of *Aaptos bergmanni*. Only terminations are shown, not any midportions, except in E. A : shows a typical blunt end. D : a typical sharp end. E : an entire typical ectosomal spicule. B and C : illustrate abnormal terminations. The enclosed scale shows 20 microns by twos.

towards a point. The other end may come (and this may be taken as the original condition) to a very sharp point (see fig. 46 D). Comment has already been made in connection with *Strongylophora amphioxa* as to the formation of a pseudo oxeote point, by addition of successive small increments out beyond a primitively blunt end. The reverse is possible. An intrinsically sharp point may be blunted by a series of stair-step-like shortenings. Fig. 46 B illustrates how this may be accomplished in the present species, and fig. 46 C shows the sharper end of a spicule that had a normal, blunter end opposed.

The type of the genus *Aaptos* is *Aaptos aaptos*, described by Schmidt, 1864, page 33, from the Mediterranean. That is a yellow sponge, but its megascleres range up to 45 by 1800 microns, where those of *bergmanni* are, at most, about 15 by 950 microns. Wilson, 1902, page 388, identified a West Indian sponge as *Aaptos aaptos*. The Bermuda species is peculiar for the strongyloxeote modification of many of its spicules and their small size.

Genus Terpios Duchassaing and Michelotti.

This genus comprises Suberitid sponges with a spiculation of tylostyles which are of the same size range in the ectosome as in the endosome. The heads of these spicules are exceptionally distinct as compared to the situation in other Suberitidae, often being nearly or quite double the diameter of the spicule shaft. In young sponges these spicules often have a head that is distinctly lobate, with indications that the lateral growth of this head has (primitively) arisen by polyactinal branching. It may represent a pentactinal spicule with four clads in one plane, and a very long rhabd.

Terpios fugax Duchassaing and Michelotti. (See Pl. II, fig. 7.)

Bermuda specimens of this sponge are represented by British Museum (Natural History), register number 1948.8.6.44.

Date collected.—June 30, 1947, and many others.

Locality.—Harrington Sound, Walsingham Pond, Mangrove Lake and the waters about the Bermudas in general. This species was even growing voluntarily—that is to say, self sown—in the exhibition tanks of the Government Aquarium at Flatts. The Aquarium specimens did not exhibit any perceptible difference from the specimens which grew under more natural conditions. Mangrove Lake was found to be somewhat brackish; this species must therefore be added to the small list of sponges that can endure brackish water. It was the only species to invade brackish water in the Bermudas.

Shape.—Small specimens are mere crusts. Larger specimens are smoothly rounded, lobate, at times somewhat like inverted grape-clusters, because many processes are sub-spherical, and about the size of grapes.

Size.—Specimens reach a size of at least 20 cm. high, 15 cm. in diameter. The larger ones are all from relatively calm water—in strong currents this species appears to be only very thin crusts at most.

Colour.—This is basically a rich golden yellow; the interior always has this hue, and sometimes more or less of the exterior does also. Much more often, however, the surface is blue, not dingy, but a clear, rich blue. Occasionally the blue appears to be restricted to those portions of the sponge which were most exposed to the light, whereas shaded portions of the surface exhibit the yellow colour. In the field one practically never sees any exposure of the yellow colour, only the blue, and even buried or covered portions may be blue. The blue pigment is water-insoluble, alcohol-insoluble, although over a period of many months in spirit it may fade to some extent. The alcohol is at once coloured orange, apparently from the endosome pigment, because the endosome is promptly bleached. The yellow colour is also bleached, and the blue colour somewhat paler, in dry specimens.

Consistency.—Much like cheese.

Surface.—Mostly smooth—the occasional irregularity may be accidental.

Oscules.—Microscopic, not readily distinguishable from the inhalent openings. Specimens are consistently lipostomous.

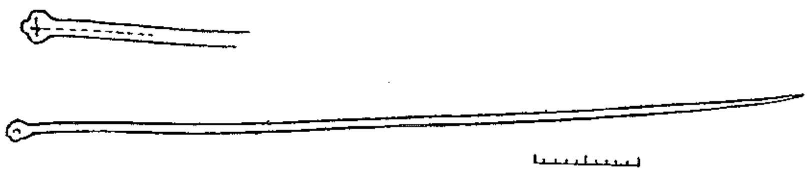
Pores.—Microscopic and very contractile, usually not to be found even with the microscope.

Ectosome anatomy.—The spicules near the surface are erect, points out, in little sub-radiate clusters or bouquets. There is no sharp demarcation, however, between an ectosomal as compared to an endosomal region, and the spicules are the same throughout the sponge.

Endosome anatomy.—This species, like *Aaptos* but even more so, can be locally recognized by its great resemblance to cheese. There is a relatively large amount of fleshy material present, but well impregnated with spicules.

Skeleton.—There are no microscleres, and only one type of megasclere, although its head undergoes modifications. This spicule is a tylostyle, 2 by 160 to 3 by 400 microns in size. The head consistently is wider and shorter than is true of the tylostyles of many other sponges, such as—for example—the above-mentioned *Desmacella.* In younger sponges some of the spicules have the tetracephaline structure that was described in the discussion of the genus *Terpios.*

Fig. 47.



Camera lucida drawing, ×666, of the spicule of *Terpios fugax.* The enclosed scale shows 20 microns by twos.

The genus *Terpios* has been recognized as containing Suberitid sponges, in many ways very characteristic of the family, but distinguished by their possession of a peculiar type of megasclere. In those specimens which have long been recognized as typical, in and among the ordinary tylostyles, there occur spicules with remarkable heads. The pointed end of these spicules is commonplace, but at the opposite end there are four lateral, rounded protrusions at right angles to each other and to the shaft. It is significant that the axial canal of the spicule branches, going out at right angles to the shaft, into each of these short, lateral rays. Thus the spicule is a pentactine, very suggestive of some of the pentactinellid spicules which characterize the class Hyalospongiae. Similar pentactinellid spicules occur in the genus *Acarnus* of the family Tedaniidae, which (like *Terpios*) is Demospongiae. This spicule type, while not predominating, is full of philosophical significance, and properly lends interest to the genus *Terpios.*

Topsent, in 1896, page 126, erected the genus *Laxosuberites* for sponges otherwise like *Suberites*, but with an ectosomal spiculation of tylostyles of the same size as those of the endosome. They are erect, points out, as in *Suberites*, but rather more often stand in clusters or bouquets, each cluster slightly radiate, where in *Suberites* the spicules are more uniformly perpendicular and parallel to each other. This description also applies to *Terpios* ; the only distinction between that diagnosis and *Laxosuberites* has been the tetracephalic megascleres of *Terpios.*

Studies at Bermuda in 1947 proved to be revealing. Not just a few long-preserved specimens were available but hundreds of living specimens, in the field. Clearly a single species ocurred, of which the young, thin forms corresponded to

Terpios, and the older ones to the diagnosis of *Laxosuberites*. Every conceivable sort of intermediate existed, close together, in the same environment. It may be called in passing, that this is surer proof of the conspecificity of two end forms that are greatly different than if the genuine or presumed intermediates come from widely scattered localities. A quite different sponge might be caused to seem intermediate by environmental agencies, or by its method of preservation, or one of the end forms might similarly be caused deceptively to seem intermediate. No such pitfall obtained in the Bermuda series.

This series of specimens at Bermuda offers ample grounds for dropping the name *Laxosuberites* in synonymy to the earlier *Terpios*, but this is not all that is involved in the matter of nomenclature. Topsent established *Laxosuberites* for *Suberites rugosus* as described by Schmidt, 1868, page 15; if Topsent's original does not make the type designation definite, it may be observed that Burton, 1930, page 674, clearly establishes *rugosus* as genotype; but Topsent, 1938, page 20, redescribes Schmidt's original material, which consisted of 28 specimens of *Suberites rugosus*. Topsent discloses that they are not at all what Schmidt described, and therefore are not like the diagnosis of *Laxosuberites*, instead, they all fall to the genus *Hymeniacidon*, species *sanguinea*. One interpretation of the International Rules of Zoological Nomenclature would therefore hold that *Laxosuberites* would fall in synonymy to *Hymeniacidon*. Whether it falls to that or to *Terpios* it is clearly no longer a usable name for the genus.

An analysis may be given of those species which have been first described as *Laxosuberites*. *L. aquaedulcioris* Annandale, 1914, page 157. Indian, brackish water, encrusting, green to gold, spicules 6 by 330 microns. Typical architecture, probably a good species of *Terpios* to which it is here transferred.

L. conulosus Burton, 1930, page 669. India, massive, colour in life not given, surface conulose, spicules 7 to 14 by 560 microns. A good species, unless perhaps a synonym of *aquaedulciorus*. This, of course, must be transferred to *Terpios*.

L. durus Stephens, 1915, page 37. Irish.
L. ectyoninus Topsent, 1900, page 189. Mediterranean.
L. incrustans Stephens, 1915, page 36. Irish.

These three were transferred to *Suberites* by de Laubenfels, 1936, page 147. A new name is required for *incrustans* of Stephens, because there are already three other species named *Suberites incrustans*; it may therefore here be named *Suberites stephensi*.

L. lacustris Annandale, 1915, page 45. India, brackish water, spicules 8 by 570 microns. This is here regarded as emphatically conspecific with and falling in synonymy to the earlier *aquaedulcioris*, in *Terpios*.

L. mexicensis de Laubenfels, 1935, page 9. Pacific coast of Mexico, a single, small specimen. It is my present opinion that this should rather go to the genus *Prosuberites*, which transfer is here made. There is a similar species in Japan, which was described as *Leucophloeus perforatus* by Thiele, 1898, page 47; this should also go to *Prosuberites*. Thiele, 1898, page 48, also described *Leucophloeus incrustans* from Japan; this is here designated as conspecific with *perforatus*, and thus also referred to *Prosuberites*. In order to make these transfers, the generic diagnosis of *Prosuberites* requires a slight alteration. It has been used exclusively for sponges so thin that they were scarcely thicker than the length of one of their spicules. It must be assumed that specimens several times as thick should still be included, not put in a supposed genus *Laxosuberites*. Thus it may be said that *Prosuberites* comprises sponges somewhat like those of *Terpios*, with a spiculation of tylostyles, but these are much larger than those of *Terpios*, and do not have heads so large in proportion to the diameter of the shaft as is true of those in *Terpios*; also, not even the young spicules have the peculiar lobate form which is true of juvenile spicules in *Terpios*. *Prosuberites* was established by Topsent, 1894, page xlii; its type (designated by de Laubenfels, 1936, page 148) is *Prosuberites longispina* Topsent, 1894, page xlii, a Mediterranean sponge with tylostyles that are 17 by 2000 microns. As a result of this redescription of *Prosuberites*, the West Indian sponge described as *Prosuberites microsclerus* by de Laubenfels, 1936, page 149, should be transferred to *Terpios*; it is probably an immature specimen of *Terpios fugax* and is here so dropped in synonymy.

L. proteus Hentschel, 1909, page 389. West Australia, spicules 5 by 158 to 11 by 808 microns. With some slight doubt this is here transferred to *Terpios*.

L. zeteki de Laubenfels, 1936, page 450. Pacific coast of Panama, red and green ectosome, yellow endosome, massive, spicules 3 to 20 by 700 microns. This is here transferred to *Terpios*.

The genus *Terpios* was established by Duchassaing and Michelotti in 1864, page 97, for a number of West Indian sponges. The type was established by de Laubenfels, 1936, page 152, as *Terpios fugax* Duchassaing and Michelotti, 1864, page 102, which has been described above. The following species have been described as of this genus:

T. aurantica Duchassaing and Michelotti, 1864, page 99. This is represented by British Museum (Natural History) register number 28.11.12.7 and may be a *Pseudosuberites*, but wants further study.

T. australiensis Hentschel, 1909, page 394. West Australian. It is here dropped in synonymy to *Terpios proteus* of the same author, same locality, almost identical description.

T. cladocerae Duchassaing and Michelotti, 1864, page 100. Represented by British Museum (Natural History) register number 28.11.12.9. It may be a synonym of *T. fugax*, but wants further study.

T. coerulea Carter, 1882, page 355. British. This is here referred in synonymy to *T. fugax*, Carter's description fits that of Bermuda specimens very neatly.

T. corallina Duchassaing and Michelotti, 1864, page 98. Specimens lost, species unrecognizable.

T. desbonii Duchassaing and Michelotti, 1864, page 98. Specimens lost, species unrecognizable.

T. echinata Duchassaing and Michelotti, 1864, page 102. Represented by British Museum (Natural History) register number 28.11.12.10. It may be a synonym of *Terpios fugax*, but wants further study.

T. fugax Duchassaing and Michelotti, 1864, page 102. The genotype, represented by British Museum (Natural History) register number 28.11.12.11.

T. janiae Duchassaing and Michelotti, 1864, page 101. Specimens lost, species unrecognizable.

T. lendenfeldi Keller, 1891, page 320. Red Sea. This is here dropped in synonymy to *Terpios viridis*, same author, same locality. The principal, almost only difference is that *lendenfeldi* is described as black rather than dark green. This difference may be due to accident in preservation, or different symbionts. If such a difference were borne out by field studies of living specimens, it would be more significant. Yet one may recall that at Bermuda the varying amount of dark blue material (possibly symbiont) at the very surface rendered specimens of somewhat varying colour.

T. niger Duchassaing and Michelotti, 1864, page 102. Specimens lost, species unrecognizable.

T. symbiotica Hentschel, 1909, page 395. This was transferred to the genus *Terpiosella* by Burton, 1930, page 675. This genus was established on the same page, by Burton; the type and only other species is *Ophtlitospongia* (sic) *fucoides* Bowerbank, 1876, page 771. The spelling was an obvious lapse for *Ophlitaspongia*. The diagnosis of *Terpiosella* is thin sponges growing on algae, with a spiculation of tylostyles. The growth on algae would hardly seem to warrant a new genus; one may note those various Bermuda sponges, such as specimens of *Dysidea fragilis* and *Xytopsues griseum*, which are loaded with coarse algal growths. Data about the spicules of these two species are not all that could be desired, but it seems clear that they and the entire genus *Terpiosella* should be dropped in synonymy either to *Terpios* or to *Prosuberites*. *Pro tem.* it may be regarded as a genus inquirendum.

T. tenuis Duchassaing and Michelotti, 1864, page 100. Represented by British Museum (Natural History) register number 28.11.12.8. It may be a synonym of *T. fugax*, but wants further study.

T. viridis Keller, 1891, page 319. Red sea, encrusting, dark green, slimy, with spicules 2 by 210 microns. Because some spicules are described as being oxeote, the generic allocation of *viridis* is questionable, it is left here with doubt.

Certain species require consideration in connection with the genus *Terpios*, although they were first described in other genera. Some of these are :—

Suberites lobiceps Schmidt, 1870, page 47. West Indian. This is quite obviously a synonym of *Terpios fugax*, of the most typical sort. The species is here transferred to *Terpios* and so dropped in synonymy.

Hymedesmia tenuicula Bowerbank, 1882, page 68. This British sponge was transferred correctly to *Terpios* by Topsent, 1894, and is here relegated to synonymy with *Terpios fugax*. This action serves to call attention, however, to the co-existence of an *Hymedesmia tenuicula* of Lundbeck, 1910, page 52. In order to avoid ambiguity in referring to these two, a new name is required for that of Lundbeck, hence it is here designated as *Hymedesmia tenuicella*, nomen novem.

Hymeniacidon gelatinosa Bowerbank, 1866, page 222. This British sponge is here transferred into the genus *Terpios* and relegated to synonymy with *fugax*.

Hymeniacidon callosus Bowerbank, 1882, page 86. This British sponge is here transferred into the genus *Terpios* and relegated to synonymy with *T. fugax*.

Hymeniacidon calcifera Row, 1911, page 354. This Red Sea sponge is described in such a way that it appears definitely to be a thin encrustation of *Terpios viridis* Keller, overgrown by a thin crust of ascidian of the family Diademnidae, which fate may be often observed as occurring to sponges. The species is therefore here transferred into *Terpios* and relegated in synonymy to *T. viridis*.

Hymeniacidon zosterae Row, 1911, page 355. This Red Sea sponge is described much like the preceding, except not overgrown by ascidian, instead it is on seaweeds of the genus *Zostera*. Comparison should be made with the genus *Terpiosella* as above discussed. The species *zosterae* is here transferred into the genus *Terpios* and relegated in synonymy to *T. viridis* Keller, from the same locality.

It will thus be observed that the following six species are all that are left standing in *Terpios* :

1. *fugax* Duchassaing and Michelotti, 1864. West Indies and England.
2. *viridis* Keller, 1891. Red Sea.
3. *aquaedulcioris* Annandale, 1914. India.
4. *conulosus* Burton, 1930. India.
5. *proteus* Hentschel, 1909. West Australia.
6. *zeteki* de Laubenfels. Panama and Mexico.

Of these there is some doubt as to number 2 (if it has oxeas), of 4 (if it equals number 3), and of 5 (if it really does have two spicule sizes). The principal species of *Terpios* are thus *fugax*, *aquaedulcioris* and *zeteki*.

Family CLIONIDAE Gray.

The sponges of this family have spiculation which is much the same as that of the family Choanitidae. Many specimens of *Cliona*, the type genus, have spicules which closely resemble those of *Spirastrella*. This has already been discussed in connection with the curious Bermuda species, here called *Spirastrella dioryssa*, but which may actually be a *Cliona*. The distinctive feature of the Clionidae is the fact that these sponges excavate galleries into calcium carbonate. As pointed out by de Laubenfels, 1947, page 42, *Cliona celata* may grow in water that is intermittently brackish, but then it lives entirely within its self-excavated tunnels. It may also grow in waters of full oceanic salinity. Then it remains hidden in burrows only while small and young ; as it grows older it emerges and becomes a large, fully exposed sponge.

Genus CLIONA Grant.

Sponges of this genus have a principal spiculation of tylostyles, to which oxeas may be added. Many of them are already known also to have spirasters as microscleres, but these tiny spicules are usually difficult to find ; it may well be that all species of *Cliona* have spirasters, especially when young, but that these may be lost as the sponge grows older, or merely be excessively difficult to find because of rarity and small size.

CLIONA CARIBBOEA Carter.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.46.

Date collected.—July 29, 1947.

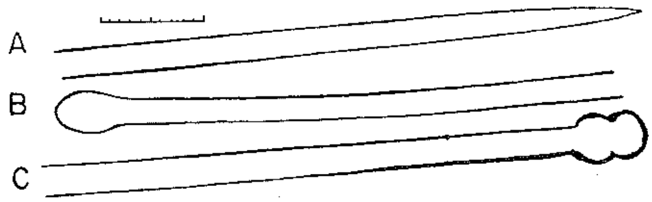
Locality.—Near Daniel's Head, off the west end of Bermuda.

Abundance.—There were dozens of large, head-size specimens of *caribboea* in the one locality, about a kilometre long from north to south, contiguous with the open ocean. None were found anywhere else, nor any small specimens. This is almost certainly the species which Verrill in 1907 reported as being then common throughout Bermuda; he identified it as *Cliona celata*, a species to which *caribboea* is well known to be very closely related. It may well be that during the intervening forty years *lampa* has taken over the locations that are favourable to boring sponges, leaving only this one last remnant of big, old *caribboeas* out at the far western end.

Shape.—All the specimens were built up of rounded lobes which in turn formed cake-shaped masses.

Size.—The lobes were 1 to 5 cm. in diameter. All the specimens were as large as human heads, many as much as twice that size, up to masses 20 cm. thick and 50 cm. in diameter.

Fig. 48.



Camera lucida drawing, ×666, of the spicules of *Cliona caribboea*. A: shows the point. B: the head of the same spicule, but not all of that spicule is shown. C: shows an unusual type of spicule head, a sort that is found in about one spicule of 200 or 300 in this species. The enclosed scale shows 20 microns by twos.

Colour.—Bright yellow-ochre. When put into alcohol they turned the fluid brown, but thereupon the interior of the sponge turned green. This is a very unusual colour or pigment behaviour among sponges. Brown often masks the green of chlorophyll, or is a mixture of this green with red or violet—in such cases the alcohol turns green by leaching it out of the sponge. Here it seems that an alcohol-soluble brown pigment was masking an alcohol-insoluble green pigment. The green colour that results from alcohol immersion of this sponge endures for at least several weeks, and the outside retains the ochre tint.

Consistency.—Somewhat cork-like, firm but compressible.

Surface.—Smooth, even glistening, over the coarse tubercles or rounded lobes.

Oscules.—Abundant, perhaps 20 to 30 per specimen, each 1 to 2 cm. in diameter, but somewhat contractile.

Pores.—Rather uniformly distributed or scattered, in contrast to similar old specimens of *Cliona celata*, in which they are often aggregated into clusters or special pore areas. The pore diameter is about 150 microns when they are fully opened.

Ectosome anatomy.—The surface is thickly beset with microscopic spicule-brushes. Each tuft comprises a hundred or so megascleres, points upward and outward, heads close together. These tufts are about 150 microns apart, centre to centre.

Endosome anatomy.—Confused, cavernous. There are many inclusions of foreign objects, chiefly calcareous—bits of dead coral and shells. Practically no tendency to fibre or tract formation is to be seen, instead, the spicules of the interior are strewn in complete confusion.

Skeleton.—There are spicules of one sort only, tylostyles with rather elongate heads (see figs. 48 B and 49 A). Some have double heads (see fig. 48 C). The common size is 8 by 310 microns, heads 10 microns in diameter.

This species is close to *Cliona celata*, Grant, 1826, page 79, the type of the genus ; *celata* is a sponge of world-wide distribution in cooler waters. *Cliona caribboea* (when evacating) makes larger burrows, and then does not fill them so compactly as does *celata*. When emergent it is more brownish, and the pores not aggregated as in *celata*. Its spicules are thinner but as long as those of *celata*. It seems to be confined exclusively to the West Indian region, including the Bermudas.

Cliona lampa, sp. n.

The syntype of this specis, which is a portion of the holotype, is deposited in the British Museum (Natural History), register number 1948.8.6.45. The residue of the holotype is deposited, at least temporarily, in the Museum of the Government Museum at Flatts, Bermuda.

Date collected.—June 30, 1947, and many others.

Locality.—Harrington Sound, and the coasts of the Bermudas in general, except apparently not at the west end of the archipelago, where *Cliona caribboea* is found instead.

Abundance.—Extremely common. It excavates the local rock, and as all Bermuda is basically aeolian limestone, the field of operations for *Cliona lampa* is enormous. It prospers most, however, where currents are strong. For example, at the inlet to Harrington Sound where the water is eternally rushing, either in or out, there are huge areas of this sponge, areas of hundreds of square metres.

Size.—Indefinite lateral growth. Certainly continuous masses of several metres in diameter occur. It does not arise into the water above the rock in which it is burrowing, although other species of *Cliona* often do so. It certainly penetrates to a depth of 4 cm. into the rock. It would be an interesting bit of research to employ a rock drill and, by tests in various localities, to ascertain just how deep at the deepest it may bore. The opinion is here expressed that it will probably be found to go at least as deep as 10 cm.

Colour.—The living *lampa* is a brilliant red, tending toward the vermillion. In alcohol it is promptly bleached to nearly white, but it thus imparts the bright cherry red to the preservative fluid, and the colour lasts amazingly long in the alcohol, at least several weeks. Dried specimens of *lampa* are slightly brownish, but very pale.

Consistency.—One may readily deduce that this sponge is soft, but this texture is not palpable because of the location within rock interstices. Actually one feels the stone.

Surface.—The stone, shell or coral that is permeated by *lampa* exhibits the distinctive colour of the sponge, but otherwise retains to an astonishingly great degree the same appearance that it would have had if not inhabited by a boring sponge.

Oscules.—Not made out.

Pores.—Not made out.

Ectosome anatomy.—This species does not seem to have dermal papilles such as are described for some kinds of *Cliona*.

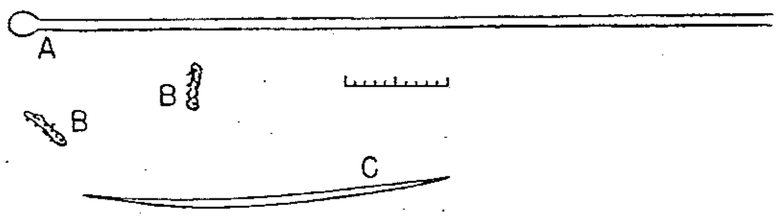
Endosome anatomy.—Buried in rock.

Skeleton.—The principal spicules are straight tylostyles (see fig. 49 A), 3 by 150 to 3 by 210 microns. These are certainly megascleres. There are fairly numerous finely microspined oxeas (see fig. 49 C) which are so small that they may rather be large microscleres than small megascleres; the size is 2 by 70 microns. There are abundant streptasters, only 1 by 10 microns, microspined.

The spiculation of *lampa* is so nearly that of the abundant old-world *Cliona vastifica*, that my first reaction was to regard it as being *vastifica*. Since the summer of 1947 it has become my privilege, as it has not been previously, to work with numerous specimens of *Cliona vastifica* in the field, alive. They are so different from *lampa* that I am almost tempted to put *lampa* into a new genus.

The clear-cut *vastifica* varies in colour from yellowish, usually rusty orange, to rusty red, but *lampa* was uniformly bright vermillion in all of the many varied localities in which it occurred.

Fig. 49.



Camera lucida drawing, ×666, of the spicules of *Cliona lampa*. The enclosed scale shows 20 microns by twos.

The clear-cut *vastifica* bores with burrows which are roughly circular in cross-section, and which meander through coral or other calcium carbonate in much the same way that *Cliona celata* burrows, except that—as Hancock noted in his original description of *vastifica*, 1849, page 342—there are fewer and smaller papillae than in *celata*. The papillae of *vastifica* are between 1 and 2 mm. in diameter, with a round opening, about a third of the total diameter but contractile. Presumably some of these are inhalent, others exhalent. They lead to meandering, occasionally branching galleries. In contrast, *Cliona lampa* is much more diffuse. Instead of only scattered window-like exits and entrances, it covers the entire surface of the mineral in which it lives. There are strands of continuous sponge protoplasm buried in the rock; these are about 1 mm. in diameter and 2 to 6 mm. apart, and may correspond to ordinary *Cliona* galleries, but *lampa* is not confined to them; it penetrates interstices in all directions.

There is a slight spicular difference, too. The microspined streptasters of *Cliona vastifica* are distinctly angulated, whereas those of *lampa* are straight.

The peculiar rock penetration of *Cliona lampa* calls strongly to mind the perplexing situation with regard to the species *dioryssa* which was described above as of the genus *Spirastrella,* but which permeates into minute rock crevices, and perhaps excavates as it goes. It is to be hoped that both will be investigated at length in the future.

Order *EPIPOLASIDA* Sollas.

The sponges of this order have a general appearance which, to the experienced student of sponges, strongly suggests that they belong to the following order or Choristida. Probably many such students have entertained the idea that they really do so belong. Yet it would be difficult to justify such a notion on paper. The Choristida are distinguished by tetractinal megascleres, which the Epipolasida lack. The Choristida often have large, coarse oxeas in addition to their tetraxons, and these are practically the only meglascleres in the Epipolasida, but so are they also in some of the Haplosclerina. Both Choristida and Epipolasida tend to have pronouncedly corticate and radiate structure, but so do the sponges of the order Hadromerina. Both Choristida and Epipolasida frequently have astrose microscleres, but these are also common in the Hadromerina. Thus Epipolasida are like the Hadromerina, except that they usually possess diactinal instead of monactinal principal spicules, and never have tylostyles. They are like the Choristida except that they lack the tetractinellid spicules.

Family JASPIDAE de Laubenfels.

Sponges of this family are distinguished, by their possession of astrose microscleres, from the sponges of the family Sollasellidae, which lack microscleres. Each of these two families is characterized by rather simple radiate architecture. Other families of the Epipolasida have either peculiar structure and shape, or else have the lithistid modification.

Genus Stellettinopsis Carter.

This is one of two genera of Jaspidae that has the remarkable combination of both euasters and streptasters within the same specimen, a most unusual spicule association for any family in the phylum Porifera. The other genus of Jaspidae which has such a combination of microscleres is *Tethyorhaphis,* which has euasters and microspined microstrongyles. It is very close to, and some day may be dropped in synonymy to *Stellettinopsis.* The genus *Melophlus* Thiele, 1899, page 8, should be transferred to the family Jaspidae, close to *Tethyorhaphis,* which it somewhat resembles, but lacks the euasters. It is not suggested that *Melophlus* be dropped in synonymy to *Stellettinopsis.* Sponges of this latter genus have obscurely radiate structure, large coarse oxeas, and—as already observed—euasters plus streptasters.

Stellettinopsis ketostea, sp. n.

The syntype of this species is deposited in the British Museum (Natural History), register number 1948.8.6.47. The residue of the holotype is deposited, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—July 10, 1947, also August 9, 1947.

Locality.—Whalebone Bay, north shore of Bermuda, St. George's Parish.

Abundance.—Two specimens were found. Each was hidden under a rock, depth about one metre.

Shape.—Amorphous to encrusting.

Size.—1 cm. thick, and a little over 2 cm. in diameter.

Colour.—Nearly black as to exterior. In alcohol it faded only slightly. The interior is grey.

Consistency.—Firm, hard, only slightly compressible.

Surface.—Minutely verrucose.

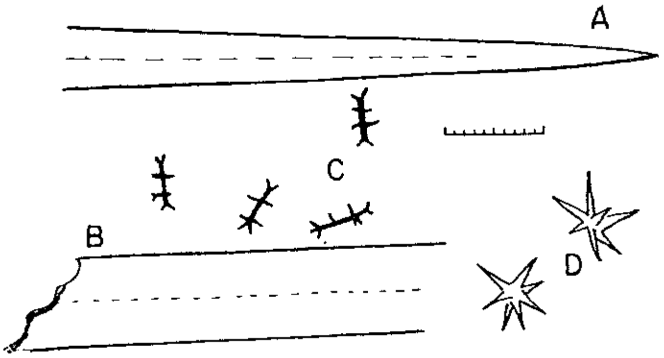
Oscules.—Not to be discriminated from the pores.

Pores.—Abundant over the entire surface, each about 60 microns in diameter. As noted above, in all likelihood some of these apertures are vents, rather than inhalent.

Ectosome anatomy.—There is a cortex about 200 microns thick, characterized chiefly by its content of cells that are full of large, dark spherules.

Endosome anatomy.—Somewhat confused, but with an evident tendency to be radiate. The suppression of symmetry that exists here is probably due to environmental effects.

Fig. 50.



Camera lucida drawing, ×666, of the spicules of *Stellettinopsis ketostea.* A shows a megasclere termination; it could be either end of any megasclere. B illustrates a small fraction of the central portion of one of the megascleres, to show the thickness that is attained. C represents four of the streptasters, and D two of the euasters. The enclosed scale shows 20 microns by twos.

Skeleton.—The megascleres appear to be exclusively oxeas, of great size-variation (see figs. 50 A and 50 B). Representative sizes are 3 by 400, 8 by 600, 15 by 800 and 25 by 1000 microns. The microscleres include abundant, straight streptasters, 12 to 18 microns long (see fig. 50 C) and nearly as common, equally widely distributed oxyasters (see fig. 50 D) 30 microns in greatest diameter.

It was a matter of great satisfaction, and welcome, even though essentially needless confirmation, to find the second specimen of this unusual species, and in this second example the identical spiculation of the first specimen. It is conclusive proof that this combination of the two microsclere sorts can occur; they are both abundant, obviously proper (not foreign or borrowed), and each of the two is a clear-cut representative of its spicule category.

The type of *Stellettinopsis* is *corticata*, set up at the same time as the genus; Carter said of it (1879, page 348), " n. gen. et sp.", which is probably a good type designation, but if not, it was confirmed by de Laubenfels, 1936, page 159. This

Australian sponge was pale yellowish, had the pores in sieve areas, and the streptasters appeared somewhat strongyliform; in this latter respect it resembles the only species of *Melophlus*, which is *sarasinorum*, a South Pacific sponge (Thiele, 1899, page 8). Carter does not give spicule sizes for his species.

The second species of *Stellettinopsis* has been *simplex* (Carter, 1879, page 349), from the same locality as *corticata*. It is described as lacking the cortex and having streptasters that are somewhat sceptrelliform. In this latter respect it approaches the Bermuda species, but *ketostea* is corticate. Both the Australian species (or are they conspecific ?) had special pore areas and yellowish colour, whereas *ketostea* has scattered pores and is nearly black.

Genus EPALLAX Sollas.

Sponges of this genus are quite typical of the family Jaspidae, with radiate structure, large oxeas as megascleres, and astrose microscleres. The distinguishing feature of *Epallax* is the possession of two quite distinct types of (euastrose) microscleres.

EPALLAX AJAX, sp. n.

The syntype of this species, which is a portion of the holotype, is deposited in the British Museum (Natural History), register number 1948.8.6.49. The residue of the holotype is deposited, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—August 8, 1947.

Locality.—Walsingham Pond, Bermuda.

Abundance.—One specimen. This occurrence was a very striking sight. The large white *Epallax* was partially overgrown by bright green *Haliclona viridis*, which was itself partially overgrown by bright red *Tedania ignis*.

Shape.—Massive, sub-spherical.

Size.—About 4 by 5 by 6 cm.

Colour.—White, slightly marred by small quantities of debris on the surface. The white colour, as might be expected, is maintained in alcohol.

Consistency.—Cartilaginous.

Surface.—Almost smooth, but slightly hispid in places, especially where it was overgrown by the other two sponges. This may be a reaction to the overgrowth, but is probably the original condition, the hispidating spicules having been worn off from the exposed portions.

Oscules.—Very small, not distinguishable from the inhalent openings.

Pores.—Abundant, 35 microns diameter. It would seem that the vents are this same small size.

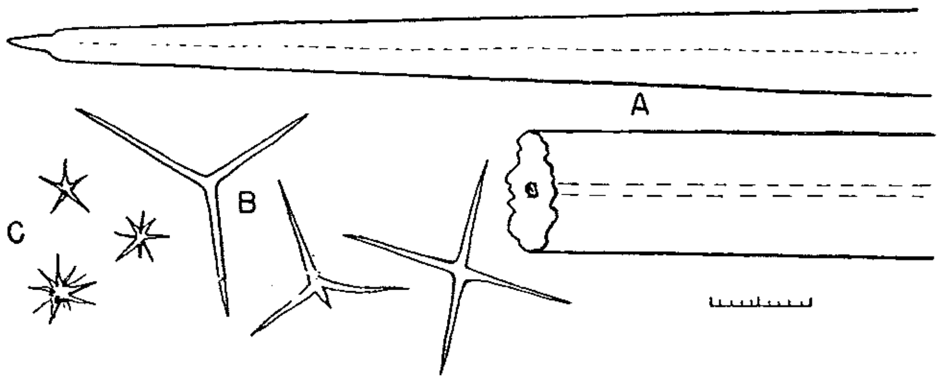
Ectosome anatomy.—Obviously affected by the overlying neighbours. Under the other sponges the cortex is reduced to a thin dermis, only about 10 microns thick. Where not overlaid, it is a normal fibrous cortex, as is to be expected in the Epipolasidae. It is 500 microns thick. The spicules of this cortex, however, are much the same as the spicules of the endosome.

Endosome anatomy.—The interior is densely fleshy, microcavernous, and very full of spicules.

Skeleton.—The megascleres are exclusively oxeas (see fig. 51 A), often 15 by 1500 to 32 by 3300 microns in measurement. In the very centre of the sponge they are packed in confusion, but elsewhere they tend to be orientated perpendicular to the surface (radiate structure). In places they are arranged in fascicular tracts about 130 microns in diameter, each tract containing some 15 spicules per cross-section. As might be expected from the close association with other sponges, a number of obviously foreign spicules occur at the surface.

The microscleres are of two sorts. There are abundant triaxons (see fig. 51 B) and the occurrence among them of occasional tetraxons (also illustrated) indicates that they are probably reduced asters. Their rays are only 1·5 by 30 microns, which seems to put them very definitely into the microsclere category. This is an important matter for consideration, however. If these were megascleres, they would lift the sponge into the order Choristida, and thus it would fall into

Fig. 51.



Camera lucida drawing, ×666, of the spicules of *Epallax ajax*. A : illustrates one end and part of the mid-portion of one of the oxeas. The enclosed scale shows 20 microns by twos.

the genus *Astroplakina*. Their rays, however, are not even as long as the diameter of the obvious megascleres. There are also abundant asters present that are certainly microscleres (see fig. 51 C), and these are only about 18 microns in diameter. Both sorts are euasters, with smooth, sharp rays.

Epallax was established by Sollas, 1886, page 178, for *E. callocyathus* (type species); this is a stalked, flower-shaped vase, and came from the East Indies. Its larger category of microscleres (microcalthrops) had rounded ends to their rays, that is to say, the strongylote modification. This and the shape sharply differentiates it from the species *ajax*.

Topsent, 1890, page 68, described *Epallax incrustans* from the Azores, which also is a mid-Atlantic archipelago, thus analogous to the Bermudas. His entire description (with no illustrations) is " *E. incrustans* possède des oxes, et des asters semblables à ceux de *Hymedesmia spinatostellifera* Crtr., mais avec moins de rayons ". Carter's species, which is thus mentioned, has very peculiar megascleres, with hundreds of acute-angle branches of the axial canal arising at one point near its end. This is quite likely a pathological condition. It has asters with nodally arranged microspines. If *incrustans* has these too, it is very distinct indeed from the Bermuda *Epallax*.

It is greatly to be desired that a series of *Epallax* specimens might be obtained from the North Atlantic region for study, because it is—of course—unsatisfactory to base species on single specimens, yet impossible to refer specimens (such as this one from Bermuda) to species that are evidently different from them.

Family TETHYIDAE Gray.

Sponges of this family are well characterized by their peculiar external shape. They tend to become covered with ectosomal pedunculate tubercles. The degree of development of these numerous surface growths varies during the life of the individual sponge, almost certainly in connection with reproductive processes, but the verrucosities are practically always discernible, and usually are conspicuous.

The architecture is strongly radiate, which is likewise true of the preceding and following orders. The same may be said for the fact that they are corticate, and have astrose microscleres. They are certainly not Choristida, which have tetractinellid spicules, but the order allocation as between Hadromerina and Epipolasida is not easy. A chief difference has been that of monactinal versus diactinal megascleres, respectively. The spicules of Tethyidae are intermediate; they are not quite like ordinary diacts nor monacts, but are strongyoxeas that may be equi-ended, hence diactinal, or—still the same peculiar type—they may be inequi-ended, hence technically monactinal. Some are pronouncedly monactinal.

Genus TETHYA Lamarck.

Almost the only genus of the family, this one has a venerable history; it was one of the earliest to be separated from the parent genera, *Spongia* and *Alcyonium*. Sponges of the genus *Tethya* are in all respects typical of the family Tethyidae as described. There are three other genera in the group. *Tethytimea* de Laubenfels (1936, page 164) includes sponges with decidedly monactinellid megascleres, but otherwise similar to *Tethya*. *Tethycordyla* de Laubenfels, 1934, page 8, includes sponges which vary in external shape considerably in the direction of the peculiar habitus of *Stylocordyla* and thus in general toward the family variously known as Stylocordylidae or Podospongiidae. The genus *Taboga* de Laubenfels, 1936, page 452, has in its original diagnosis an emphasis on the presence of four types of asters, one with branched rays. Perhaps even greater emphasis should be laid on the fact that there is an ectochrote of erect megascleres, densely packed, outside the extremely muscular but otherwise rather typical Tethyoid cortex. The asters with branched rays (as found in *Taboga*) bear an interesting resemblance to the distinctive characters of the following new species.

TETHYA ACTINIA, sp. n. (See Pl. II, fig. 8.)

The syntype of this species is deposited in the British Museum (Natural History), register number 1948.8.6.48. Additional syntypes are deposited, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—June 30, 1947, and many others.

Locality.—Harrington Sound, Walsingham Pond, and the coasts of Bermuda, generally.

Abundance.—Very common in diverse marine localities.

Shape.—Sub-spherical, often ovoid, taller than thick.

Size.—Typically the size as well as the shape of an egg. Specimens as tall as 5 cm. are exceptional.

Colour.—The living sponge is probably always bright orange. The interior is consistently of this hue, but several situations obtain for the exterior. Especially in Walsingham Pond, but often everywhere, *Tethya actinia* appears bright green. It seems obvious that this is due to algal symbionts in (or on) the surface. This colour dissolves into alcohol promptly as chlorophyll dissolves, so that a green sponge may quickly " turn orange " upon being plunged into spirits. Especially in Harrington Sound, but occasionally in the other localities, *Tethya* appears bright orange externally as well as internally. Locally these specimens are quite appropriately called " tangerines " as a result of their resemblance to lumpy specimens of that citrous fruit. A few specimens were found that were intermediate, with just enough green to dull the orange to a sort of grey or drab ; these were not so common as the bright orange ones, which in turn were less abundant than the bright green specimens. In the first week of July 1947, one unique specimen was discovered—a typical *Tethya actinia* in all respects except that the exterior was a rich purple colour. A careful microscopic study, especially of the spicules, revealed its identity in the most minute details with the green and with the orange specimens or—for that matter—with the drab ones.

Consistency.—Cartilaginous, modified by the high ratio of spicule to flesh.

Surface.—Extremely verrucose. The surface lumps are themselves lumpy. The primary protrusions are about 3 mm. in diameter, the secondary, superimposed bumps are about 300 to 500 microns in diameter. The diameters are much more uniform than the heights. Some specimens are covered with stalked warts 5 mm. high. A height of between 2 and 3 mm. is much more common, and specimens occur with the warts as little as 1 mm. high.

Oscules.—These are regularly small and contractile in *Tethya,* seldom observed.

Pores.—These are also small (microscopic) and extremely contractile. *Tethya* is one of the very most " muscular " of all sponges.

Ectosome anatomy.—A tough, fibrous, strongly contractile cortex, usually a little over 1 mm. thick.

Endosome anatomy.—Emphatically radiate. The large megascleres are packed, parallel, in fascicular tracts which radiate from a point near the centre of the base of the sponge and are approximately perpendicular to the surface. The soft parts are confined to the comparatively small areas between the spicular columns.

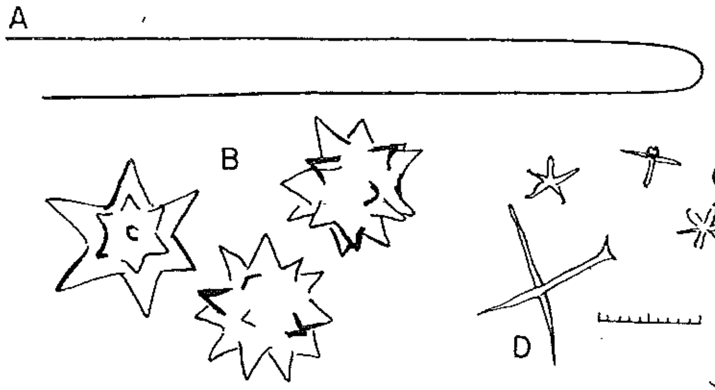
Skeleton.—The megascleres are of a very distinctive type, called strongyloxeas (see fig. 52 A). The fact that the ends are rounded (as illustrated) gives rise to the resemblance to the strongyle ; but the fusiform shape (not illustrated) with a thick centre, tapering to only a minute fraction of that largest diameter before rounding off, affords considerable resemblance to an oxea. These spicules are often 20 by 2000 microns, or even longer, in *Tethya actinia.*

There are three distinct types of microscleres. There are abundant spherasters (see fig. 52 B), total diameter about 30 microns, of which the solid centre is about 15 microns thick ; this sort is commoner in the cortex than the other microscleres, but in the interior it is less common than they are.

There are very abundant chiasters (see fig. 52 C), total diameter 10 to (rarely) 15 microns. Most of them have about 8 rays. A sort with only 5 rays may constitute a distinct variety. The rays are blunt and microspined. Finally there are regularly present, but rather uncommon, large oxyasters (see fig. 52 D) total diameter 32 microns, with only 4 to 7 rays; the commonest number is 5 rays. Furthermore, almost always one or more of these rays are dichotomously branched, near their tips.

Tethya was established by Lamarck, 1814, page 69, having as its genotype the sponge which was first described as *Alcyonium aurantium* by Pallas, 1766, page 210. The genotype was fixed by Topsent, 1920, page 643. The fact that scholars of a century ago placed sponges in the Coelenterate genus *Alcyonium* need not be elaborated upon in this treatise.

Fig. 52.



Camera lucida drawing, ×666, of the spicules of *Tethya actinia*. A: illustrates only the termination of one of the megascleres. The enclosed scale shows 20 microns by twos.

It is with great reluctance that I propose a new name in this genus, which has already many times as many names as there are valid species. Quite frankly it must be anticipated that *actinia* is not really a new species, but may some day be reduced to synonymy—but this reduction should not be lightly undertaken. It must depend upon a redescription, based on type material, of some older name. The situation that exists is as follows: very many specific names crowd the literature of *Tethya*, based upon specimens from many parts of the world, but with exceedingly brief and inadequate descriptions. No description has yet covered a *Tethya* with the peculiar asters of the Bermudan one, but such spicules may really exist in some of the ill-described species. Unless such are found in type material, or until they are found, *actinia* is available as a useful designation. Very similar asters with branched rays do occur and are described by de Laubenfels, 1936, page 453, fig. 43 D, in the sponge from Pacific Panama, named *Taboga taboga*. The distinctive character of *actinia* is the aster with forked rays, as here illustrated in fig. 52 D.

B. B. Crozier, as already noted, referred Bermuda specimens of *Tethya* to three species of *Donatia*. Nardo set up the name *Donatia*, 1833, page 522, almost twenty years later than *Tethya*, which dates to Lamarck, 1814, page 69; consequently it must, of course, fall in synonymy to *Tethya*, yet—curiously enough—even in the last few years various writers have continued to use Nardo's name. Of Crozier's three names, *lyncurium* was described as an *Alcyonium* by Linné, 1767, page 1295, but is a synonym of *aurantium*, as Linné himself indicated, and as confirmed by Topsent, 1900, page 294. *Alemo seychellensis* Wright, 1881, page 13, is a name proposed for a *Tethya* from the Indian Ocean, which is very inadequately described, but which appears to be an *aurantia ;* certainly there is nothing in its description to set it off from *aurantia.* Besides *lyncurium* and *seychellensis*, Crozier used the name *ingalli.* This was set up as *Tethea* (sic) *ingalli* by Bowerbank, 1858, page 307, and specialists in the Porifera who read Bowerbank's description do not find how it differs from *aurantia* ; it is curious to note that Crozier, who had not specialized in regard to sponges, considered it different.

Crozier was swayed by extreme preoccupation with cortex thickness, but this is utterly unreliable as a differentiation between species of *Tethya.* Each individual sponge of this genus has a cortex which starts thin and grows thicker. It appears that about once a year (the rhythm has never been followed long enough to be sure of its exact length) the entire ectosome of the sponge goes into a violent effort of bud formation, each bud dropping off to serve as a potential new sponge. Among the items not yet ascertained are these : does the sponge then die, or does it survive to repeat the cycle ? If so, how long is it until the next outburst of bud formation ? How old is the sponge when it has its first great effusion of asexual buds ? But as for cortex thickness, this is modified most effectively by this cycle ; early in the sequence the cortex is thin, later it is thicker.

The species *actinia* is clearly closely related to *aurantia*, but appears to reveal that evolution has been going on its way in Bermuda. The comparison to *Taboga taboga* is interesting because this latter sponge, being in Panama, is still further removed from the centre of abundance of *aurantia* than Bermuda is. How does it happen that *actinia* differs from *aurantia* by being a little like *Taboga* ? One of many possible theories is that *actinia* could be the primitive form, that east of Bermuda *aurantia* evolved by losing the asters with forked rays, while west of Bermuda *taboga* evolved by gaining the peculiar ectochrote on its surface.

Family SCLERITODERMIDAE Sollas.

Once in a long time a living lithistid sponge is found, as happened on the 8th of August, 1947, at Walsingham Pond, Bermuda. Fossil lithistid sponges are among the most abundant of all fossil Porifera. This does not indicate that the lithistid modification occurred more frequently in bygone ages than it does now, but merely that when this modification does happen, the result is therefore more likely to serve as a fossil. Other sponges are likely, when they die, to disintegrate. Their isolated spicules may endure ; in fact, isolated spicules are common, tantalizing fossils—but little can be deduced about the sponge from only its spicules. One need only recall the diverse sorts of sponge which have only oxeas as spicules to perceive the quandaries that result.

Vosmaer, in his famous monograph of the Porifera for Bronn's " Thier-reich ", divides all the sponges, other than the calcareous ones, into three orders.

I. Hyalospongiae (page 252). Now regarded as a class.

II. Spiculispongiae (page 281). This and the following now make up the class Demospongiae.

III. Cornacuspongiae (page 335). This was divided into (first) the suborder Halichondrina, now an order, in which he included also the modern orders Poecilosclerina and Haplosclerina, and (second) the suborder Ceratina, which corresponds to the modern order Keratosa—actually an older name for the group.

Vosmaer's Spiculispongiae were divided into two suborders, of which his Tetractina includes the modern orders Choristida, Carnosa, Epipolasida and Hadromerina. His other suborder (and his suborders were, it may be noted, more like what would now be regarded as subclasses) was Lithistina (page 281). This monograph was published in fractions, from 1882 to 1887. By Vosmaer's own account, in his ' Bibliography of Sponges ', page 281 was first published in 1885.

Lithistid sponges often have some spicules which are like those of sponges that are not lithistid. Some or all of the spicules, however, have secondary deposits of silica added, so that they become grotesquely lumpy, and they even ankylose. If not actually cemented together, they at least interlace, so that the resulting articulate skeleton stays together long after the sponge has died. This is the reason that such forms assume great importance in the field of paleontology. Sometimes only the secondary deposit is in evidence, and it is not possible to ascertain what type of spicule was thereby modified.

The idea that the lithistid sponges constituted a natural order has been questioned. There are numerous cases, as noted, where it is possible to see what sort of sponge secondarily metamorphosed. Sponges that would otherwise be classified in several orders are clearly involved, perhaps any sort of sponge may undergo the lithistid modification. It must be emphasized that it may even be pathological. The outline of the phylum Porifera which was published in 1936 (de Laubenfels, Carnegie Institution Publication number 467) puts various familes of lithistids into several different orders. This still, however, leaves a perplexing situation when lithistid sponges are found with spicules of the sort called acrepid desmas. This may be explained further as follows : The elaborate, warty structures are all called desmas, and a monactinal spicule, as the result of lithistid modification, becomes a monocrepid desma. If it is a tetraxon spicule, the result is a tetracrepid desma. The puzzling case is " acrepid ", no base being discernible. A Bermudan sponge requires description, but its classification is difficult, because it is a lithistid species with acrepid desmas. It has, however, some spicules that are not desmas. With much hesitation, on the basis of these spicules, it is put into the family Scleritodermidae.

Sponges of the family Scleritodermidae have desmas, also diactinal simple spicules, and may have raphids, or sigmaspires, or both. The diacts are sometimes strongyloxeote, suggesting resemblance to the Tethyidae ; it is for this reason that I put them in the order Epipolasida. Actually their phylogenetically correct allocation is enigmatical.

Genus Desmascula, nov.

The genus is characterized by a dictyonine amalgamation of coarsely acanthose desmas that appear to be acrepid. To this are added smooth monaxon spicules and peculiar contorted microscleres which seem to be greatly modified oxyasters. Other genera of Scleritodermidae do not have microscleres at all like this. The type species of *Desmascula* is *desdemona*.

Desmascula desdemona, sp. n.

The syntype of this species, which is a portion of the holotype, is deposited in the British Museum (Natural History), register number 1948.8.6.50. The residue of the holotype is deposited, at least temporarily, in the Museum of the Government Aquarium at Flatts, Bermuda.

Date collected.—August 8, 1947.

Locality.—Walsingham Pond, Bermuda.

Abundance.—One specimen.

Shape.—A thin encrustation on another sponge, namely *Spheciospongia othella*.

Size.—400 microns thick, 23 mm. in diameter.

Colour.—The living sponge was red, medium dark, slightly brownish. In alcohol it has become brown.

Consistency.—Brittle, fragile.

Surface.—Smooth.

Ectosome anatomy.—No specialization is evident.

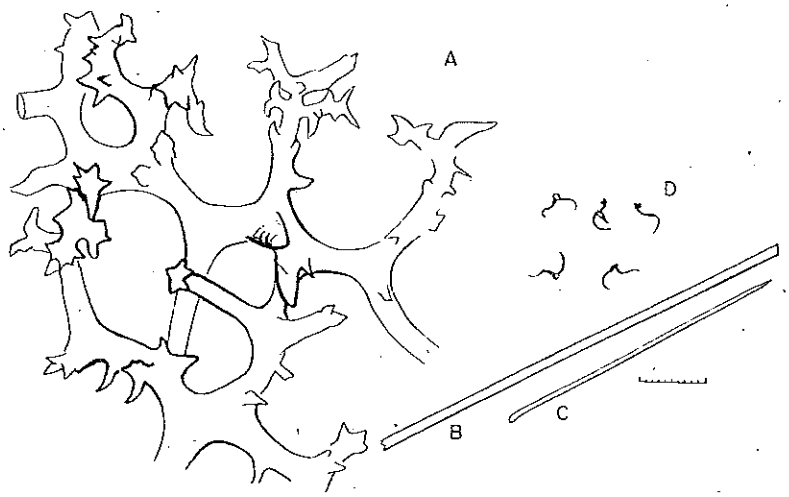
Endosome anatomy.—Exceedingly little protoplasmic material in a large amount of skeleton. If lithistid sponges are pathological, that fact might be an explanation of the nature of this endosome. It had definitely living, cellular tissue, however, when collected.

Skeleton.—The sponge body is filled with three-dimensional reticulations of ankylosed desmas. There are a number of such units, dove-tailed together, not just one perfectly continuous network. The gnarled desmas are coarsely spiny (see fig. 53 A) and often about 10 microns in diameter. There are no conspicuous (or even evident) axial canals. Among this dictyonine framework stand many smooth, straight spicules, practically all of which were broken (see fig. 53 B). They are 4 microns thick, and at least 700 microns long. The internal end of one such spicule and the external end of another were found. Each of the two was acute, so the indication is that the spicule type is an oxea. There were some scattered styles (see fig. 53 C) about 2 by 100 microns, not certainly proper. There were tylostyles, but these could not be distinguished from those of the underlying *Spheciospongia*.

The microscleres that are present in moderate abundance (see fig. 53 D) are interesting, best described by the camera lucida drawing. Each has a globular portion, about 2 microns in diameter, that may be the remains of the centrum of an aster. From this sphere, one or (more often) two rays extend. When there are two, they may be near each other or almost diametrically opposed. Each ray is much contorted, tapers gradually to an exceedingly sharp point, and is about 10 to 12 microns long.

In the field this sponge looked extremely like the locally abundant sponge, *Spirastrella coccinea*, and was almost ignored for that reason. Other specimens may have been overlooked in that way. It occurred to me to see if this was or was not another *Spirastrella* specimen, and at first I thought surely it was. There were tylostyles (as in *Spirastrella*), but these probably were from the underlying *Spheciospongia* (or were they ?), and there was a dense dermal mass of spiny, contort silica, amazingly like the mass of spirasters which occurs at the surface of *coccinea*. I still wonder if this is a modified *Spirastrella*. The ankylosed condition was then noticed. Perhaps the soundest reason for believing that this is not a metamorphosed *Spirastrella* is the occurrence of the peculiar microscleres.

Fig. 53.



Camera lucida drawing, ×444, of the spicules of *Desmascula desdemona*. The style which is illustrated at C is not certainly proper. The enclosed scale shows 20 microns by twos.

The genus *Leiodorella* Zittel, 1878, page 113, has a similar acanthose dictyonine net, but we do not know of any microscleres for it. It may have had them, but is known only as a Jurassic fossil from Poland. In Vosmaer's key to the Lithistida, our species comes down to *Arabescula* Carter, another thin crust, but *Arabescula* has no recorded microscleres, and its desmas were smooth on the side toward the surface. The genus *Scleritorderma* Schmidt, 1879, page 28, has desmas less ankylosed than *Desmascula*. It has straight strongyles rather than oxeas, and small, curved, sigmoid oxeas. It is especially interesting for comparison because it is recorded by its author from the West Indies.

Order *CHORISTIDA* Sollas.

The sponges of this order are typically " tetraxonid ", with at least some large megascleres that have rays extending out in four different directions from a single point. Sixty years ago a considerable difference was supposed to exist between these and the contrasting group or " monaxonid " sponges. There are many indications, however, that most or all of the Epipolasida, while technically monaxonid, are actually more closely related to the Choristida. Both of these orders are characterized by large spicules, radiate architecture, and distinct, fibrous cortex. The microscleres of both are asters.

Family ANCORINIDAE Gray.

Sponges of this family are well representative of the Choristida, and have euasters for microscleres. Some of them also have streptasters. They never have the sterraster armour of the Geodiidae.

The genus *Monotria* de Laubenfels, 1936, page 179, should be transferred to this family. In the reference cited, the assumption is made that triods were present. The species on which the genus is based, *Coppatias solidissima* Wilson, 1902, page 387, is there inadequately described, inasmuch as Wilson merely refers to the presence of "triaenes" without giving their size, or stating if they were triods, protriaenes, mesotriaenes, anatriaenes, or whatever. I have come definitely to the conclusion, however, that they were one of the other sorts, not triods, hence the change in family allocation.

Genus STELLETTA Schmidt.

This is one of the most typical and common of all Choristid genera. The structure is as indicated in the family description. The megascléres are those most representative of the order: large oxeas, plagio- or even dichotriaenes, and often protriaenes and anatriaenes. Both of the latter are probably present in every species, but perhaps not in every specimen, because it seems that one or both of them may be very rare without this rarity having any especial taxonomic significance. A critical point to separate the genus *Stelletta* from other closely related genera, is that sponges of this genus have two distinctly different kinds of microscleres; these are euasters. The genus was established by Schmidt, 1862, page 46.

STELLETTA GRUBII Schmidt.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.51.

Date collected.—July 9, 1947.

Locality.—Walsingham Pond, Bermuda.

Abundance.—Although elsewhere common, this sponge, and Choristida in general, are astonishingly rare in the Bermudas. Only the single specimen of *Stelletta* was found in a summer's collecting, but this is the first West Indian record of this genus.

Shape.—Sub-spherical.

Size.—This specimen is about 25 mm. in diameter. The genus is often represented by fist-size, or even head-size sponges.

Colour.—Dingy white, alive and in alcohol. The sponge itself is probably quite white, but coarser or finer debris may be responsible for the somewhat grey appearance.

Consistency.—Cartilaginous, modified by the high ratio of spicule to flesh.

Surface.—Decidedly hispid, with spicules protruding in dense stands. Members of this and related genera are often as dangerous to handle as are cactus plants. The needles easily penetrate the skin; they are removed only with difficulty and pain.

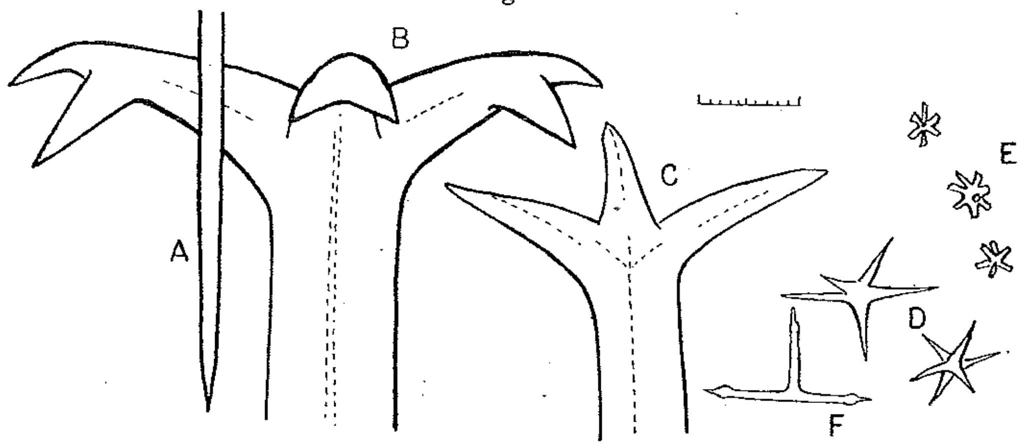
Oscules.—Small and contractile, thus not found. In this genus they are regularly contractile, but sometimes are so large to begin with that, even so, they are readily observed.

Pores.—Microscopic and contractile.

Ectosome anatomy.—There is a dense, fibrous, muscular cortex about 1 mm. thick over the entire surface. This contains rather numerous microscleres, and is underlaid by the (tangent) cladomes of the large triaenes. It is pierced by the long oxeas that render the surface hispid ; these extend as much as 1 or 2 mm. beyond the organic surface.

Endosome anatomy.—Very full of spicules, radiate, with soft parts crowded into the interstices. Enough spicules are in confusion to give a coherent basis to the mineral portion, too.

Fig. 54.



Camera lucida drawing, ×666, of the spicules of *Stelletta grubii.* A shows a pointed end of a megasclere. This could be either end of one of the oxeas, or the inner end of the rhabd of one of the triaenes. The central portion of the oxea is not illustrated. B and C show dichotriaene and plagiotriaene respectively. Only the cladomes are shown, and the extreme upper portion of the rhabd. It appears that in all sponges having either of these two types, the other may be expected, that the spicules in question are first formed as the plagiotriaene, then made over into the dichotriaene later. In many specimens, including this from Bermuda, all intermediates occur. D shows typical oxyasters, E typical chiasters, and F illustrates a freakish spicule, probably to be regarded as a modified oxyaster. The enclosed scale shows 20 microns by twos.

Skeleton.—There are numerous large megascleres. Probably the commonest are oxeas, certainly as large in some cases as 30 by 4500 microns, and perhaps larger (see fig. 54 A). Smaller, developmental forms occur. Then there are plagiotriaenes (see fig. 54 C) which, as usual, grade into dichotriaenes (see fig. 54 B). The rhabds of these textrons are almost or quite as large as the oxeas, up to 30 by more than 400 microns. The clads reach a length of at least 60 microns. The microscleres are of two or more sorts. There are oxyeuasters (see fig. 54 D) common throughout the whole sponge, cortex and interior ; their diameters vary from 15 to 30 microns ; they have 5 to 8 rays. Then there even more abundant chiasters (see fig. 54 E), all about 8 microns in diameter. They are microspined. Some occasional odd-shaped microscleres are probably abnormal variants rather than additional categories.

Stelletta grubii was described by Schmidt, 1862, page 46, from the Mediterranean, and is the type of the genus. Later, many species have been added, but it seems that the supposed bases of difference between them and *grubii* in many cases are merely normal variations within a species or even within a specimen. Because of the multiplicity of names, however, the real distribution of *grubii* is not established. It is at least Mediterranean and West Indian, perhaps cosmopolitan or (rather) circum-mundane.

This multiplicity of synonyms is especially acute in the genus *Myriastra*, which is extremely closely related to *Stelletta*, but has only one kind of aster instead of two. In the West Indian region there is such a species, first described as *Ancorina fibrosa* by Schmidt, 1870, page 67, then as *Pilochrota variabilis* by Wilson, 1902, page 384, and then as *Stelletta incrustata* by Uliczka, 1929, page 47. The three names are here reduced into synonymy, to be called *Myriastra fibrosa*. Except for the aster situation, this species is much like *Stelletta grubii*.

Family GEODIIDAE Gray.

Sponges of this family are much like those of the Ancorinidae, except for the addition in Geodiidae of a distinctive and important variety of spicule known as the sterraster. This is essentially an aster with rays so numerous that scarcely any space is left between them, even at their tips. These tips are blunted, so that the surface is rather to be termed verrucose than hispid like the surface of an oxyaster.

Genus Geodia Lamarck.

The megascleres of this genus are much like those of *Stelletta*, and so is their pattern or arrangement. Both genera have small oxyasters. In *Geodia* there are also the very characteristic sterrasters. These are first built as oxyspherasters with exceedingly numerous rays; such microscleres in various developmental forms may be found in the interior of *Geodia*, from very small up to 20 or 30 microns in diameter. Then they are moved on out to the cortex and completed into the large, nearly spherical or ovoid, mature sterrasters. These are so abundant that they form more than half the volume, and much more than half the weight, of the cortex. They are strongly knit together by fibres and muscle cells, so that it is appropriate to term the cortex of *Geodia* a sterraster armour. In the genus *Erylus* a somewhat similar end product is arrived at from a different sort of aster to begin with; its sterrasters can be recognized by their flattened shape, almost like discs rather than balls.

Geodia gibberosa Lamarck.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.52.

Date collected.—July 28, 1947, and many others.

Locality.—Harrington Sound, and the coasts of the Bermudas in general.

Abundance.—Nowhere outstandingly common, this species is yet so very widespread that in the aggregate it is one of the common sponges of Bermuda. It is usually hidden, under rocks, in crevices, under other sponges, or algae. It is easily overlooked.

Shape.—Amorphous, massive, always somewhat rounded at the edges.

Size.—Elsewhere this species becomes head-size or larger, but no Bermudan specimens were found greater than fist-size. Larger ones doubtless occur.

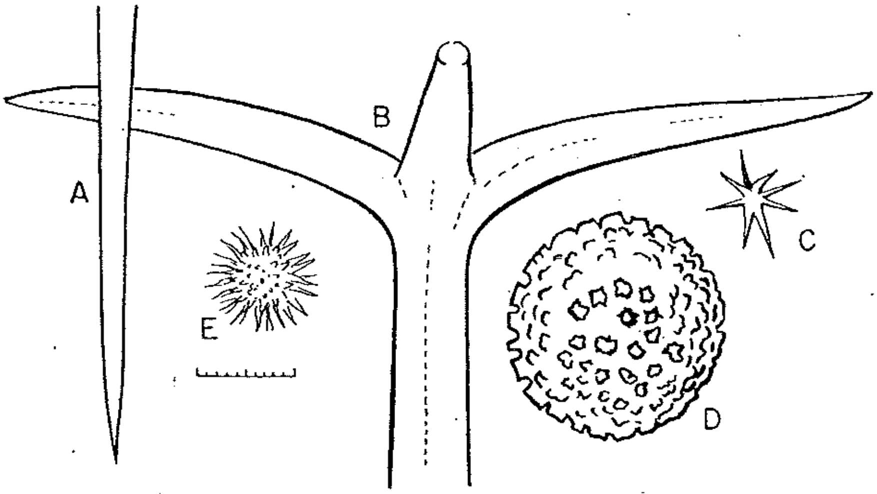
Colour.—The basic colour tends to be white, because of the refraction of light by the sterrasters in the armour. On the surface of some specimens there occurs a thin layer of dark rich blue, akin to that which almost always occurs on *Terpios*, insoluble both in alcohol and in water. Grey, even rather dark grey specimens are sometimes found, perhaps due to surface debris. The interior is often darker than the exterior, always dull coloured, a sort of drab.

Consistency.—The cortex is stiff, like the leather sole of a shoe, and the interior is rather cork-like, with obvious tactile sensations of the abundant spicule content.

Surface.—Smooth, but conspicuously punctiform.

Oscules.—Difficult to tell from the pores.

Fig. 55.



Camera lucida drawing, ×666, of the spicules of *Geodia gibberosa*. A could be either end of one of the oxeas, or the pointed end of the rhabd of one of the triaenes. B shows the cladome of a mature triaene; smaller, shorter-rayed spicules are common. This sort could be called an orthotriaene, or a plagiotriaene. C is the oxyeuaster, D the mature sterraster, and E an immature sterraster. It is important not to confuse this latter with a true oxyaster. The enclosed scale shows 20 microns by twos.

Pores.—Probably because of the limitations produced by the sterraster armour, the inhalent openings of *Geodia* are often, perhaps usually, in the form of porocalyces. These are nearly 1 mm. deep and about the same diameter. The oscules are so nearly this same size, not averaging any larger, that it is a long and laborious task to ascertain for any given opening whether it was an inlet or an outlet. Naturally most of the surface pits remain unexplored. These pits are not uniformly distributed at all. Large areas of the surface are completely imperforate, other areas are so full of holes that the partitions are narrower than the apertures. Some of these may be pore areas, some may be groups of oscules.

Ectosome anatomy.—A tough cortex, 1 mm. thick or even slightly thicker. It is densely packed with sterrasters.

Endosome anatomy— Basically radiate, but as the sponge grows laterally the focal point is inevitably enlarged to become a focal area, and in this central area the structures are confused rather than neatly radiate. The protoplasmic structures are restricted to the scanty spaces between spicules.

Skeleton.—The abundant megascleres are simple oxeas (see fig. 55 A), often 20 by 3200 microns—some perhaps much larger. These are, in general, perpendicular to the surface, and here and there they may protrude somewhat. There are also orthotriaenes (see fig. 55 B) with rhabds of the same size as the oxeas; their clads are upwards of 100 microns long. It is to be expected that the dicho modification would occur, but it is rare or wanting in *Geodia gibberosa.* The cladomes are, of course, usually parallel to the cortex and placed immediately below the cortex.

There are abundant oxyeuasters (see fig. 55 C) in the endosome, 15 to 20 microns in diameter. The mature sterrasters (see fig. 55 D) are only about 40 microns in diameter in Bermudan specimens. This is commonplace, except that elsewhere some of them are found to grow considerably larger.

The genus *Geodia* and the species *gibberosa,* its type, were established by Lamarck, 1815, page 333, for specimens from the West Indies. This species (and apparently no others of the genus) is abundant through the whole region. It is doubtful if *Geodias* in other parts of the world belong to *gibberosa,* but the differences are not great. Average size of sterrasters, existence of anatriaenes, protriaenes, mesotriaenes or combinations of these are appealed to for species descrimination. Doubtless many described names for *Geodia* require to be dropped in synonymy.

Family CRANIELLIDAE de Laubenfels.

Sponges of this family have the radiate, corticate structure of the Choristida. The megascleres regularly include large oxeas, anatriaenes and protriaenes, all very much like the spicules of the other families of Choristida, but the plagiotriaenes and dichotriaenes which are so common in the other families are rare or quite absent. The microscleres are probably to be regarded as being asters, and furthermore, to be homologous with the streptasters which occur in some members of the family Ancorinidae. The euasters which always occur in the Ancorinidae are, however, lacking from the Craniellidae. The microscleres that are present are usually (and probably correctly) classified as being spirasters, but this is not obvious. They are elongate and spiral or sigmoid, but at first glimpse they resemble smooth sigmas or sigmaspires with blunted, strongylote ends. It is usually possible, however, to make out microspines over their surfaces, either with the high-power or with the oil-immersion microscope objective. The thoughtful criticism of this is to enquire if sufficient magnification might not reveal minute roughening on almost any and every microsclere.

Genus CINACHYRA Sollas.

This genus was later reported with the spelling *Cinochyra,* but the original and correct spelling is *Cinachrya* Sollas, 1888, page 23. Sponges of this genus are typical of the Craniellidae, with rather more hispid surface than most of the other genera have, and with the especial peculiarity that the inhalent openings are situated in the concavities of extra large porocalyces. These inlets are much larger than the oscules, and may occupy special zones around the body of the sponge.

CINACHYRA CAVERNOSA (Lamarck) Topsent. (See Pl. II, fig. 7.)

Bermuda specimens of this sponge are represented by British Museum (Natural) History) register number 1948.8.6.53.

Date collected.—June 30, 1947, and many others.

Localities.—Harrington Sound, Walsingham Pond; and the coasts of the Bermudas in general.

Abundance.—This species is extremely common in shallow water everywhere about the Bermudas.

Shape.—Sub-spherical or oblate, flattened on top and on bottom.

Size.—Specimens with a diameter as great as 8 cm. are fairly common. Smaller specimens are, of course, even more common.

Colour.—The living sponge is rich ochre yellow. In alcohol this fades somewhat, but remains the same general hue. Dry specimens turn a dark brown, almost like amber.

Consistency.—Firm, dense. This is the result of a moderately soft protoplasmic mass which is densely permeated with quantities of long siliceous spicules. One does not palpate this sponge extensively because of the cactus-like surface.

Surface.—Extremely hispid, with a surface-plush which is as much as 4 or 5 mm. high.

Oscules.—Small, contractile, probably up to 200 microns when fully expanded. They are numerous and scattered on the upper surface of the cake-shaped sponge.

Pores.—The inhalent openings of this genus were long mistaken for oscules. Each porocalyx is 5 to 8 mm. in diameter; a few are round in outline, but the great majority are decidedly elliptical. The spicules of the surface radiate from them like the petals of a sunflower or daisy when the calyx is fully opened, but its surrounding tissue is muscular, and when the calyx contracts, the tall spicules are so bent inwards that they form a bristling protection quite covering the opening. If the sponge grows in the vicinity of sand, which was observed to be the case at the west end of the Bermudas, the tall spicule fringe is bent so as to serve as a grating or sieve to keep sand particles out of the porocalyx. The lining of the calyx is smooth, punctiform, with very contractile inhalent apertures thickly disposed about it. These may possibly open to as great a diameter as 70 microns. The porocalyces are placed in an equatorial zone about the sponge, leaving the lower surface imperforate (on the substrate) and the upper surface exhalent.

Ectosome anatomy.—There is a definite, contractile and fibrous cortex, but it is thin as compared to the size in most Choristids—usually under 50 microns thick.

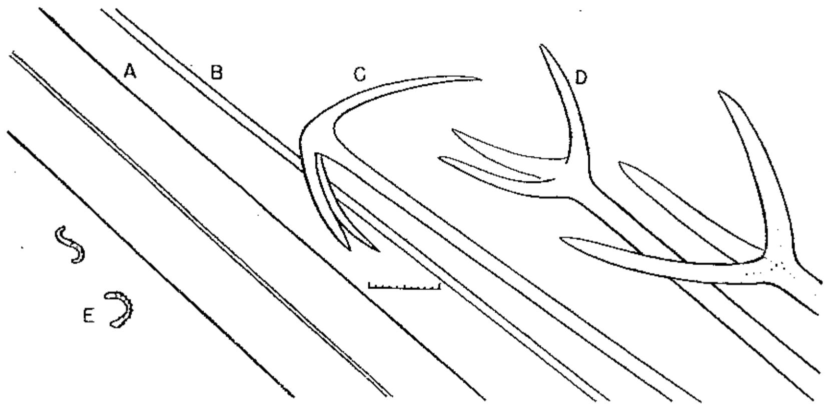
Endosome anatomy.—Pronouncedly radiate, with huge masses of spicules arranged in fascicular columns which are perpendicular to the surface. The protoplasmic structures are actually so scanty as to be inconspicuous (and even overlooked) in the interstices between these spicule tracts.

Skeleton.—The chief spiculation consists of vast numbers of huge oxeas (see fig. 56 A), 35 by 3500 to 50 by 7000 microns. They are perpendicular to the surface of the sponge, and some of them protrude as much as 4 or more mm.

beyond the organic surface. Among them are slender spicules (see fig. 56 B) at least as thin as 3 microns, and at least as long as 1000 microns. Some are doubtless developmental forms of the oxeas, others of the triaenes. There are anatriaenes, chiefly in the surface-plush, cladomes out (see fig. 56 C), their clads often as long as 50 microns, rhabd diameter only about 5 microns. There are also protriaenes, likewise chiefly in the surface-plush, cladomes outward (see fig. 56 D), clads up to 50 microns long, rhabd diameter about 10 microns.

There are also abundant, but very inconspicuous microscleres. These are blunt-ended sigmas or sigmaspires, completely microspined, only 10 microns in total chord length.

Fig. 56.



Camera lucida drawing, ×444, of the spicules of *Cinachyra cavernosa*. A shows a very brief fraction of the mid-portion of one of the mature oxeas, for size comparison. None of the pointed ends are illustrated, as they are quite commonplace, as illustrated for the preceding species. B shows a bit of one of the thinner spicules, again for size comparison. C illustrates the anatriaene and D two of the protriaenes. The microscleres are shown to scale at E. The enclosed scale shows 20 microns by twos.

This species was described as *Tethya cavernosa* by Lamarck, 1815, page 70, and transferred to *Cinachrya* by Topsent, 1931, page 5. There are quite a few species names in the genus *Cinachrya*, indicating a world-wide distribution. It is very difficult to say of many within the group how they differ from *cavernosa*; it is the oldest species name in the genus, and doubtless some (but which ones ?) should be dropped in synonymy. It is my surmise that the species *cavernosa* is so widespread that one may term it cosmopolitan. Lamarck's specimen is thought to be from the Indian Ocean, and the Bermudan specimens match it fairly.

Order *CARNOSA* Carter.

The sponges of this order are also tetraxonid, as are those of the order Choristida. They are, however, different in structure. The radiate plan is usually absent, the cortex is only feebly developed if at all, but the flesh or protoplasmic portion is very much in evidence, hence the name. This implies less extreme abundance of silica, and it is true that large spicules are rare in this group—the majority of the species of Carnosa have only exceedingly small spicules, or even have only microscleres, and in one case no spicules at all (*Chondrosia*). In a few species there are a few, scattered, long triaenes, seeming to indicate an evolution from Choristida.

The typical spicule of the Carnosa (though not quite always present) is the calthrops. This is microsclere size, a tetraxon with four equal rays as widely divergent from one another as possible, like the perpendiculars to the surfaces of an equilateral tetrahedron. This is usually considered to be a very small triaene, but some calthrops may be euasters with only four rays—such spicules certainly do occur in sponges of the Epipolasida (see *Epallax*, above) and Choristida.

Family HALINIDAE de Laubenfels.

The sponges of this family are quite typical of the order. They do not have the the long-shafted triaenes which render *Poecillastra* and other Plakinastrellidae somewhat atypical, nor do they lack the tetraxons as do the Chondrosiidae.

Genus Samus Gray.

The sponges of this genus are so remarkable that Sollas, 1887, page 423, gave them a family all their own. Almost the only objection to this is that it unduly multiplies the number of families, and that only small imperfect specimens of *Samus* have as yet been discovered. The principal spicules of *Samus* are amphitriaenes, and are very distinctive. They are somewhat like two calthrops joined together, or—as their name implies—a pointless rhabd with a cladome at each end. Lumpy sigmoid spicules also occur, resembling microscleres (sigmaspires), but they are about the same size as the amphitriaenes. The whole order Carnosa has been called " Microsclerophora " (Minchin, 1900, page 147, also Sollas). The sponges of this genus not only have exclusively very small spicules, but are also themselves exceedingly minute. They are found, for example, in the 1 mm. diameter burrows of *Cliona*, or is the *Samus* itself an excavator, a boring sponge like *Cliona ?*

Samus anonyma Gray.

Bermuda occurrence of this species is, at the moment, represented only by a microscope slide in the author's possession.

Date collected.—July 16, 1947.

Locality.—Castle Harbour, Bermuda, north of the west end of the causeway.

Abundance.—Very rare.

Shape.—This species is usually amorphous.

Size.—This species is usually extremely small, almost microscopic.

Colour.—Nondescript.

Consistency.—Mediocre.

Surface.—There seems to be no special surface structure known.

Oscules.—Very small sponges are commonly lipostomous.

Pores.—As noted for the oscules.

Ectosome anatomy.—No specialization is described.

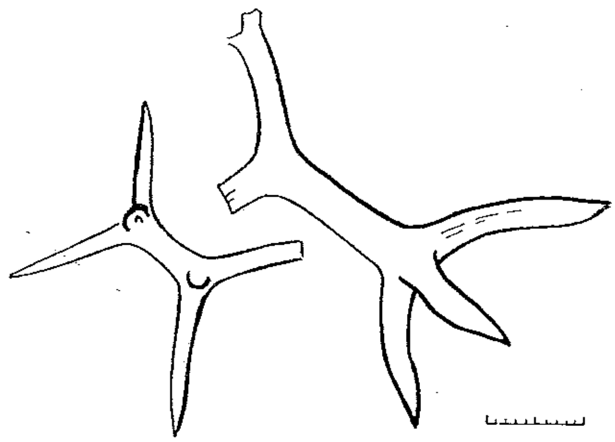
Endosome anatomy.—Confused.

Skeleton.—Amphitriaenes and lumpy sigmaspires.

In 1867, page 526, Gray erected for *anonyma* the new genus *Samus*. Some other species names have been put here since, but every one is either quite unrecognizable or has been removed to some other genus. This one species, *anonyma*, seems to be confined to the West Indian region. I found it near the Dry Tortugas, north of Cuba, on June 22, 1932, but this was a record fully as fragmentary as this Bermudan record.

On the 16th of July, 1947, in the Bermudas I collected a specimen of *Dysidea fragilis*, already described in this paper. It contained, as is characteristic of that species, a number of obviously foreign spicules. Among them were two of the very distinctive amphitriaenes of *Samus anonyma*, familiar to me from my study

Fig. 57.



Camera lucida drawing, ×666, of the two spicules upon which are based this record of the occurrence of *Samus anonyma* in the Bermudas. The enclosed scale shows 20 microns by twos.

of the species in 1932. This is excellent evidence that the species occurs in the Bermudas. The other conceivable alternative is that some as yet undescribed but related species so occurs. It may be that when better specimens are found, a new name will prove to be necessary, but on the basis of present evidence that is not warranted.

More specimens of *Samus* should be sought. They are to be expected deep within holes in limestone, or in deep, narrow fissures. They will probably be minute, and so nearly the colour and appearance of the limestone as to be easily overlooked. It may be that this sponge is not so much extremely rare as it is extremely well hidden and unnoticed. There must have been the sponge present for the *Dysidea* to have obtained its distinctive spicules.

Genus PLAKORTIS Schulze.

The sponges of this genus are fleshy, with only small spicules, as warranted by the names "Carnosa" and "Microsclerophora". The spicules are chiefly diactinal, but have one, two or even three bends in the middle, which indicates that they are reduced polyactinal spicules, probably calthrops. An occasional triactine is also found, which is seldom or never regular, but instead is sagittal or alate ("T" shaped).

PLAKORTIS SIMPLEX Schulze.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.54.

Date collected.—August 8, 1947.

Locality.—Walsingham Pond, Bermuda.

Abundance.—One specimen.

Shape.—Encrusting.

Size.—1 cm. thick, 4 by 5 cm. in area.

Colour.—The living sponge was brown. In alcohol it has become slightly duller, and the fluid has become brown.

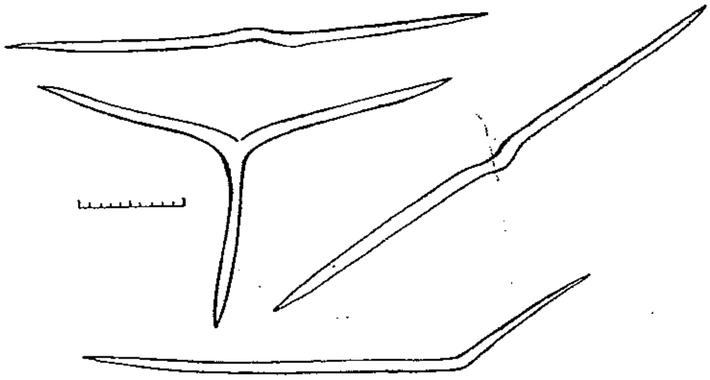
Consistency.—Firm, dense, like cheese.

Surface.—Essentially smooth, microtuberculate.

Oscules.—Five are in evidence, each a little over 1 mm. in diameter, with rims just slightly raised.

Pores.—Abundant, 30 microns in diameter.

Fig. 58.



Camera lucida drawing, ×666, of the spicules of *Plakortis simplex.* The enclosed scale shows 20 microns by twos.

Ecotosome anatomy.—The pores open directly into canals which are also 30 microns in diameter, and which go almost perpendicularly down into the sponge. The flagellate chamber region also comes very nearly to the surface. There is, therefore, no special dermal structure in evidence.

Endosome anatomy.—Very few visible cavities exist in this extremely compact sponge. The spicules are tucked away in the walls between the chambers. These latter are abundant, round, 30 microns in diameter.

Skeleton.—As is typical of the genus *Plakortis*, the spicules seem at first to be oxeas. Then it is noticed that a few siliceous triaxons are present, perhaps amounting to as much as one per cent. of all the spicules. Then one notices that many of the common spicules have sharp kinks in their middles, a few are once bent, making "V's" ; more are twice bent, so that the two extremities are again nearly in line with each other. It is doubtful that any of the spicules are simply or genuinely oxeas. Common sizes are 2 by 80 to 3 by 100 microns. The triaxons have rays about 3 by 45 microns.

This species was described by Schulze, 1880, page 430, from the Mediterranean.

It is widely distributed, including West Indian and Australian records, the only species of the genus.

In 1936, page 178, I described a sponge from the Dry Tortugas, north of Cuba, as *Roosa zyggompha*, new genus and new species. Topsent, in 1937, page 1, pointed out that this was Schulze's *Plakortis simplex*, with which sponge he was familiar. Such indeed proves to be the case, and both genus and species must be dropped into synonymy.

Family CHONDRILLIDAE Gray.

The sponges of this family are less provided with spicules than are the other families of Carnosa already discussed—they have, at most, only such as may certainly be termed microscleres (euasters) and some of them have no spicules at all. The emphasis on flesh that is here found well merits the name Carnosa.

Genus Chondrilla Schmidt.

Sponges of this genus have oxyspherasters in moderate abundance, but no other mineral skeleton. They only other genus of the family is *Chondrillina* de Laubenfels, which has not only euasters but also spirasters in addition.

Chondrilla nucula Schmidt.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.55.

Date collected.—June 30, 1947, and many others.

Locality.—Harrington Sound, Walsingham Pond and shallow water about the coasts of the Bermudas in general. This species also occurs abundantly, self-propagated or " volunteer " in the running sea-water aquariums of the Government Aquarium at Flatts. These aquarium specimens do not reveal any differences from those found in the ocean.

Abundance.—This species is extraordinarily common in the Bermudas, in all marine, shallow-water areas. It is locally known as " chicken liver ", a name very appropriate to its size, shape, surface and consistency—and only slightly inappropriate as to colour. It was possible in the summer of 1937 to collect *Chondrilla* literally by the bucketful.

Shape.—Irregular, but always rounded. Many specimens are hemispherical. It may undergo extensive lateral growth, so that it gives somewhat the impression of being encrusting, but it is quite different from the many sponges that begin, while small, by being crusts, and then later thicken to become massive. Young *Chondrillas* are nearly spherical; it is the large, old colonies that are so wide in proportion to their (considerable) thickness.

Size.—The masses are commonly 2 cm. thick, and they may extend laterally as much as 5 to 10 cm.

Colour.—The living sponge occurs in various shades of grey, or brownish grey, darker in the places that have been the more brightly illuminated. It often seems that there is a paler region around each oscule. The hole appears dark, partly because its lining is pigmented, partly because it is shaded. Thus the oscules are like targets or bull's eyes, rather conspicuous. The interior is always a pale greyish drab. These dull colours persist in preserved specimens too. Dried specimens turn almost black, very hard and shrivelled, so that they cease to look or feel like sponges at all.

Consistency.—Extremely cartilaginous.

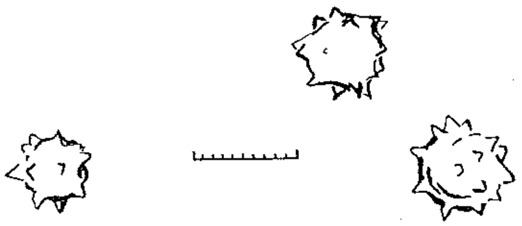
Surface.—Smooth, shining and glistening.

Oscules.—In life very conspicuous, dark dots 2 mm. in diameter, each in the centre of a pale area. They are, however, very contractile, and can scarcely be found in preserved specimens as a result. There may be one oscule for every 3 square cm. of surface, or again there may be fewer oscules.

Pores.—Microscopic and contractile.

Ectosome anatomy.—There is an outer region, 150 to 200 microns thick, which contains few or no flagellate chambers, but does contain a disproportionately large amount of the pigmented cells. This cortex also contains practically all of the spicules.

Fig. 59.



Camera lucida drawing, ×666, of the spicules of *Chondrilla nucula.* The enclosed scale shows 20 microns by twos.

Endosome anatomy.—Very dense, the longest canals still are often smaller than 150 microns in diameter. The flagellate chambers are small and spherical.

Skeleton.—Siliceous spherasters are abundant in the cortex of this sponge. They are 18 to 26 microns in diameter, average about 20 microns. The non-living colloidal jelly is rather more noticeable in these Carnosa than it is in sponges which are more filled with large spicules. Actually, such a mesogloea is probably important in all sponges. It is rather thoroughly congealed (stiff rather than semi-fluid) in *Chondrilla ;* this is favourable to the sponge, because of the lack of mineral stiffening.

This species, and the genus of which it is type, was established by Schmidt, 1862, page 39, for Mediterranean specimens. It is also common throughout the West Indies, recorded—for example—by Wilson, 1902, page 386, from Puerto Rico.

It is not recorded in my treatise of the sponges of the Dry Tortugas (de Laubenfels, 1936, page 182), but in the summer of 1936 I did find it there, north of Cuba. This occurrence has not previously been published.

Family CHONDROSIIDAE Schulze.

The sponges of this family having none, are the least provided with spicules of all. This extreme skeletal situation, only jelly being present, would seem to cause Chondrosiidae to lie close to the Halisarcidae in the Keratosa. In fact, earlier sponge workers sometimes did put the two into a single family. Vosmaer in Bronn's 'Klassen und Ordnungen des Thier-reichs', page 325, puts the two families into a suborder, Oligosilicina. But it is clear that Chondrosiidae are separated from Chondrillidae only by lack of the asters—in fact, it is difficult in field or laboratory to tell *Chondrosia* from *Chondrilla,* and *Chondrilla* grades into the other Carnosa. On the other hand, *Halisarca* is a conulose sponge, with a somewhat spongin-like dermis, and with large, sack-shaped, flagellate chambers. It thus closely resembles the clearly Keratose family Aplysillidae. One may recall that portions of Aplysillid sponges are sometimes devoid of skeleton, although fibres are elsewhere present.

Genus CHONDROSIA Nardo.

Sponges of this genus are very fleshy; the original species (type) is called *reniformis,* the "sea kidney", which gives an idea of its general appearance.

CHONDROSIA COLLECTRIX (Schmidt) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.56.

Date collected.—July 12, 1947.

Locality.—Hungry Bay, on the south shore of Bermuda.

Abundance.—Only one specimen was collected. It may be, however, that *Chondrosia* is more common than this would seem to indicate. *Chondrilla* is very abundant, and pale specimens of *Chondrosia* would readily be confused, hence overlooked. Thus at Tortugas for several years' collecting, the *Chondrillas* were overlooked, being confused with pale specimens of *Chondrosia.*

Shape.—Rounded, at first nearly spherical, but becoming kidney-shaped or lobate as the sponges grow laterally.

Size.—The Bermuda specimen is a little more than 1 cm. thick. Horizontally it covers about 4 by 5 cm.

Colour.—The living sponge was black on those portions of the exterior where it was struck by greatest illumination, in this case nearly full sunlight. Elsewhere it was grey, palest where most shadowed. The interior is always greyish drab. The colour bleaches only slightly in alcohol. Dry specimens look very black and not at all like sponges, very shrivelled and hard.

Consistency.—Extremely cartilaginous.

Surface.—Smooth, shining, glistening.

Oscules.—A few scattered oscules occur at one place on this specimen; they are about 1 mm. in diameter and 5 mm. apart. They have thin collars about 1 mm. high around each. The residue of the sponge shows no oscules.

Pores.—This species is described in the literature as having pores up to 100 microns in diameter. In the Bermuda specimen they could not be located, due to their contractility.

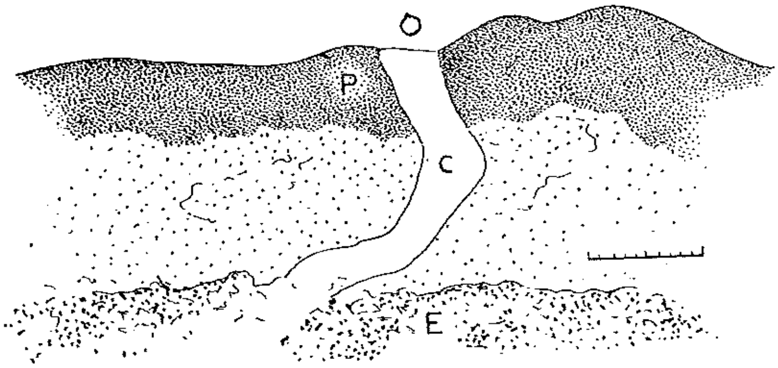
Ectosome anatomy.—There is an outer cortical region about 250 microns thick that contains few or no flagellate chambers, and does contain an extra large number of the pigmented cells.

Endosome anatomy.—Very dense. No canals of greater diameter than 100 microns could be found. The flagellate chambers are small and round.

Skeleton.—A cartilaginous gel or stiffly colloidal ground substance is the only skeleton of *Chondrosia*. Such a gel is entirely responsible for the framework rigidity of *Chondrilla*, and a major item in the support of all the Carnosa. In fact, skeletal jellies are quite important in most sponges.

This species was first described as *Cellulophana collectrix* by Schmidt, 1870, page 25, from the West Indies, to which locality it may be restricted. It differs from the older species of *Chondrosia*, that is to say, *reniformis*, in its tendency to

Fig. 60.



Camera lucida drawing, ×150, of a section of *Chondrosia collectrix* perpendicular to the surface. It is lettered as follows: O=oscule. C=cloaca. P=heavily pigmented cortex. E=endosome with chambers. The pale region intermediate between P and E is probably the region of contractile or muscular tissue. The enclosed scale shows 100 microns by tens.

black colour. It is by this that it is most likely to be recognized in the field as contrasted to the common *Chondrilla*. At the Dry Tortugas it was *Chondrosia* that was the commoner, in the Bermudas the *Chondrilla* predominates. The two genera are found in similar situations and are obviously interrelated.

The genus *Cellulophana* which Schmidt employed is not Porifera, but Chordata—that is to say, an ascidian. It is very difficult to discriminate in the field between *Chondrosia collectrix* and some of the abundant blackish ascidians which occur in the West Indies.

Class **HYALOSPONGIAE** Vosmaer.

Sponges of this class usually have a unified, continuous skeleton of siliceous strands somewhat like the steel framework of a modern building. Like the metropolitan building, however, the framework is really made of separate beams (spicules), which are then fastened together, and in some of the Hyalospongiae the spicules are, at least temporarily, separate. Even in those cases they so interlock, and are cemented by organic material that a somewhat rigid net results. The protoplasmic structures are rather widely scattered on this framework, the whole living thing being very open-work, not a tight system of canals and small chambers.

The Hyalospongiae are confined to deep water. In the warmer portions of the world they are not to be expected at less than 500 or 1000 metres—that is to say, so deep that the water is cold. In the Antarctic, under the ice sheet (and nowhere else) they come to within 100 metres of the surface. Since this account is of the shallow-water sponges of the Bermudas, and only shallow water collecting is here reported, no sponges of this class are here available.

Class **CALCISPONGIAE** Schmidt.

Sponges of this class always have a skeleton of calcium carbonate. Inasmuch as none of the others ever do, this alone is a sharp line of demarcation. Another distinction is that the cells of the Calcispongiae are two or more times as large as the corresponding cells of the Demospongiae and Hyalospongiae. Only in Calcispongiae do sponges occur with the first two types of sponge architecture, that is to say, ascon and sycon. There are Calcispongiae with the third type of rhagon architecture, but even so, the gap between this class and the other two is very great. In both the other two, but never in Calcispongiae, there are astrose microscleres. In both the other two, but never in Calcispongiae, there are microscleres of the birotulate type, amphidiscs as in some fresh-water sponges (*Meyenia*), in *Hyalonema*, and in *Iotrochota* ; chelas as in *Myxilla*. Yet the tetraxons, triaxons and oxeas of the Calcispongiae resemble similar spicules that occur in the Choristida, or even more, some of those in the Carnosa.

Order *SYCONOSA* de Laubenfels.

Sponges of this order are characterized by the spongocoel. This is a relatively large, axially placed cavity, leading outward to a single oscule, and receiving directly from the flagellate chambers. These chambers are large sack-shaped and in general, or on the average, are perpendicular to the spongocoel, radially arranged around it. Thus the spongocoel corresponds to, and is homologous with the exhalent canals which in most sponges lead to the oscular cloaca. The type or architecture of the Syconosa has long been known as syconoid—the order takes its appellation from the structure. All of the order have this structure, at least in a transitory way. In some few the spongocoel branches, giving rise to a rhagonoid structure somewhat like that present in the majority of sponges ; this is especially the case in the Leuconiidae, and is true in a very modified, incomplete way of some of the Djeddeidae and Amphoriscidae (two families that probably need to be merged). There is much closer resemblance between the architecture of the Syconosa and the Hyalospongiae than between Syconosa and Demospongiae. In fact, the Hyalospongiae may be said to be semi-syconoid, and their largest cavity may still be a spongocoel.

Family LEUCONIIDAE de Laubenfels.

This family was established by de Laubenfels, 1936, page 194, as a subfamily of Grantiidae, characterized by the well-developed cortex and subdermal spaces. The Grantiinae, which remain as the only Grantiidae, are otherwise typically syconoid, but the Leuconiidae have the branching spongocoel and " leuconid " structure. I have come strongly to feel that the structure of *Leuconia* is to be regarded as rhagon, so that if we use the term " leuconid " architecture, it must be as a minor variant of the rhagon, just as the term " sylleibid " has long been regarded. This structural difference is so great that the group is worthy of full family rank.

This need not increase the number of families. As de Laubenfels, 1936, page 197, points out, the Djeddeidae de Laubenfels=Heteropiidae Dendy are very close to the family Amphoriscidae Dendy. The sponges of the latter group have radially placed orthotriaenes, cladomes near the surface, their enormous rhabds perpendicular and radiate. The Djeddeidae may do so likewise, but Dendy was convinced that the enormous portion of the corresponding spicules was not a rhabd, but an over-developed clad—that the three short rays were the other two clads and the rhabd. A slight variation in the angle of branching will produce this effect, and Dendy's conclusion is by no means inescapable. Even if he were correct, which I doubt, this is hardly enough for more than subfamily differentiation, therefore I here propose to merge Djeddeidae into the one family Amphoriscidae.

Sponges of the family Leuconiidae have a cortex, separated by extensive subdermal spaces from the underlying tissues. They also have large, even relatively enormous cloacas, more or less axially placed. The spongocoels which open into it are so narrow in proportion to it, that the rhagon type of architecture is attained, although the young sponge is said to pass through an intermediary syconoid stage.

Genus LEUCONIA Gray.

Sponges of this genus have a special dermal skeleton made up of tangentally placed rays of spicules, or entire spicules placed tangentally. Deeper than that the principal skeleton is confused. There are typically diactinal spicules present, and these are always arranged perpendicular to the surface. Both triaxon and tetraxon spicules also occur.

LEUCONIA ASPERA (Schmidt) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.58.

Date collected.—June 30, 1947, and many others.

Locality.—Harrington Sound, Walsingham Pond, and various places on the north shore of the Bermudas.

Abundance.—An hour's collecting in any of the above-mentioned localities should always yield at least one specimen of *Leuconia*, but these sponges hide in crevices and under stones so that they are easily overlooked. They are locally known by the very inappropriate designation of " glass sponges ".

Shape.—Cylindrical, hollow, slightly contracted at each end. The central cavity or cloaca in larger specimens has a diameter which is half the total diameter of the sponge, but in smaller specimens it is less than half the total diameter—thus it evidently enlarges faster than the walls about it thicken.

Size.—Specimens were found up to 55 mm. high and 20 mm. in diameter ; these would be referred to as " larger ". Much more often one finds specimens less than 20 mm. high ; these would be referred to as " smaller ".

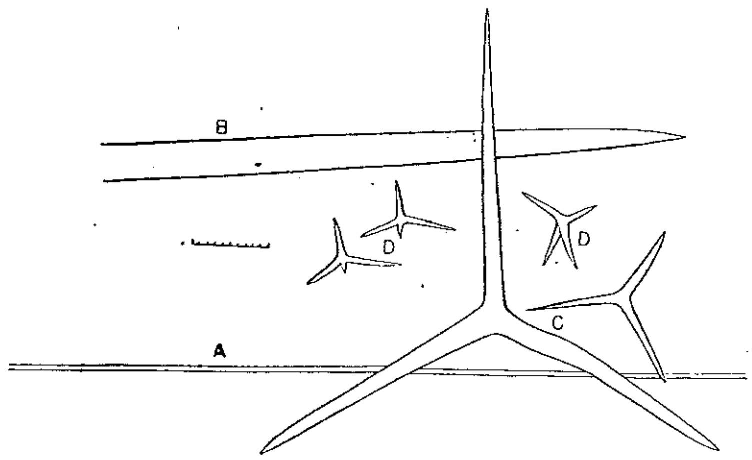
Colour.—Basically white. Some specimens are glassy, glistening white, hence the local misnomer. Usually, however, enough foreign debris occurs on the outside of this sponge to render it pale grey or pale drab. The preserved specimens —both dry and pickled—darken as compared to the appearance in life, unless they are macerated.

Consistency.—Fragile, brittle—but there is enough cohesion due to the interlocking spicules so that specimens will retain their shape even though handled, if they are handled carefully.

Surface.—Hispid. In the larger specimens the spicule plush is extremely dense, as in velvet—the " nap " of hispidating spicules projects 2 or 3 mm. beyond the organic surface of the sponge.

Oscules.—Apical, solitary, and in size as great as 10 mm. in the larger specimens. The oscule tends to have the same diameter as that of the cloaca. A high, thin palisade of erect spicules (coronal fringe) surrounds each oscule. A serious likelihood of confusion exists, however, in that environmental buffeting may break off this coronal palisade. Several Bermudan specimens were found that

Fig. 61.



Camera lucida drawing, ×100, of the spicules of *Leuconia aspera*. A shows a small fraction of the mid-portion of one of the coronal oxeas ; B shows one of the ends of one of the hispidating oxeas ; the mid-portion is not illustrated. At C one may observe a large and a small triaxon ; these illustrate the general size-range of the triaxonid spicules of this species, but do not show extreme maximum nor extreme minimum. D illustrates the tetraxons. The enclosed scale shows 100 microns by tens.

superficially appeared to have smooth, non-crowned oscular rims. Microscope study was necessary to discover the broken ends of the fringe that had actually been present, in one sense of the word that was still present.

Pores.—Abundant, so that the walls between them are thinner than the pore diameter ; this measurement is from 25 to 50 microns.

Ectosome anatomy.—There is a cortex or protoplasmic dermis about 15 microns thick, permeated by the pores, and supported by enclosed, tangentally placed rays of spicules.

Endosome anatomy.—Rhagon architecture, with flagellate chambers so densely crowded together that their outlines therefore become polygonal. They are often 60 to 70 microns in diameter, but owing to the crowding, odd shapes are assumed, for example, some are elongate, flattened, 30 by 80 microns in cross-section.

Skeleton.—There are four categories of spicule present. First, the oxeas of the coronal fringe (see fig. 61 A)—8 by more than 5000 microns—nearly always broken, so that maximum length cannot be determined. Second, the oxeas that hispidate the surface (see fig. 61 B), 100 by more than 4000 microns. Again, those that would have yielded the maximum length measurements seem always to have been broken—therefore unbroken ones always are still not full size. Third, triaxons of the surface and of the chamber walls (see fig. 61 C) usually with rays 35 by 350 microns. A few are so large that their rays are 65 by 650 microns. A somewhat larger minority are smaller, say with rays 10 by 100 microns. These may represent an additional category, but seem more likely to be merely undeveloped spicules of the third category. Fourth, tetraxons, chiefly of the lining of the cloaca (see fig. 61 D) ; their rays are about 8 by 80 microns, but one of the four rays is usually shorter—say 50 microns only. This ray may project into the cloacal cavity while the other three, like a cladome, lie tangentially in the wall of this cavity.

This sponge was first described as *Sycon asperum* by Schmidt, 1862, page 15, and is here transferred to *Leuconia*. It is common in Europe, has been recorded from the Arctic and from the Azores, and now Bermuda.

The genus *Leuconia* was established by Grant, 1834, page 199, and is a large one, with numerous species in many parts of the world. Those most interesting in connection with the Bermudan specimen are as follows.

Leuconia barbata was described by Duchassaing and Michelotti in 1864, page 111, as *Medon barbata*. It is the common *Leuconia* of the West Indian region, and may be distinguished from *aspera* by its lack of coronal spicules. Some Bermudan *Leuconias* superficially appear to be *barbata* because their oscular fringe has been rubbed off. In other respects the two species are very similar. One must search the oscular rim with the microscope to discriminate, unless the oscular fringe is obviously present.

Lambe, 1900, page 32, described a sponge from the American Arctic much like the Bermudan sponge, as *Leucandra valida*. This may be a record of *Leuconia aspera*, inasmuch as *aspera* has been elsewhere recorded from the Arctic ; but in the same article, page 34, Lambe describes *Leucandra cumberlandensis* from the same locality as his *valida*. This, which of course should be *Leuconia cumberlandensis*, has distinctive long-shafted protriaenes. It may be that his *valida* represented specimens of *cumberlandensis* in which the protriaenes were rare.

Poléjaeff, 1884, page 54, described *Leuconia multriformis* from " Bermuda " but actually from rather deep water offshore, hence not in the ecological region that is treated in the present article. It is here suggested that this species is in no described detail different from, and should be dropped in synonymy to, *Leuconia nivea* (Grant). In the same article, page 56, Poléjaeff described *Leuconia typica* from " Bermuda ", with oxeas somewhat different in size from the oxeas of his *multriformis*. This also falls within the range of variation of *nivea*, and *typica* should be dropped in synonymy to *nivea*. On page 58, Poléjaeff described *Leuconia rudifera* " from Bermuda ", which seems to be a valid species, but neither it nor *nivea* should be added to the fauna that is recorded in the present article. On page 65 he described *Leuconia dura* " from Bermuda ". Dendy and Row, 1913, page 734, wisely transferred this to *Leucetta*. It is probably *Leucetta floridana*, as discussed below, but represented by just such reef-modified specimens of *floridana* as I found in the reefs in 1947.

LEUCONIA CRUSTACEA (Haeckel) de Laubenfels.

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.59.

Date collected.—July 9, 1947 and August 8, 1947.

Locality.—Walsingham Pond, Bermuda.

Abundance.—Two specimens found.

Shape.—A contorted cylinder (see fig. 62 B) tapering slightly at the ends. It is hollow, with walls only about 1 mm. thick, hence the cloaca is relatively huge.

Size.—50 mm. high, 15 mm. in diameter.

Colour.—In life and in alcohol, nearly white.

Consistency.—Fragile.

Surface.—Slightly lumpy, but not hispid.

Oscules.—The single apical oscule has a thin, sharp rim, like the edge of a sheet of paper. Even with the microscope there is no trace of coronal fringe; the rim is stiffened with horizontal, tangential rays of the sagittial triaxons, and filled in with cellular protoplasmic material right up to the very brim. The oscule has a diameter of 6 mm. and its cloaca about 5 to 8 mm. The (exhalent) openings into the cloaca are about 1 mm. in diameter, and are only about 1 mm. apart, centre to centre.

Pores.—Abundant, 50 microns in diameter.

Ectosome anatomy.—There is an organic dermis, chiefly protoplasmic, about 10 microns thick.

Endosome anatomy.—Pronouncedly rhagon type, with rounded, flagellate chambers crowded together. The canals to and from them are relatively quite short, as a concomitant to the thinness of the wall of this species. There are many spicules in the walls, probably more volume of spicule than protoplasm. The flagellate chambers are all about 40 microns in diameter.

Skeleton.—There are about equal numbers of triaxons and tetraxons, with rays varying in size all the way from 5 by 100 to 50 by 750 microns. In the triaxons one ray is often longer than the other two, and in the tetraxons one ray is often shorter than the other three. Near the oscular rim the triaxons are large and sagittal ("T" shaped), with the crossbar parallel to the rim, the long rhabd tangential to the surface, perpendicular to the rim, always pointing away from the rim.

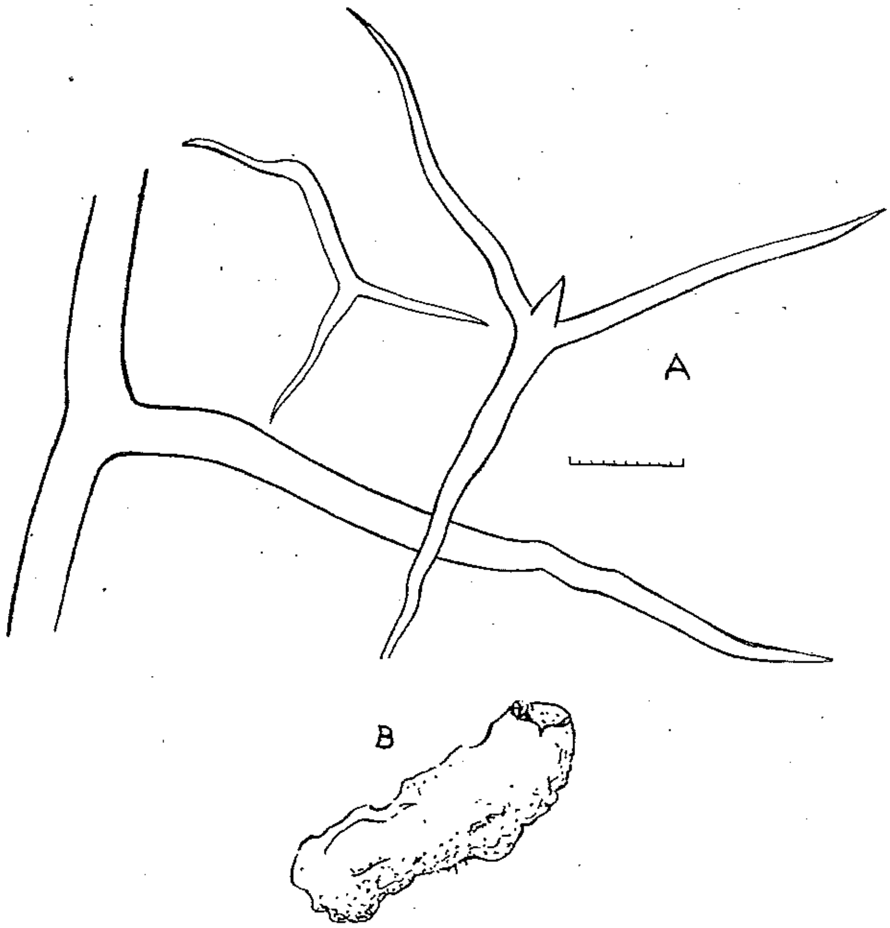
The spicules of *Leuconia crustacea* are amazingly crooked. As a rule, spicules are symmetrically curved or straight, often as straight as a ruler. An occasional crooked ray, or crooked monaxon can be found. In the present species this is reversed. By diligent search one might find an occasional straight ray, but practically all are crooked, even very crooked. It is common to find rays with four to seven rather angular bends.

This species was described by Haeckel, 1872, page 146, from West Indian material; that is rather to say, from the coast of Venezuela, near Caracas; the specimens were sent to Haeckel by a collector named Gollmer. His specimens were white crusts on a crustacean, but the structure and especially the extremely peculiar spicules of Haeckel's sponges are so much like those of the Bermudan species as to make it practically certain that the two are conspecific.

This sponge is very distinctive, not likely to be confused with other members of the genus *Leuconia*. In fact, it may well be argued that a new genus should be erected for it, emphasizing not only the extremely crooked spicules but perhaps also stressing the somewhat unusual lack of oxeas.

Haeckel described this as *Leucaltis crustacea*. It is not a satisfactory member of that genus, which has a type of architecture intermediate between ascon and and rhagon, therefore it is here transferred to *Leuconia*. As already remarked, this is not necessarily final, as a new genus may be required.

Fig. 62.



Camera lucida drawing (A) of the spicules of *Leuconia crustacea*, ×150. One of the smaller triaxons and one of the medium-sized tetraxons are shown complete. Of one of the large-sized sagittal triaxons the rhabd is illustrated, and the basal (but not the distal) portions of the two clads. The enclosed scale shows 100 microns by tens. B is a sketch of the entire sponge, life size.

Mention may be made of a *Leucaltis* record near, but not quite in the area that is discussed in the present article. Poléjaeff, 1884, page 45, described as a new species *Heteropegma nodusgordii* " from Bermuda "—actually from deep water offshore. Dendy and Row, 1913, page 790, show that this is the species that Haeckel, 1872, page 159, described from Florida as *Leucaltis clathria*, the type of the genus *Leucaltis*.

Family SCYPHIDAE de Laubenfels.

The sponges of this family are the simplest of all the sycon sponges. Unlike the Grantiidae, they do not have a cortex or dermal layer around the outside of the sponge, enclosing subdermal spaces, but the rounded ends of the flagellate chambers stick out naked, roughly perpendicular to the long axis which is formed by the spongocoel. Thus the architecture is like a lot of little ascons erect around a spongocoel into which they all discharge their water.

Genus Scypha Gray.

The sponges of this genus are quite typical of the family description, without other peculiarities. They are often used in beginning courses of zoology as though they were typical of the whole phylum Porifera.

Scypha ciliata (Fabricius) de Laubenfels.

Bermudan specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.62.

Date collected.—August 9, 1947.

Locality.—Whalebone Bay, Bermuda, under rocks on the shore, just below low tide.

Abundance.—Nine small specimens were found. Were one to search especially for this type of sponge, doubtless it would prove to be more common than appears to be indicated by the small number of 1947 records.

Shape.—Typical sycon or vase-shape, cylindrical, bulging centrally, with a conspicuous oscular crown.

Size.—The largest Bermudan specimen is 12 mm. long, about 3 mm. in diameter. Measurements are a little difficult to assign, owing to obscuring spicule projections.

Colour.—White in life and in alcohol.

Consistency.—Fragile.

Surface—Pronouncedly hispid.

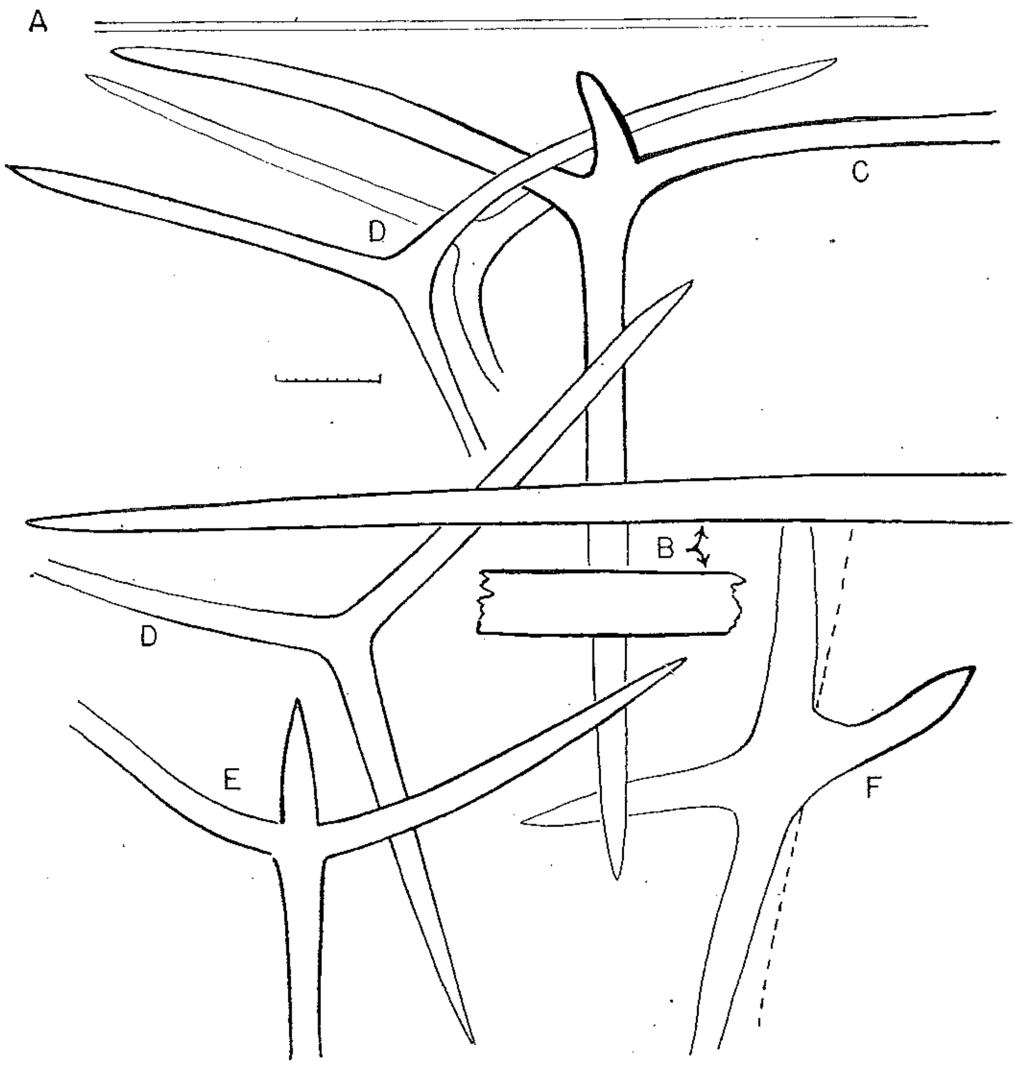
Oscule.—Single, apical, about 1 mm. in diameter.

Pores.—The inhalent openings to the flagellate chambers are at the most 5 to 10 microns in diameter, and are very difficult to find, even with the microscope. Actually these are rather appropriately termed prosopyles, and there are no true pores present at all. Some scientists call these prosopyles " pores " and give the name ostia to the usual inhalent openings of the Porifera (singular, ostium); this name is not popular, and it is very difficult to anglicize it. The phylum received its name from the numerous small inhalent apertures, and while they are not exits, as in human pores, the name is well established and should not be altered to ostium. In some species of *Scypha* the spaces between the chambers are partially blocked off from the outside world by partial partitions between the chamber ends. The holes through these barricades do correspond to true pores, but the present species has no true pores.

Ectosome anatomy.—The present species has no ectosome, because the distal ends of the chambers are naked.

Endosome anatomy.—Typical sycon; the axially placed spongocoel runs the while length of the sponge and is about 1 mm. in diameter. While the chambers should be regarded as perpendicular to it, radially arranged, they are not perfectly

Fig. 63.



Camera lucida drawing, ×666, of the spicules of *Scypha ciliata*. A shows a small fraction of the total length (mid-portion) of one of the coronal wisp-oxeas. B shows one end, and a short bit of the mid-portion of one of the hispidating oxeas. C shows one of the tetraxons of the oscular rim, all except the tip of one of the clads. D shows (below) one of the chamber triaxons, all except the tip of one of the rays, and (above) shows portions of two others, to illustrate the variations in shape. E shows one of the chamber tetraxons, although the ends of two of the rays are omitted. F illustrates one of the tetraxons from the spongocoel lining, with the location of the surface of the lining shown by a dotted line—flesh to the left, cavity to the right. The projecting ray is drawn darkly, the other three are tangential to the surface; of two of them the ends are not illustrated. The enclosed scale shows 20 microns by twos.

rigid, and therefore lop and bend somewhat. They are 150 microns in diameter, and often 1300 microns (1·3 mm.) long. In the smaller specimens, and near the base and near the oscule in any case, they are a little narrower and a great deal shorter than this, say 100 by 400 microns.

Skeleton.—There are about six categories of spicules present. First, the wisp-oxeas of the oscular crown (see fig. 63 A), varying from 2 to 5 microns thick, usually three, and at least 2000 microns long—usually broken. Second, the echinating oxeas (see fig. 63 B). Only about a third of their length protrudes, however, the principal portion being embedded in the chamber area, nearly perpendicular to the surface of the sponge, but not quite—they are inclined somewhat, so that the distal end leans toward the oscule. They are 10 to 15 microns in diameter, lengths at least 2000 microns. Third, sagittal tetraxons of the linings of the oscular rim (see fig. 63 C). The short ray that is drawn darker than the others protrudes inward, and would interfere if any small animal tried to crawl into the spongocoel. The other three rays lie tangentally in the lining of the spongocoel; they are about 9 by 90 microns, the rhabd 10 by 125 microns, the short ray is only about 9 by 40 microns. Fourth, triaxons of the chamber walls (see fig. 63 D), rays usually about 6 by 100 microns. Fifth, tetràxons of the chamber walls (see fig. 63 E), rays usually about 6 by 100 microns. Sixth, tetraxons of the lining of the spongocoel; the shorter ray, drawn darker than the others, projects into the lumen, bent to point towards the oscule—like a valve permitting egress but restricting entry. The other three rays are embedded tangentally in the lining of the spongocoel. They are about 5 by 50 microns to 7 by 70 microns.

This species was first described as *Spongia ciliata* by Fabricius, 1780, page 448. It is widespread throughout the old world, especially about the coasts of Europe. On the American coast of the North Atlantic it is replaced by *Scypha linga* (Haeckel) de Laubenfels, the sponge which has been so often mis-identified in elementary text-books as being a *Grantia*. The rays that project into the spongocoel are very feebly developed in *lingua*, and there are minor differences in spicule size and proportion.

Scypha barbadensis is West Indian, but it seems to have few or no tetracts, and it does have oxeas of peculiar swollen shape. It was first described as *Sycandra barbadensis* by Schuffner, 1877, page 425, and is here transferred to *Scypha*.

Poléjaeff, 1884, page 70, reported *Sycum arcticum* Haeckel from " Bermuda ". Actually the locality was deep water, offshore, and is not within the scope of the present article. It appears from his description, however, that he probably had a specimen of *Scypha ciliata*. The species *arcticum* may or may not be a synonym of *ciliata*; they are certainly very close together.

Order *ASCONOSA* de Laubenfels.

The sponges of this order never assume the syconoid form. They start as more or less ascon type, and some remain permanently in this form. Others metamorphose very quickly into pronouncedly rhagon type, in this respect resembling the developing sponges of the Demospongiae.

Family LEUCETTIDAE de Laubenfels.

The sponges of this family have the rhagon architecture developed to a high degree, which is to say that they are extremely like the Demospongiae except for the chemical nature of the spicules. Other families of the order include, at the other extreme, the Leucosoleniidae, which represent the ultimate in simple ascon structure for adult sponges; also the Leucaltidae, which are rhagon, but not typical, inasmuch as distinct traces of ascon ancestry or preliminary development still shows in the adult. There is also the family Petrostomidae, characterized by peculiar " pharetrone " skeletal modifications.

Genus LEUCETTA Haeckel.

This genus exemplifies to the highest degree the characteristics of the family as described. Other genera of the family are peculiar in one or more respects as compared to this. Some *Leucettas* require chemical investigation of the spicules to be sure they are not Demospongiae, and all bear great resemblance to the common sponges. They have many oscules, and these are served by cloacas, with no spongocoel. The flagellate chambers are discreet, with inhalent and exhalent canals. The whole body plan is compact, almost like the body plan of a bath sponge.

LEUCETTA FLORIDANA (Haeckel) Dendy and Row. (See Pl. II, fig. 8.)

Bermuda specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.80.

Date collected.—June 30, 1947, and many others.

Locality.—Harrington Sound, Walsingham Pond, and the coasts of the Bermudas in general. This sponge flourishes only in places of very dim illumination, never in total darkness, nor in bright light.

Abundance.—This species is extremely numerous, with huge specimens, in Harrington Sound. Elsewhere it is uncommon, and represented by only small specimens. For example, on August, 9, 1947, one was found in Whalebone Bay, on the coast, under a rock; this was only 1 cm. in diameter, a mere nugget.

Shape.—Irregular, lobate. Some specimens are shaped like a long, low, thick wall, rapidly growing laterally in only one or two directions while growing only slowly in thickness and height. Some specimens make head-sized masses. Others have long, digitate—almost ramose—projections; these are locally known as " dead man's fingers ", actually they might be called " dead man's hand ".

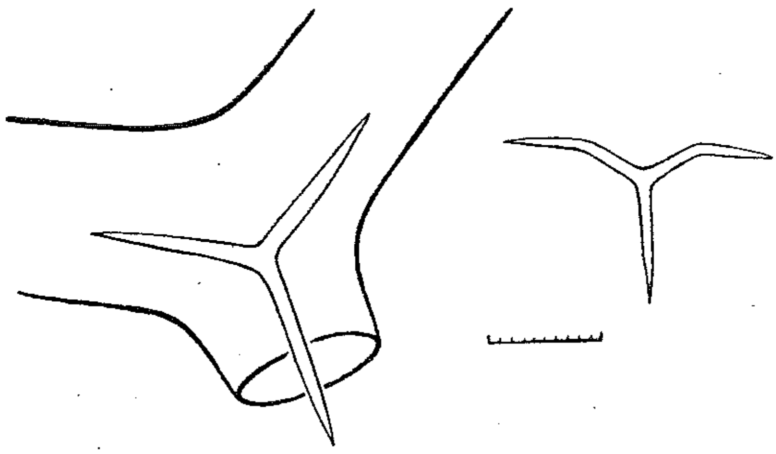
Size.—Colossal for the class Calcispongiae. This is immensely the largest one known. One specimen was taken in 1947 that was 54 cm. long! (See Pl. II, fig. 8.) It is common to find sponges of this species that are more than 30 cm. high and at the same time more than 15 cm. thick.

Colour.—The living sponge is basically white, with more or less pink surface tinges. It is often found in the many submarine caves which line the shores of Harrington Sound. Outside the cave, where the light is rather bright, the species will be absent. Near the mouth of the cave one comes to the first specimens; these will be rosy pink, like a rouged cheek. Farther back there are paler and paler *Leucettas*, until in the darkest crannies some are almost snow-white. The reaction to spirits is unexpected; in alcohol this sponge turns brown, but an amazingly dark brown for Calcispongiae—the shade known as walnut. This is, when dry, probably the darkest Calcisponge.

Consistency.—Fragile when alive, and much more so when dry; in fact dry specimens crumble between the fingers if carelessly touched. Yet there is an extra large amount of matter present per cubic centimetre—the fragility is not due to openwork structure but to the fact that the spicules do not interlock, and were cemented, in life, only by protoplasm or very fluid colloid.

Surface.—Optically smooth, but rough and gritty to the finger-tips. It is not uncommon to find sponges with siliceous spicules that readily and painfully penetrate the fingers of one who touches them, but it has not previously been my experience that any calcareous spicules so behaved. Even the very dangerous-looking, hispid-bristling *Leuconias* can be handled with impunity by one who has thin skin. Yet the spicules of *Leucetta floridana*, although not hispidating the surface and seeming to be exceptionally innocuous, do represent real danger to one's fingers. Perhaps there is a rough or gritty sub-microscopic texture to their surface, so that they stick in the wounds which they make—certainly they are amazingly easy to receive and equally difficult to remove. Not only the appearance of the sponge, and the size, but even the spicule behaviour simulates a Demosponge rather than a Calcisponge.

Fig. 64.



Camera lucida drawing, ×150, of some of the spicules of *Leucetta floridana*. To the left is one of the smaller, common triaxons, superimposed on a bit of the central portion of one of the larger common triaxons, to illustrate the extreme size-variation. To the right is one of the alate triaxons from the oscular throat-lining. The straight ray is tangentially placed in the lining, pointing away from the vent. The enclosed scale shows 100 microns by tens.

Oscules.—Not round but irregular in outline, about 1 cm. in diameter. They are usually at the ends of low domes or digitate processes, but not always by any means, and many of the lobes and processes do not bear oscules. The oscular rims are smooth, not elevated into thin-walled collars. The cloacas, which deliver to the oscules, branch—as do those in Demospongiae, and they receive fair-sized tributaries, that is to say, exhalent canals 400 microns in diameter.

Pores.—Densely crowded over the entire surface, 100 to 150 microns in diameter.

Ectosome anatomy.—No specialization, as in the Haliclonidae, which see.

Endosome anatomy.—Typical rhagon architecture, with long inhalent and exhalent canals, dense structure. The flagellate chambers are rounded but not quite spherical. Some views show them 60 by 100 microns—others 80 by 80 microns. Toward the end of the summer specimens were found in which the chamber structure could not be made out—a situation that is relatively common in the Porifera. Yet earlier in the summer (late June, and July) the chamber system was crisp and clear. Perhaps there is a season of degeneration in late August.

Skeleton.—Most of the spicules are regular triaxons, having equal rays and equal angles. The size-variation is enormous; many have rays 9 by 90 microns—many have 18 by 180, 100 by 600 is perhaps commonest, but some triaxons have rays at least 150 by 750 microns. In the lining of the cloaca, near the oscular rims, occur alate triaxons as illustrated.

Apropos the immense size of this Bermuda sponge, one may observe that in the 'Challenger' Expedition Report on the Calcispongiae, Poléjaeff states that the largest calcisponge in the world is a specimen which was collected near Bermuda. He lists it as *Leuconia multriformis* variety *goliath*, giving a height as 233 mm. He figures it as a long, narrow sponge, largely hollow, with an apical oscule. Bermuda specimens of *Leucetta floridana* occur more than twice as tall, and six times as thick, so that they dwarf it—yet, does this indicate that sponges in general may grow large near Bermuda, or instead that *floridana* is an exceptional species? The latter is definitely indicated. Poléjaeff does not describe the spiculation of his specimen called *goliath*. His figure shows it to be smooth surfaced, like *floridana*, and thus unlike his description of *multriformis*. I consider it highly probable that a study of Poléjaeff's actual specimen would disclose that it is not a *Leuconia* at all, but a *Leucetta floridana*.

This species was described by Haeckel, 1872, page 144, from Florida (material sent to him by Agassiz) and transferred to *Leucetta* by Dendy and Row, 1913, page 734. It is close to *Leucetta primigenia*, the type of the genus, yet Haeckel did not even regard it as congeneric, placing it in the genus *Leucaltis*. It is quite unlike the type of *Leucaltis*, which is very feebly rhagon. Haeckel was greatly impressed by such matters as whether or not there were any tetraxons. This species seems to have none, but they are rare in other *Leucettas*, and after long search someone might find one in the species *floridana*. The large size, pink colour, and shape of the alates may serve to distinguish *floridana*, which is clearly the West Indian component of a world-wide genus.

Family LEUCOSOLENIIDAE Minchin.

The sponges of this family are the simplest of all sponges, pronouncedly ascon in architecture. To be sure, there are sponges like *Chondrosia* with no spicules, but their chamber structure is complex. The Leucosoleniidae are mere tubes with ultra-thin walls, and their flagellate cells are scattered on the concave surface —not in chambers. Or one may regard the ascon entire sponges as homologous with single chambers of other sponges.

Genus Leucosolenia Bowerbank.

Sponges of this genus are the simplest members of this simplest family—the other genera have some peculiarity or other, such as the colossal longitudinal oxeas in *Ascute*.

Leucosolenia canariensis (Miklucho-Maclay) Dendy and Row.

Specimens of this sponge are represented by British Museum (Natural History) register number 1948.8.6.61.

Date collected.—June 30, 1947, and many others.

Locality.—Harrington Sound and Walsingham Pond.

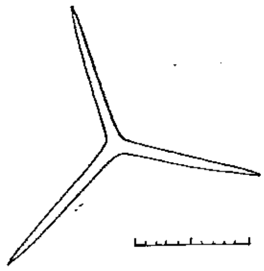
Abundance.—Moderately common—an hour's field collecting should yield two or three specimens.

Shape.—A clathrous reticulation of ascon tubes, with meshes about the same diameter as that of the tubes.

Size.—Masses of 2 cm. total diameter are common. Smaller ones may be more abundant, but be overlooked. Or again, this species may be seasonal, and all the specimens may be at or near maximum size in the late summer.

Colour.—The living sponge is nearly always bright canary or lemon-yellow. In mid-August one was observed to have slight orange tints. This may be due to a reproductive climax to be followed by a disintegration. When preserved in alcohol *Leucosolenia* specimens are white.

Fig. 65.



Camera lucida drawing, ×150, of a typical spicule of *Leucosolenia canariensis*. The enclosed scale shows 100 microns by tens.

Consistency.—Softly fragile, somewhat compressible, easily torn.

Surface.—Optically smooth, microscopically roughened by projecting rays of the spicules.

Oscules.—These are merely the open ends of ascon tubes, and are uncommon, due to the fact that many tubes coalesce into a single channel before reaching the vent. There are about five oscules per cubic centimetre of sponge mass, as a rule.

Pores.—Actually there are no true pores in an ascon sponge; the inhalent openings are prosopyles. They are very small, say 10 microns, but vary greatly in life, and in preserved specimens. In the dead sponge they may enlarge as a result of tissue maceration, or they may be wanting as a result of contraction of the cells around them.

Ectosome anatomy.—No specialization.

Endosome anatomy.—Simple, typical ascon structure.

Skeleton.—Practically exclusively triaxon spicules, and very nearly regular. Each ray is about 9 by 90 microns to 12 by 120 microns. After long search an occasional tetraxon may be found, of the same size-range as the triaxons, and one oxea was discovered. The oxea was almost certainly foreign, an accidental inclusion. The few tetraxons were probably freaks, like human beings with six fingers. Yet they serve to illustrate the difficulty of rigid classification on presence or absence of tetraxons, as Haeckel tried to do—he could put different specimens of the same species into different genera ! This species, unlike most *Leucosolenias*, is to be described as essentially one of only triaxons.

This sponge was described as *Nardoa canariensis* by Miklucho-Maclay, 1868, page 230, from the Canary Islands, and properly transferred to *Leucosolenia* by Dendy and Row, 1913, page 796. It is an abundant species throughout the whole West Indian region.

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EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. At the left, *Ircinia ramosa*, At the right, *Ircinia fasciculata*, } $\times \frac{3}{8}$.
Dried specimens to show the difference in shape, surface conules and other items.

Fig. 2. Two specimens of *Verongia fistularis* form *ansa*, $\times \frac{3}{4}$.
From dried specimens.

Fig. 3. At the left, *Dysidea fragilis*, At the right, *Haliclona viridis*, } $\times 1\frac{1}{8}$.
Each of these two, like many other sponges, closes the oscule by drawing a veil-like membrane over it. In the *Dysidea* this had just begun to pull in when the sponge was preserved. In the *Haliclona* it had almost completely closed the aperture. The oscule of the *Haliclona*, when fully open, had been almost exactly the same size as the equally opened oscule of the *Dysidea*. From alcoholic specimens.

Fig. 4. At the left, *Callyspongia vaginalis*, At the right, *Homaxinella rudis*, } $\times$ about $1\frac{2}{5}$.
On the central tube of the *Callyspongia* one may see the (shrivelled) anemone-like coelenterates *Parazoanthus*. Below, the tubes are very wide and very short. Dried specimens.

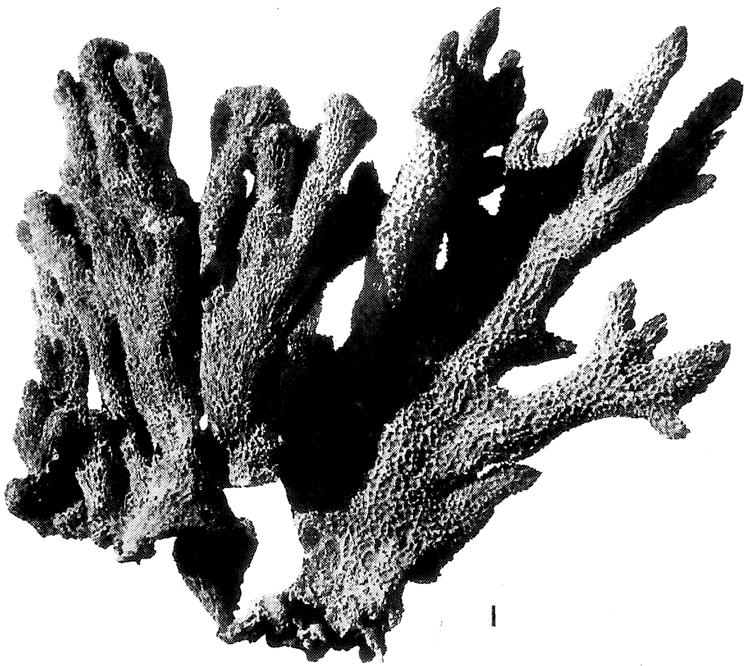
PLATE II.

Fig. 5. *Pellina coela*, $\times 1\frac{1}{2}$, an alcoholic specimen.

Fig. 6. *Spheciospongia othella*, $\times \frac{3}{8}$.
At the left, a specimen from a region of strong currents. At the right, a (smaller) specimen from a relatively calm area. Note in the latter the extremely tall oscular tubes. In the larger specimen one can see about fourteen openings that are obviously oscules, and about a hundred of the openings of intermediate size.

Fig. 7. At the upper left, *Cinachyra cavernosa*.
At the lower left, *Tethya aurantia*.
At the right, *Terpios fugax*.
All are approximately $\times \frac{3}{4}$. They are photographed after preservation in alcohol, but this has not materially affected any item of appearance that would be reproduced in a black-and-white halftone.

Fig. 8. An unusually long, thin specimen of *Leucetta floridana*, collected June 30, 1947, in Harrington Sound. This probably is by far the longest Calcisponge ever collected, 543 mm. long.



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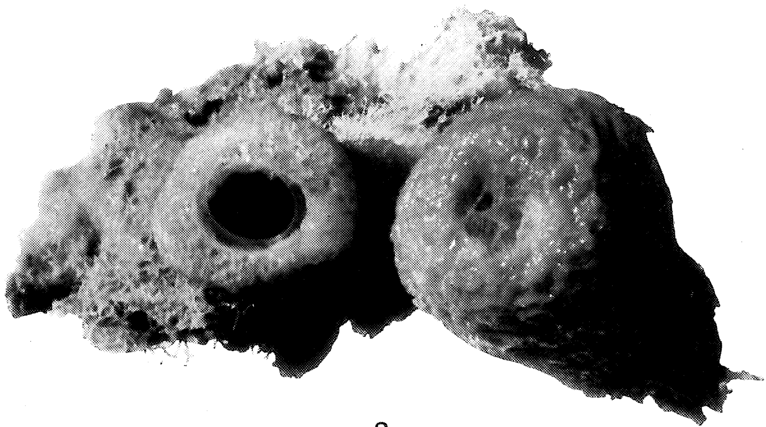

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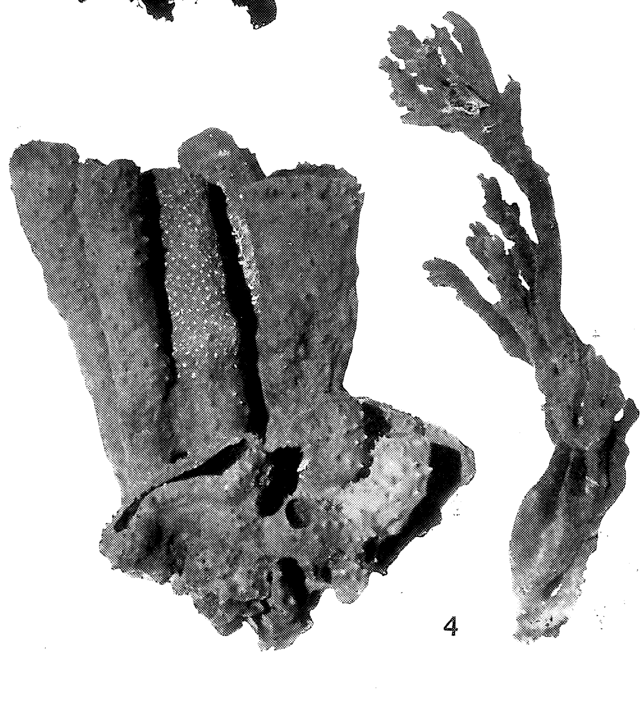

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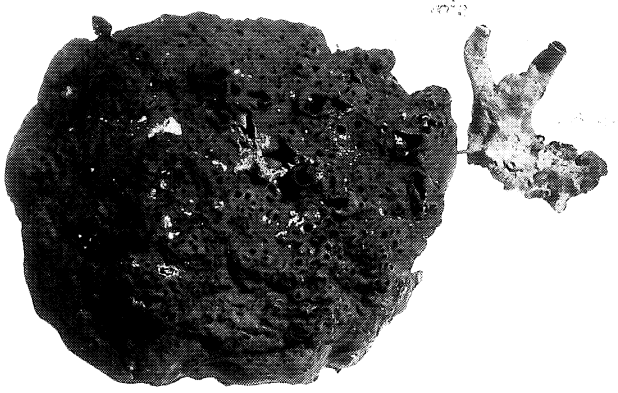

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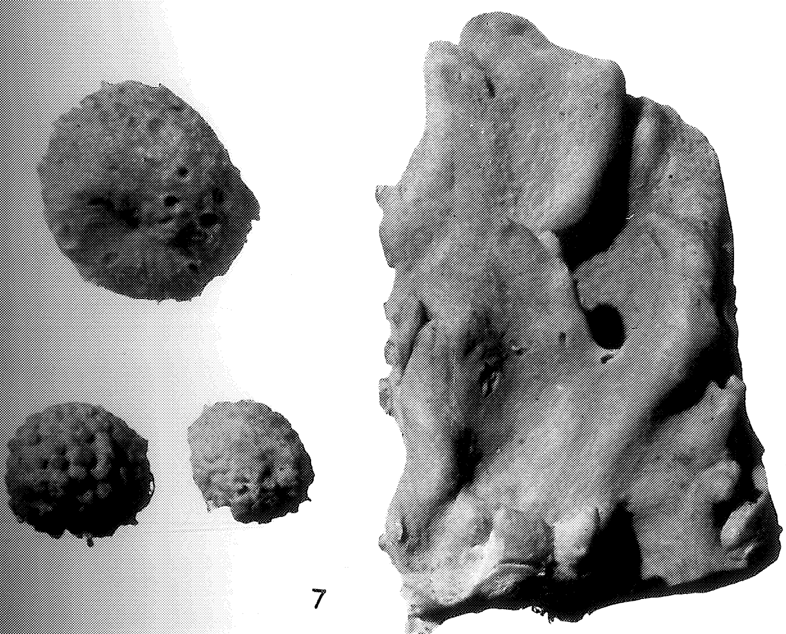

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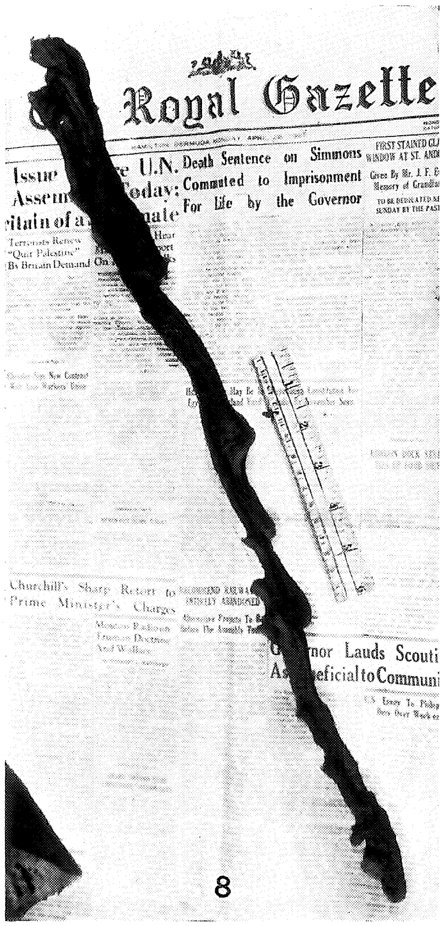
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"Quit Palestine"
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Prime Minister's Charges

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