
SPONGES OF BEAUFORT (N. C.) HARBOR AND VICINITY



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FOREWORD.

The present paper by Messrs. George and Wilson on Sponges of Beaufort (N. C.) Harbor and Vicinity is one of a series of papers dealing with the different groups of animals and plants inhabiting the waters in the neighborhood of the U. S. Fisheries Biological Station at Beaufort, N. C. Soon after the Beaufort laboratory was established for practical service to the fisheries, it was determined that one of the essential foundations for such service was an exact knowledge not only of the directly useful fishes and shellfishes, but of all animals and plants inhabiting the region and necessarily having some relation to fishes and shellfishes as food, as enemies, as competitors, or as affecting their existence in other ways. A series of sympathetic studies was therefore started simultaneously with the beginning of activities in practical fishery experiment work. While none of the sponges of the Beaufort waters are now known to have a positive economic value, some of them are encountered as direct or indirect enemies of oysters. Other species have served as a basis for experimental work which may have a bearing upon sponge culture in other waters. A final appraisal of the significance of the sponges in such waters can not, however, be made in the present stage of our knowledge. This report contributes to the desired foundation of knowledge, and its publication by the Bureau is desirable.

H. M. SMITH,
Commissioner of Fisheries.

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Contribution from the United States Fisheries Biological Station, Beaufort, N. C.



INTRODUCTION.

The following report includes a description of the forms of sponges which are present and in any degree conspicuous in the Beaufort area. The collections were made from time to time, especially between the years 1904 and 1907. Doubtless additional forms will be recorded. It is especially probable that intensive examination of "oyster rocks" and scattered shells will result in the discovery of other small, inconspicuous species, comparable in this respect to *Pleraplysilla latens*, herein described. Considering the interest and value for experimentation of *Pleraplysilla*, a horny sponge of exceedingly simple character, such a search would be well worth undertaking. Collecting along the sea beaches has been incidental. Most of the material so collected proved unfit for precise study. Such sponges, in fact, are usually macerated, the microscleres lost, and the cellular tissues destroyed. The "Fishing Bank" off Beaufort Inlet has yielded specimens of four species. Collecting here, however, has been casual only, and the bank is probably the home of many more species. This bank is of a coralline nature, with a fauna which appears to be West Indian. It lies about 20 miles southwest of Beaufort and has been charted by the U. S. Bureau of Fisheries steamer *Fish Hawk*.

Of the 17 forms described in this paper, those especially available for biological investigations of an experimental nature are species of *Cliona*, *Suberites*, *Tetilla*, *Reniera*, *Stylotella*, *Lissodendoryx*, *Microciona*, and *Pleraplysilla*, representing chiefly the two great monaxonid groups, but including also a tetractinellid species and a horny sponge. It is quite possible that some of the other forms, especially the species of *Spirastrella*, *Esperiopsis*, and *Hircinia*, might be made use of for such investigations. These species occur in some abundance on the "Fishing Bank" and perhaps nearer the inlet. With care, living specimens, or, at any rate, living pieces which would answer the pur-

pose, might be brought to the laboratory, or certain breeding experiments might be begun on shipboard, and the cultures handled in the laboratory later.

The scheme of classification followed is, in general, that used by Dendy in 1905. Some alterations which seem to be advisable have been made. In the scheme as here adopted the larger groups of the noncalcareous sponges are as follows:

- Order 1. MYXOSPONGIDA.—Simple forms without a skeleton. Absence of the skeleton primitive (*Halisarca*, *Bajalus*, *Hexadella*, *Oscarella*).
- Order 2. HEXACTINELLIDA (*Triaxonida*).—With triaxonid, characteristically hexactinellid, siliceous spicules.
- Order 3. TETRAXONIDA.—The characteristic form of spicule is a siliceous four-rayed sclerite, each ray representing a particular axis (tetraxonid or tetractinellid spicule). But in some groups these spicules have been lost.
- Suborder 1. HOMOSCLEROPHORA (Dendy, 1905).—Megascleres and microscleres are not yet sharply differentiated from one another (*Plakinidæ*, *Corticidæ*, *Thrombidæ*).
- Suborder 2. ASTROTETRAXONIDA (Hentschel, 1909).—Tetraxonid sponges without desmas, characterized fundamentally by the astrose microscleres, which, however, have been lost in the evolution of some groups.
- Tribe 1. ASTROPHORA (Sollas, 1888).—With tetraxonid megascleres and astrose microscleres.
- Tribe 2. ASTROMONAXONELLIDA (Dendy, 1905).—Sponge body generally compact and massive, sometimes approaching a definite shape, but also incrusting. Megascleres all monaxonid, often radially, or somewhat radially, arranged. Skeleton rarely fibrous, not distinctly reticulate, and usually without spongin. Microscleres, if present, are asters of some form or other. Presumably derived from the *Astrophora* through loss of tetraxonid megascleres. Equivalent to *Hadromerina*, Topsent.
- Suborder 3. SIGMATOTETRAXONIDA (Hentschel, 1911).—Tetraxonid sponges without desmas, characterized fundamentally by microscleres which are either sigmata or forms derivable from the sigma. But the microscleres have been lost in some groups.
- Tribe 1. SIGMATOPHORA (Sollas, 1888).—With tetraxonid megascleres. Microscleres when present are sigmata.
- Tribe 2. SIGMATOMONAXONELLIDA (Dendy, 1905).—Megascleres all monaxonid. Skeleton very commonly reticulate or fibrous, with a good deal of spongin. Microscleres, when present, either sigmata or derived forms such as chelæ. True astrose microscleres are absent, except, possibly, in an aberrant species or two. Presumably derived from the *Sigmatophora* through loss of the tetraxonid megascleres. Equivalent to *Halichondrina* auct.
- Suborder 4. LITHISTIDA.—Tetraxonida with desmas.
- Order 4. KERATOSA (*Euceratosa*, Dendy, 1905).—Skeleton made up of horny fibers. Without proper spicules. Absence of spicules primitive and not due to evolution by loss. Sand grains and other foreign mineral particles often aid in forming the skeleton, and in exceptional cases constitute its chief part.

The families, subfamilies, and genera represented are defined in the text. In constructing these and the above definitions we have freely used the memoirs of Dendy, Lendenfeld, Lundbeck, Sollas, Topsent, and Vosmaer. A consideration of some comparative data, falling for the most part under the head of variation, together with a discussion of the facts on which the genera are made and classified, has considerably lengthened the sections assigned to several of the species. This matter follows, in each section, the description of the species, from which it is more or less conspicuously set off.

ASTROMONAXONELLIDA Dendy.**Family SPIRASTRELLIDÆ.**

Megascleres usually styles or tylostyles, sometimes diactinal. Asters of various forms occur, often forming an ectosomal crust.

Spirastrella O. Schmidt.

Sponge incrusting, or cushion-shaped with processes, or massive; or vase-shaped with large cloaca, in which case the incurrent and excurrent surfaces may be differentiated. Megascleres styles or tylostyles, or a mixture of the two forms. Microscleres usually present, and abundant, in the form of spirasters, but these spicules may be exceedingly scarce, or even wanting.

Spirastrella andrewaii, n. sp. (Pl. LVI, figs. 3, 6, 7a, b; Pl. LXVI, fig. 49a, b, c, d.)

A specimen was trawled August 1, 1914, in 15 fathoms of water by the *Fish Hawk* on the "Fishing Bank" off Beaufort Inlet, Fish Hawk station 8199. Since 1914 the *Fish Hawk* has taken in her summer dredgings several very similar specimens in the same locality. Several specimens of the species, now in the National Museum at Washington, were taken by the *Albatross* off the Carolina coast at a depth of about 30 fathoms during the summer of 1885. The species has also been taken in Jamaican waters by Prof. E. A. Andrews.

The striking characteristic features of the sponge are its large size, habitus, and the differentiation of incurrent and excurrent surfaces. The sponge is cylindrical, with large cloacal cavity. Living specimens occur that are high and vase-like. The dried specimens, which, doubtless, have all collapsed more or less, are comparatively low and cushion-like. The external surface of the sponge is incurrent, the cloacal surface excurrent.

The following description is based on the specimen taken in 1914. The sponge is cushion-shaped, 60 centimeters across and 30 centimeters high; cloacal cavity 30 centimeters across at the mouth, 20 centimeters deep. The color is dark brown at the surface, lighter within. Consistency in an alcoholic specimen is like firm, dense cartilage, sponge becoming woody on drying. Whole sponge is greatly excavated by canals which contain many shrimp. The lateral surface is closely studded with small incurrent apertures (fig. 7b), which measure 1 to 2 millimeters in diameter. The upper surface around the mouth of the cloaca shows irregular areas of similar apertures. They are all actual openings, not closed by pore membranes. Beneath the ectosome of the lateral and upper surfaces the sponge is cavernous, with large canals 6 to 8 millimeters wide, or even larger, extending more or less radially into the interior. Several incurrent apertures, perforating the ectosome, lead into each canal. On the walls of these great canals are abundant apertures leading into surrounding small canals.

The external surface of the sponge between the incurrent apertures appears to the eye comparatively aporous. It is, however, dotted with abundant small, round subdermal cavities, for the most part 200 to 300 μ in diameter, but as small as 80 μ in diameter. The thin, dermal membrane covering these cavities is perforated by pores 40 to 50 μ in diameter, one to a few (about 3 to 4) pores leading into each cavity. The membrane roofing in a subdermal cavity contains spirasters, but is free from megascleres, excepting such as project into it from the surrounding tissue. The subdermal cavities are produced into small canals which pass inward, as may best be seen in a series of thick tangential sections.

The anatomy suggests that the large incurrent canals serve to carry water directly into the deeper interior of the sponge, while the external region is fed by small canals, some of which arise as branches of the larger and others of which arise between the incurrent apertures, as just described. It is needless to say that observations on the living sponge in this connection are desirable.

The cloacal wall is studded with oscula, 4 to 5 millimeters in diameter and smaller, although the smaller sizes are obviously often due to partial closure (fig. 7a). Oscula are numerous, the distance between fully open ones being less than the oscular diameter. Each osculum, which, with its surrounding rim of "oscular membrane," forms a circular depressed area in the dried sponge, is the aperture of

a large efferent canal extending more or less radially into the sponge substance. The efferent canals in this specimen are somewhat smaller than, and not so close together as, the corresponding incurrent canals; but this is a matter of individual variation.

Numerous very small subdermal cavities, covered in by dermal membrane, underlie the cloacal surface between the oscula. Some are circular and about $80\ \mu$ in diameter; others are elongated and about $200\ \mu$ across. From them small canals, often about $80\ \mu$ in diameter, pass radially into the interior. (Sponge being shrunken, such dimensions are, of course, far from what they must be when the sponge is expanded.) The areas of dermal membrane covering in the subdermal cavities are thin and in life are doubtless perforated by the (now closed) pores. In correlation, perhaps, with the completely closed condition of the pores and the contracted state of the sponge these areas now contain megascleres scattered tangentially. The inference to be drawn from the anatomy is that the cloacal surface is not an exclusively excurrent surface.

Spicules.—Megascleres: (1) The characteristic spicule is a tylostyle (fig. 49c), smooth, slightly curved, about $350\ \mu$ by $8\ \mu$. The common range in length is 325 to $425\ \mu$ in thickness, 7 to $11\ \mu$. The head may be evenly rounded, or it may be somewhat elongated and bear a constriction. Modifications of this spicule sometimes occur in the form of (2) tylostyles (fig. 49a), in which the apex is not pointed, but rounded, and (3) styles (fig. 49b). Microscleres: Spirasters (fig. 49d), 8 to $20\ \mu$ long, of one or two complete "turns." The spines are short and conical, sharp in some spicules, truncated and blunt in others. The spicules occur at the dermal and cloacal surfaces and in the walls of the canals. They are abundant, but not very abundant; nowhere do they form a continuous layer or "crust," but everywhere they are spaced well apart. The common range of length in the spicules at the dermal and cloacal surfaces is 8 to $12\ \mu$. In the walls of the large canals they reach $20\ \mu$ in length.

Skeletal framework.—The septa of sponge tissue between the canals are well filled with megascleres except in the region immediately around a canal. In places the megascleres lie crossing one another in all directions. But in many septa, both thick and thin, the spicules all lie about in the same direction and are compactly arranged, thus constituting a fairly distinct tract. Different tracts cross one another at various angles, connecting and branching, and thus give to the skeleton a fibrous appearance which is inconspicuous in alcoholic, but conspicuous in dried, material. In the canal walls the megascleres are strewn thickly and tangentially.

At the dermal surface, while there are some tangentially placed spicules, the bulk of the megascleres occupy an obliquely radial or radial position, their points projecting; but they are not divided into distinct brushes. They form a continuous covering, which is only interrupted by the large, incurrent apertures and the areas of membrane over the small, subdermal cavities.

At the cloacal surface also many megascleres lie radially and obliquely, projecting slightly. At this surface there is in this specimen a particularly dense skeletal layer, about 1 millimeter thick, in which the spicules lie in all directions. This is a detail which is not present in all the specimens.

The first specimen of this species studied by us was collected a number of years ago in Jamaican waters by Prof. E. A. Andrews, of Johns Hopkins University. Some data concerning this specimen may be recorded here. The characteristic size of the tylostyles is $420\ \mu$ by $14\ \mu$. The spirasters at the dermal surface are commonly about $14\ \mu$ long and are more abundant than in the Beaufort specimen, forming a continuous crust. In the walls of the larger canals they reach a length of $20\ \mu$.

In the dried fragment of this specimen sent us for examination, the incurrent apertures of the dermal surface were for the most part filled with what were doubtless small anemones. Dendy records (1896, p. 252) that in *S. papillosa* R. and D., occurring in the neighborhood of Port Phillip Heads, Australia, "the surface is sometimes much infested by a parasitic actinozoan."

The habitus of the Jamaican specimen as recorded by Prof. Andrews is interesting: "Height of sponge, 2 feet; diameter, 11 inches; diameter of mouth, 4 inches; depth of cloacal cavity, 10 inches. Sponge stood upright on a reef 20 feet below the surface. In life the color was black or perhaps purplish black, very dark brown when dried. When alive, sponge was covered with peculiar small objects which seem to be actinians, partly embedded in the surface, each 1 millimeter in diameter. Sponge hard, smooth, compact."

The *Albatross* specimens in the National Museum "average 18 inches in diameter, 12 inches high; cylindrical in shape, but with deep cavity in top." (Letter from Dr. Mary J. Rathbun of the U. S. National Museum.) A particular specimen measured 30 centimeters high by 40 centimeters in cross diameter; cloacal cavity 15 centimeters deep, 25 centimeters across at the mouth. The sponge (dried)

is hard and woody. Color, dark brown at surface; canalar walls not so dark; parenchyma whitish gray. Large canals 6 to 7 millimeters in diameter, up to twice that size, extend in from both dermal and cloacal surfaces.

A fragment of this specimen was examined microscopically. The tylostyles had a distinct but only slightly developed head; measured 414 to 468 μ by 11 to 14 μ ; were in general slightly and evenly curved, but sometimes bent more or less abruptly. The spirasters were commonly 10 to 12 μ long. In respect to the abundance of the spirasters at the dermal surface, the specimen (fragment) proved to be intermediate between the Beaufort and the Jamaican sponges.

The vasselike habitus with differentiated incurrent and excurrent surfaces has not hitherto been described in *Spirastrella*. The nearest approach is made by the type specimens of *Spirastrella (Alcyonium) purpurea*, collected by Peron and Lesueur in 1803 in Australian waters and first described by Lamarck in 1815. Topsent, who in recent years has reexamined these specimens (1906a, p. 3), thinks that one, at any rate, possibly represents a marginal fragment of a vasiform sponge. The two faces are different. One, which Topsent suggests may be the outer surface, is imperforate and bears radial tuberosities, while the other bears orifices visible to the eye about 1 millimeter apart. The interior of the sponge is porous but not cavernous.

Vosmaer (1911) has shown that a great number of forms described from many parts of the world intergrade in respect to any of the points he has considered. He hence combines them all as one species, which he designates *S. purpurea* (Lamarck). It may be doubted if the name is well chosen; certainly not if Topsent's interpretation is correct and Lamarck's fragments belong to a vasiform sponge with differentiated faces. This would be very different from the remainder of those combined by Vosmaer, and a new name would thus be necessary for Vosmaer's species.

Certain gross anatomical points of resemblance between *S. andrewsii* and *Poterion* are obvious. These are the vasiform shape and the differentiation of pore and oscular surfaces. But the pore areas and afferent canal system of *P. atlantica* are quite different structures from the incurrent apertures and great canals of *S. andrewsii*, and the oscula and oscular canals of the two forms are likewise very different. The resemblance is only the gross likeness which results from the sponges independently acquiring the same shape of body and the same type of distribution of the incurrent and excurrent orifices.

While *S. andrewsii* is a striking species in the matter of size, one species of the genus already is recorded that exceeds it. This is the great *Hymeniacidon pulvinatus* of Bowerbank (1872, p. 126), which Vosmaer (loc. cit.) merges into *Spirastrella purpurea* (tropus *pyramidalis*). This sponge, occurring at Calebert Quay near Belize (British Honduras), is a massive, sessile form reaching 8 feet in height. The oscula and pores are scattered over the surface. The sponge is cavernous with large canals.

Position of the genus.—The spiraster of *Spirastrella* has generally been regarded as a modified aster, and the genus accordingly put in the Astromonaxonellida (*Hadromerina* of Topsent). But Vosmaer (1909) has concluded that the spicules are spiral monaxons with spines, since the latter contain no axial canals, as do the actines of a true aster. Dendy (1916, p. 96), perhaps reasoning from this fact, transfers the *Spirastrellidæ*, and along with them the *Clionidæ* and *Suberitidæ*, to the *Sigmatotetraxonida*. Awaiting Dendy's detailed reasons for the change, the families are retained in this paper in their old position.

Family CLIONIDÆ.

Astromonaxonellida that bore into and excavate molluscan shells and other calcareous bodies.

Cliona Grant.

The complete spiculation includes tylostyles, oxeas, and spirasters. Of these elements one or two fail to appear (undergo atrophy) in certain species.

Cliona celata Grant. (Pl. LVI, figs. 2, 4, 5; Pl. LXVI, fig. 50.)

Spongia sulphurea, Desor, 1848, p. 67.

Cliona sulphurea, Verrill and Smith, 1874, p. 450.

Cliona sulphurea (Desor), Leidy, 1889.

Cliona celata Grant, Lambe, 1896, p. 202.

Cliona celata Grant, Topsent, 1900, p. 32. (Synonymy here given in full.)

A common sponge in Beaufort Harbor, especially occurring in oyster and clam (*Venus*) shells. The specimen figured was taken just below low-water mark from the edge of a little island.

The sponge consists of anastomosing trabeculæ (Pl. LVI, fig. 5), which lie in the body of the shell, and numerous projecting tubular papillæ bearing pores or oscula. The sponge trabeculæ completely fill the excavations in the shell, and in an old specimen the excavations occupy nearly all the space between the thin shell walls. The papillæ may be extended a few millimeters, or may be retracted into the shell. They are of two kinds: (1) Pore papillæ, which, when extended, have a tubular stalk with a mushroom-shaped cap covered by a dermal membrane riddled with pores 15 to 35 μ in diameter. No pores were found except over the expanded end of these papillæ. The diameter of the tubular stalk of the pore papillæ in a preserved specimen is 1 to 2 millimeters and the diameter of the expanded end 1.5 to 3 millimeters. They connect with the trabeculæ in the interior of the shell. (2) Very similar tubular papillæ, each bearing a single terminal osculum 1 to 1.5 millimeters in diameter, instead of a porous cap. In the living specimen, observed in shallow aquaria, the oscular papillæ are found to be conical at the tip and are easily distinguished from the pore papillæ, with which they are intermingled over the surface of the shell. They are few in number as compared with the pore papillæ.

Coarsely granular or spheruliferous cells (*cellules spheruleuses*) are exceedingly abundant, as in the sponges examined by Topsent (1900).

Spicules.—Tylostyles, smooth, slender, slightly curved, with a pretty sharp point, measuring 200 to 400 μ by 4 to 9 μ . The spicules taper slightly toward the head end, as well as toward the point. The curvature is in the upper (head) half of the spicule.

Skeletal framework.—The skeleton of the sponge trabeculæ within the shell consists of irregularly scattered, moderately abundant tylostyles. The skeleton in the wall of the tubular pore papillæ consists of a dense confused network of tylostyles, some of which have their points extending slightly beyond the dermal membrane. At the distal end of the papilla, where the pore-bearing cap spreads out, the reticulum of the wall breaks up into a system of loose fibers and trabeculæ, which extend upward at various angles, spreading out terminally in brushes to support the dermal membrane which covers the cap. The skeleton of the wall of the oscular papilla likewise consists of a dense reticular mat of spicules. As we approach the tip of the papilla the mat becomes less dense, and the spicules point more toward the tip, becoming arranged frequently in more or less definite plumose tracts. There is no spongin.

At the base of the pore and oscular papillæ there is a sharp contrast between the dense skeleton of the walls of these tubes and the loose skeleton of scattered spicules in the trabeculæ within the shell.

This sponge, as is well known, may grow out of the shell which it has excavated and eventually form a free mass of large size. But the massive phase, which is common on the New England coast, where it may reach a diameter of about 8 inches (Verrill and Smith, 1874, p. 127), has not been observed in Beaufort harbor. Farther south, on the west coast of Florida, the free phase (*Raphyrus griffithsii* Bow) is known to occur, both in the common massive form and in a branched tubular form (1) (Carter, 1884, p. 207).

Topsent (1889; 1900, pp. 34, 55) has concluded that there is no valid reason for maintaining the American form (*Spongia sulphurea* Desor) as a species distinct from *C. celata*. This, in fact, seems to be the case, although a careful and detailed comparison of specimens from the two sides of the Atlantic would in all probability show certain constant, if minute, differences. The Beaufort specimens examined do differ from the European individuals (comp. Topsent, 1900) in the following points: (1) The inhalent papillæ are tubular except at the very top, where the trabeculæ which pass out from the wall to support the pore membrane encroach upon the axial cavity. In the European sponges (Topsent, loc. cit., pp. 35, 47) these papillæ are filled with tissue except basally, where they are hollow. (2) In the Beaufort specimens the head of the tylostyle only rarely exhibits a distinct apical prolongation, whereas this is the rule in the European sponges (Topsent).

Topsent (loc. cit.) gives the range in size of the tylostyles as 180 to 360 μ by 3 to 9 μ . The range in size for the Beaufort specimens is close to this. Moreover, the shape of the spicules is the same, except for the above-mentioned detail, in the two sets of specimens. In the European sponges this is the only spicule that usually occurs. In very young specimens, chiefly in the papillæ, Topsent finds, however, spinose spirasters. But these spicules soon cease to be formed. No such very young specimens have been studied on this side of the Atlantic. In some European individuals of this species long, slender, smooth oxeas, generally in fascicles, occur. Sollas has grouped these as *var. linearis*, but Topsent thinks the point is only a character such as separates individuals and is not the mark of a subgroup.

Poterion Schlegel.

Beginning as a boring sponge, the body becomes free, large, and vase-shaped, with the incurrent apertures on the outer surface and the excurrent apertures on the inner or cloacal surface. Skeleton made up of tylostyles.

Poterion atlantica, n. sp. (Pl. LVI, fig. 1; Pl. LXVI, fig. 51a, b, c.)

A single specimen was trawled by the *Fish Hawk* on the "Fishing Bank" off Beaufort Inlet at a depth of 14.5 fathoms.

The sponge is vasiform, about 12 centimeters across at the top. The vasiform cavity extends entirely through the sponge, which, however, has had its base torn off. Actual height of the specimen is 11 centimeters. The height of the uninjured sponge was probably considerably greater.

The outer surface exhibits contiguous, or nearly contiguous, circular, or irregularly rounded areas about 5 millimeters in diameter. These in the preserved specimen are slightly depressed. The central and greater part of each area is porous and reticular, as seen with the lens and even with the eye, this part measuring about 3 millimeters in diameter. These are the pore areas. Microscopic preparations of the surface and sections through the pore areas show that each area includes numerous pores 75 to 100 μ in diameter. From each pore a canal of about the same diameter passes vertically into the cortex. The inner surface exhibits similar areas, the center of each occupied by an osculum 0.5 to 1.0 millimeter in diameter. The osculum is the aperture of an oscular (chonal) canal which passes vertically through the cortex.

The sponge has a gray, dense, cartilaginous cortex both on the outer and inner surface of the cup. The surface is now (in the preserved specimen), blackish brown, interior yellow. The interior looks fibrous and is comparatively solid.

Spicules (Pl. LXVI, fig. 51a, b, c).—Smooth, slightly curved tylostyles, 210 to 460 μ by 4 to 8 μ . The head of the spicule may be globular (fig. 51b), or there may be a slight constriction around it (fig. 51a), or the enlargement may be located a slight distance from the end (fig. 51c). There are no microscleres.

Skeletal framework.—The skeleton of the choanosome (Pl. LVI, fig. 1) consists of irregularly scattered megascleres, together with loose spicule tracts. Collections of sand grains occur abundantly in the choanosome. There is a cortical layer 1 to 1.5 millimeters in thickness, composed of compactly and confusedly arranged spicules, which however, in the main, point in a more or less radial direction, sometimes extending beyond the surface. This cortex is pretty definitely marked off from the underlying choanosome, in which the spicules are not nearly so abundant. There is no noticeable difference in the size of the spicules of the cortex and those of the choanosome. At the base of the cortex there is present in most places a thin layer of spicules arranged more or less parallel to the surface (Pl. LVI, fig. 1).

The canals are in general small, mostly 50 to 150 μ in diameter, but some are 500 μ or more in diameter.

The sponge tissue is dense and granular. The flagellated chambers are inconspicuous and measure about 30 μ in diameter.

This interesting sponge is evidently very close to the well-known "Neptune's Cup," *Poterion patera* (Hardwicke), of the Pacific, which Vosmaer some years ago (1908) showed to belong in the Clionidæ. Topsent reviewing Vosmaer's paper (1909) would delete *Poterion*, merging it into *Cliona*. But the final structure assumed is such a marked one that the genus should be retained, as Vosmaer more recently has held (1911, p. 3).

Poterion patera, which is not uncommon in the Malay Archipelago, reaches a height of 1 meter, with an aperture of 30 centimeters, the wall of the cup 25 millimeters thick (Vosmaer, loc. cit.). The Beaufort sponge differs from the Pacific species in the larger size and closer grouping of its pore areas. These (Vosmaer, loc. cit.) in the latter form are indistinct in outline, something over 1 millimeter in diameter, and about the same distance apart. The internal skeleton is stronger in the Pacific species than in the Beaufort form, consisting in the former of a firm trabecular network, the trabeculæ made up of closely packed tylostyles and including in the axial region here and there a little spongin (Vosmaer). The spicules in *P. patera* range in size from 450 μ by 14 to 11 μ to 200 μ by 10 to 7 μ (Topsent, loc. cit.).

Family SUBERITIDÆ.

Megascleres tylostyles or styles. Microscleres absent or represented in some forms by centrotylote microstrongyles.

Suberites Nardo.

Body frequently massive, but it may branch or become covered with outgrowing lobes. Without mammiform papillæ. Megascleres nearly always tylostyles. No microscleres. The spicules diminish in size toward the surface. The superficial spicules project radially, and the skeleton, as a whole, may exhibit in some measure a radiate arrangement.

Suberites undulatus, n. sp. (Pl. LVII, figs. 8, 9, 10, 11; Pl. LXVI, fig. 52.)

Fairly common in the muddy pools left at low tide around "Green Rock," in Newport River.

Sponge (Pl. LVII, fig. 8), a spheroidal mass, made up of a basal undivided portion and closely set lamellate and narrow, ascending lobes into which the former is produced over its superior and lateral surfaces. A characteristic specimen (the type) measures 60 millimeters in height, with transverse diameters of 75 and 90 millimeters. It was attached below to the shells of live oysters. A few pieces of shell were incorporated in its basal portion, and some algæ grew out from between the lower lobes.

Color light gray. Sponge fairly firm; compressible and easily torn.

The lamellate lobes are all more or less radial, but flattened in various planes. They are thus inclined to one another at all angles. Where they meet they are apt to fuse; this produces cavities closed below and around the sides, which extend into the sponge interior and open above between the

free portions of the lobes. The upper margins of the lobes are fairly sharp and have in the alcoholic specimen a dense, whitish appearance. These margins are commonly notched and undulating, but the portions between the notches may be produced into ascending lobules. The central lobes are the longest; their radial length is about one-half the vertical diameter of the whole sponge. Probably the basal part of the sponge mass has been built up during growth through the gradual incorporation of lobes.

The surface when examined with a lens is seen to be minutely roughened and well covered with projecting spicules. The ectosome includes very numerous subdermal cavities, varying considerably in diameter from about $150\ \mu$ to 1 millimeter (Pl. LVII, figs. 10, 11). The thin, dermal membrane roofing these over is perforated by pores 20 to $40\ \mu$ in diameter, several opening into each cavity. Most of the pores are closed, but enough are open to show the arrangement. Small oscula about 1 millimeter in diameter occur on the upper margin of the lobes. Probably they are naturally numerous, but now for the most part closed.

The interior of the sponge is dense as compared with the ectosome, but sections (Pl. LVII, fig. 10) show that it, too, is greatly excavated by canals, most of which are small, about 100 to $300\ \mu$ in diameter, with some larger ones. Flagellated chambers, ellipsoidal and 20 to $25\ \mu$ by 30 to $35\ \mu$, are abundant in the choanosome. The thin trabeculae and sheets of sponge tissue are favorable for histological study.

Spicules.—Tylostyles smooth and slightly curved, with well-developed, rounded head (Pl. LXVI, fig. 52). The shaft is very slightly thicker in the middle than near the head end, tapering at the other end to a sharp point. The head is not infrequently irregular, sometimes constricted near its middle. Range in size for whole sponge, 200 by $6\ \mu$ to 460 by $10\ \mu$.

In the interior the larger sizes are abundant, perhaps predominate. The spicules of the dermal skeleton are, in the average, smaller; the common range being 200 by $6\ \mu$ to 320 by $8\ \mu$.

Skeletal framework.—The skeleton (Pl. LVII, figs. 9, 10, 11) is made up chiefly of abundant and fairly compact tracts of megascleres, which pursue a rather vaguely radial course in the basal part of the sponge, becoming distinctly longitudinal in the lobes. In a slice of some size through the basal part it is easy to see that, while many individual tracts curve in all directions, the skeleton as a whole exhibits a radial arrangement. The spicules lie more or less longitudinally in the tracts and are abundantly scattered between the latter. Spongin is absent.

From the internal skeleton short tracts are given off which extend outward, usually upward and outward, through the ectosome and terminate in dermal brushes of divergent spicules (fig. 11). The dermal skeleton includes, in addition to the brushes, a good many single, radial, and projecting megascleres and abundant tangential megascleres scattered without order. The spicules of the dermal brushes usually project a considerable distance, often about half the length of the spicule. The spots at which they project are, as a rule, either not elevated, or only slightly elevated, over the surface in general; but in places these spots are elevated high enough to be called "conuli." The difference may in part be due to contraction.

In the upper margins of the lobes, or of the subdivisions of the same, the dermal brushes are so closely set as to form a continuous furze, in which the longitudinal skeletal tracts terminate. It is this dense aggregation of dermal spicules that gives to these margins their whitish appearance in the alcoholic specimen.

The lobes of the Beaufort sponge are, of course, structures quite different from the papillae of the Polymastidae.

In its extensive development of the ectosomal canal system *S. undulatus* resembles the species grouped under Topsent's genus *Pseudosuberites*: *P. sulphureus* (Bean), *P. hyalinus* (R. and D.), *P. andrewsii* Kirkp., *P. exalbicans* Tops. But this particular feature does not, it seems to us, constitute sufficient ground for excluding the sponge from the older genus. Probably when the canal system of the numerous *Suberites* species has been studied more extensively, considerable variation will be found in this matter within the genus.

SIGMATOPHORA Sollas.**Family TETILLIDÆ Sollas.**

The characteristic megascleres are protriænes, which may be very slender, arranged radially. The skeleton in general is usually strongly radiate.

Tetilla O. Schmidt.

Typically the ectosome is not a distinct layer, but shades off into the choanosome; pores and oscula scattered and not located in special depressions. In some species, however, the ectosome is to some extent histologically differentiated and partially assumes the character of a fibrous cortex; and in some species there are special depressions on the floor of which the pores and oscula are located. There is no special cortical skeleton.

Tetilla laminaris, n. sp. (Pl. LVIII, fig. 14; Pl. LIX, fig. 17; Pl. LXVI, fig. 54a to h.)

Fairly abundant in Newport River in the vicinity of "Green Rock." The specimens used in preparing this paper were dredged at half tide, at a depth of 4 feet.

Sponge body (Pl. LVIII, fig. 14) a vertical lamella, elongated horizontally, the lower part of the lamella rooted in muddy sand by abundant fascicles. The lower edge of the lamella is thin; from this edge the body thickens gradually to the upper margin, which is rounded. The lamella is sometimes folded; the folds vertical. Sponge dense, firm. Color in the fresh state, grayish brown.

The root fascicles arise from the whole lower edge and the neighboring parts of the lateral surfaces; the uppermost, relatively high up on the lateral surface, are short; they increase in length toward the lower edge. In the collected specimens the length of the lower rootlets is for the most part 10 to 20 millimeters, but in one specimen the length reaches 50 millimeters. The rootlets are so abundant that the whole lower edge of the collected sponge bears, even after washing, a continuous mass of sand held in place by the root spicules. The rootlets were in large part removed from the specimen photographed.

In the type specimen the length is 115 millimeters, the greatest height 60 millimeters, greatest thickness 13 millimeters. Smaller and larger specimens are common. The largest specimen in the collection is 180 millimeters long, with a greatest height of 70 millimeters and greatest thickness of 30 millimeters. Relatively shorter and higher specimens occur, but the horizontal length is characteristically considerably greater than the height.

The surface of the upper part of the sponge body looks smooth to the eye. In reality, as may be seen with the lens, slender megascleres everywhere project from it for a fraction of a millimeter.

Numerous small oscula, 0.5 to 1.5 millimeters in diameter, the apertures of short oscular canals, are scattered along the upper margin at intervals, 2 to 15 millimeters apart. A few occur in some specimens on the lateral surfaces, near the upper margin. Pores about 30 to 60 μ in diameter abundantly scattered between the projecting brushes of spicules. They perforate the very thin dermal membrane and lead into small subdermal cavities which occupy an ectosomal zone about 60 to 80 μ thick. The intact surface appears dense to the eye; with a lens it is seen to be finely diversified by the minute subdermal cavities.

The ectosomal zone and the whole peripheral region to a thickness of about 0.5 millimeter is denser than the interior, owing to the smaller size of the canals; but, while the canals of the interior are numerous and larger than those of the ectosome, they are only a fraction of a millimeter in diameter (Pl. LIX, fig. 17). No part of the ectosome is differentiated to form a fibrous layer.

Skeletal framework.—The mesial region of the sponge lamella includes a number of spiculo-fibers which pursue, in the main, a vertical direction. From these, radial spiculo-fibers extend outward, terminating in a layer of closely set, peripheral, radial brushes, about 800 to 1,000 μ in radial length; the spicules of the brushes, projecting for the most part a short distance, about 100 μ ; some of the protriænes three times as far (Pl. LIX, fig. 17). In the lower half of the sponge the radial spiculo-fibers pass obliquely downward. The rootlets are the prolongations of some of the radial fibers and of some

of the lower mesial fibers. The spiculo-fibers are compact, cylindrical tracts in which the spicules are arranged longitudinally, without spongin. Between the fibers are scattered megascleres.

Spicules (Pl. LXVI, fig. 54*a* to *h*).—(1) Skeletal oxea, smooth, equi-ended, tapering gradually toward each end. There are two types which intergrade. The shorter form (fig. 54*a*) helps to make up the spiculo-fibers and is scattered between them. It is also abundant in the root fascicles. It is often slightly curved. Common sizes are 600 μ by 10 μ to 1,000 μ by 12 μ . A longer form (fig. 54*b*), with very slender extremities, generally straight or nearly so, with the ends sometimes curved or bent, is abundant in the spiculo-fibers. Common sizes are 1,500 μ by 16 μ to 2,300 μ by 20 μ .

(2) Oxea of the peripheral radial brushes (fig. 54*c*), inequi-ended, the outer end much the thicker; about 800 to 1,000 μ long, 8 μ thick near outer end, thence tapering gradually to inner end. In each brush there are several of these spicules.

(3) Protriænes of three types. Very slender protriænes, with hairlike cladi (fig. 54*g*); the most abundant spicule in the peripheral radial brush; rhabdome near outer end generally about 1 μ thick, 0.5 millimeter long; cladi much thinner, hairlike, 10 to 60 μ long; spicules projecting and covering whole surface of sponge, like fine hair. Immediately around an osculum these spicules are slightly larger than elsewhere, although the cladi are no thicker. Doubtless some of these spicules develop into the stouter forms of protriæne, but they can not be regarded as young stages of a characteristic skeletal element, for they themselves are a marked feature of the skeleton.

A stouter protriæne (fig. 54*e*) occurs in some abundance in the radial bundles of the lower half of the sponge, projecting from the surface; it occurs also, but rarely, in the upper part of body. Monæne and diæne modifications are present. Rhabdome 6 to 8 μ thick near outer end, tapering gradually and becoming very slender, about 2 millimeters long. Cladi fairly strong, 30 to 48 μ long, about 4 μ thick at base.

Immediately around an osculum abundant protriænes of the type shown in figure 54*f* occur, the spicules projecting in the usual way. Rhabdome at the outer end is about 3 μ thick, thence tapering gradually. Cladi about 2 μ thick at base, 14 to 40 μ long, commonly of unequal lengths, one cladus often considerably longer than the others. With these spicules are mingled the common, very slender forms (fig. 54*g*).

(4) Anatriænes of the ordinary character (fig. 54*d*) are abundant in the radial fibers of the lower half of the sponge, the entire spicule lying within the body; rhabdome about 6 μ thick near cladome; tapering gradually and becoming very slender, about 1,500 to 2,000 μ long; cladi about 32 μ long, strong, diverging less than 45 degrees from rhabdome. The root fascicles are largely made up of similar anatriænes, in which the rhabdome reaches a greater length, measuring in some isolated spicules as much as 3.5 millimeters.

(5) Sigmata, giving the common C and S shaped appearances (fig. 54*h*), are abundant in the ectosome, including that of the root fascicles, and in the walls of the canals. They are about 12 μ long. The surface of the spicule is slightly roughened, sometimes passing into a minutely spinose condition.

Hyatt has described and Sollas redescribed (Sollas, 1888, p. 46) a Tetilla, *T. gravata* Hyatt, from our Atlantic coast (Buzzards Bay), which is, however, a distinct species from the Beaufort form, although Hyatt's species perhaps extends southward as far as the North Carolina coast. At any rate, we have a number of specimens collected at Wrightsville, N. C., and Ocean View, Va., by R. Budd Chalmers, of Wilmington, N. C., which are certainly not far from *T. gravata*, possibly representing a variety. Unfortunately, all of our specimens are beach specimens, and the surface has been rubbed so that the spicular details necessary for a precise comparison can not be made out.

Discussion of the genus.—Recent writers are not in unison with regard to the use of this genus. Lendenfeld (1903) merges into it *Chrotella* Soll., and later (1906) merges Tetilla (+*Chrotella*) in *Tethya* (*Craniella* Soll.). Lendenfeld's action is based on the occurrence of intermediate forms, which make it impossible to divide this group of species clearly into the genera recognized in Sollas's scheme, which are based chiefly on the anatomico-histological features of the cortex. The intermediate forms unquestionably exist, but

Lendenfeld's treatment tends to obscure the nice distinctions to which Sollas's classification gives expression, and which should certainly not be lost sight of.

Topsent in 1904 continues to use the three genera, *Chrotella*, *Tetilla*, *Craniella*. Dendy in 1905 (p. 89) uses but redefines *Tetilla* so as to include forms in which the ectosome is in part fibrous. His definition runs: "Cortex absent or feebly developed; no special cortical skeleton." This is one way out of the difficulty presented by the occurrence of intermediate forms, in that *Tetilla* is here made to include species that shade off toward *Tethya* (*Craniella*), and which certainly are intermediate. To be sure, another classifier using the same genera might include such or slightly different intermediate forms under *Tethya*, extending *Tethya* downward, so to speak, rather than *Tetilla* upward. Dendy also uses *Craniella* in 1905, and again uses *Tetilla* in 1916, in the sense in which he employed it in 1905. Row in 1911 uses *Tetilla* and *Chrotella*. Hentschel in 1911 uses *Tetilla*, but in 1912 follows Lendenfeld and merges *Tetilla* (+ *Chrotella*) in *Tethya* (*Craniella* auct.)

As exploration goes on the number of sponge genera known to run into one another increases. Everywhere intermediate forms are found. We meet, then, very frequently the practical difficulty of finding the record of a known species or of deciding where to record a new species. If the genera exhibited a linear arrangement, we might have sharply defined genera alternating with less homogenous intermediate ones. But it frequently happens that the species of a sponge family fall into groups which shade off in all directions toward one another. In such a case, and it looks as if discovery would show that this is all but universal in sponges, the questions arise: Shall we give up any formal grouping of the species (it is of course not a mere question of *names*, genera or subgenera)? Or shall we define all the species groups (genera or subgenera) in a comprehensive, and therefore rather loose, way, which results in overlapping? Or shall we meet the difficulty by accepting some sharply defined and other loosely defined genera? It is the latter method which is commonly employed, although not always explicitly, and no better treatment has as yet been found.

Tetilla, the simplest, and therefore presumably the ancestral genus of the family, has been gradually enlarged in the practice of recent writers (Dendy, Topsent, Hentschel) by the incorporation in it of species that depart in one direction or another from the central group of typical forms to which Sollas's definition is applicable. Topsent, for instance, includes (1904, p. 97) *T. longipilis*, in which there is the beginning of a cortex, viz, an ectosome which is in part fibrous; the species having differentiated in the direction of *Tethya*. Dendy (1905, p. 89) includes *T. hirsuta*, in which there are a more or less fibrous cortex and surface depressions, the smooth floor of which is perforated by pores or by oscula; a species with *Tethya* and *Cinachyra*-like features and which Lendenfeld (1903), in fact, lists as a *Cinachyra*. In the same paper (p. 91) Dendy includes *T. anomala*, in which the ectosome is pretty sharply differentiated from the choanosome, is fairly thick and to some extent fibrous, and "almost amounts to a cortex;" evidently a species approaching *Tethya*. Another species approaching *Tethya* has been more recently recorded by Dendy (1916, p. 105). This is *T. barodensis*, in which there is a well-developed dense cortex which is "perhaps to some extent fibrous." *T. cinachyroides* Hentsch. (1911, p. 283) and *T. limicola* Dendy (1905, p. 93) also deserve mention as intermediate forms; in the anatomy of the peripheral canal system, *Cinachyra*-like, although they lack the cortex of *Cinachyra*. *Tetilla* in this paper is accepted in the extended sense.

SIGMATOMONAXONELLIDA Dendy.**Family HAPLOSCLERIDÆ Topsent.**

Microscleres often absent; when present never chelæ. The megascleres are usually diactinal. Where the skeleton is made up of distinct spiculo-fibers, these are typically not plumose.

Subfamily RENIERINÆ.

Megascleres oxeas or strongyles varying occasionally to styles. Skeleton reticulate, or the spicules may be scattered without definite arrangement. Spongin absent or present in small amount; only exceptionally does it envelop the spicules. No microscleres.

Reniera Nardo.

The skeleton is typically a close, uniform, reticulum, each side of the polygonal mesh formed by a single spicule. Spongin usually at the nodes of the reticulum. The side of the mesh may, however, be multispicular, and long multispicular fibers may develop.

Reniera tubifera, n. sp. (Pl. LVII, fig. 12; Pl. LVIII, fig. 15; Pl. LIX, fig. 16; Pl. LXVI, fig. 55a, b, c.)

Reniera sp., Wilson, 1910.

A fairly common species in the harbor. The best collecting locality is Newport River, close to the town. The sponge is scattered over the bottom and may conveniently be taken at low tide.

The body of the sponge (Pl. LVIII, fig. 15) is of irregular shape and consists of a reticular system of anastomosing cylindrical branches varying in diameter from 3 to 8 millimeters. It is not soft, but quite fragile. The specimen figured measures 130 millimeters in length, 30 millimeters in height. Rising vertically from the anastomosing branches are numerous tubes, 2 to 10 millimeters high and 1 to 3 millimeters in diameter, bearing oscula at their tips. In some cases these oscular tubes fuse with one another where they come in contact. The walls of the oscular tubes are colorless, thin, and transparent; the oscula at the tips measure 0.5 to 2 millimeters in diameter.

The dermal membrane of the sponge is delicate and is perforated by numerous irregularly distributed pores measuring about 50 μ in diameter. The pores open into small subdermal spaces, which ramify in the meshes of the ectosomal skeleton and lead into a system of very abundant canals in the sponge body (Pl. LIX, fig. 16). The flagellated chambers are conspicuous in stained sections and are very numerous. They measure about 25 μ in diameter. The mesenchyme is granular and rather scanty. Color of sponge pink or reddish purple, varying to brown; color fading quickly in alcohol.

Spicules (Pl. LXVI, fig. 55a, b, c).—Smooth, slightly curved oxeas measuring 125 to 170 μ by 3 to 8 μ , the smaller sizes, doubtless, being young stages. The usual variants occur in the shape of styles (fig. 54b) and strongyles (fig. 54c).

Skeletal framework (Pl. LVII, fig. 12, Pl. LIX, fig. 16).—The main skeleton (fig. 16) consists of a combination of fibers, reticulum, and scattered spicules. The fibers course longitudinally through the component branches of the sponge and are conspicuous. They are 30 to 100 μ in diameter, 3 to 8 spicules abreast, the spicules parallel to one another. In the parenchyma between the spiculo-fibers are many scattered spicules. These are commonly cemented together with spongin where they meet or cross, thus giving rise to a vague and irregular, predominantly unispicular reticulum. There are also many free spicules. The dermal and ectosomal skeleton (figs. 12, 16) is a distinct unispicular reticulum. The meshes are commonly three sided but may be four or five sided.

The Beaufort species departs from the typical *Renieras*, in which the skeleton is a unispicular reticulum, and falls in the large group of species in which special multispicular tracts are developed in the midst of a skeleton that preserves more or less the orig-

inal character of a unispicular reticulum. (Vide Topsent, 1894*b*, p. 4; Dendy, 1894, p. 236.)

The following citations may help to put the Beaufort form in its proper place in the immense collection of *Reniera* species.

In *R. simulans* (Johnston) Schmidt there are multispicular primary skeletal lines (Topsent, 1901*a*, p. 356; Bowerbank, 1866, p. 308). The same is true in *R. dancoi* Tops. (Topsent, 1901*b*, p. 12). Among other species falling in this group may be mentioned *R. pigmentifera* Dendy (1905, p. 143), *R. massalis* Carter, and several other species recorded in Dendy's Catalogue (1894, pp. 236-238).

Where the habitus of the sponge is tubular the multispicular tracts may form longitudinal fibers curving outward toward the surface, connected by secondary tracts 1 or 2 spicules thick. This is the case in *R. scotti* Kirkpatrick (1908, p. 62), and is more or less true of *R. spinosella* Thiele, *R. implexa* Schmidt (Ridley and Dendy, 1887, p. 15; Topsent, 1904, p. 244), *R. utriculus* Tops. (1904, p. 246), *R. urceolus* Rathke and Vahl (Topsent, 1904, p. 246; Lundbeck, 1902, p. 35).

In several species the habitus is that of an erect lamella. In these forms also the multispicular tracts are longitudinally placed, and may be strongly developed, more especially in the basal part of the sponge. This is true of *R. parenchyma* Lundbeck (1902, p. 37), *R. folium* Lundbeck (1902, p. 39), *R. ventilabrum* Fristedt (Lundbeck, 1902, p. 40). In some forms of more or less massive habitus the multispicular tracts have no regularity of arrangement, e. g., *R. zoologica* Dendy (1905, p. 143).

Forms in which the skeleton is made up in part of a reticulum and in part of distinct polyspicular fibers might be referred, following Topsent (1904, p. 243), to *Cladocroce* Tops. The common practice (vide Lundbeck, 1902, p. 51) of not separating these species from the other less modified ones is followed, however, in this report.

In several forms the originally uniform skeletal reticulum is only retained at or near the surface, becoming looser and less distinctly developed in the interior. This is the case with the Beaufort species; with *R. (Isodictya) crassa* Bow., in which primary multispicular skeletal lines are developed (Bowerbank, 1882, p. 126); with one of the forms (*Reniera* species 8) recorded by Hentschel (1912, p. 411), in which this halichondrine tendency is not counterbalanced by the differentiation of distinct multispicular lines.

On the other hand, there are forms in which the original simple reticulum is supplanted in the ectosomal region by a reticulum composed of multispicular fibers. The original reticulum may persist at the very surface as in *R. semifibrosa* Dendy (1916, p. 112), or may here break up in halichondrine fashion into scattered spicules, as in *R. fibroreticulata* Dendy (1916 p. 111). In both of these species there are also internal multispicular fibers, and, as Dendy points out, a transition is made to *Pachychalina*.

Finally forms may be mentioned in which the skeletal reticulum departs from its primitive character in that all sides of all meshes become multispicular (Topsent, 1894*b*, p. 4).

Family DESMACIDONIDÆ.

The characteristic microscleres are cheloids (chelæ and modifications), but forms are included in which these spicules presumably have been lost during the course of evolution.

Subfamily MYCALINÆ.

Skeletal fibers, or spicular tracts, without echinating spicules and not markedly areniferous. The body has no fistular outgrowths.

Stylotella Lendenfeld.

Sponges of soft texture. Megascleres, styles in fibers or tracts and scattered. No microscleres.

Stylotella heliophila Wilson. (Pl. LVIII, fig. 13; Pl. LIX, figs. 18, 19; Pl. LXVI, fig. 53a, b, c.)

Stylotella heliophila Wilson, 1911, p. 13.

The most abundant sponge in Beaufort Harbor; common on the bottom in shallow water attached to shells, also under wharves attached to piles, stones, etc. Habitus varies. Sponge incrusts the shell or other substratum and grows up in the shape of lobes. These may be quite independent of one another. More commonly the ascending lobes fuse where they touch, and thus a more compact mass is produced, reaching, but rarely exceeding, 100 millimeters in diameter. The surface is roughened by minute conic elevations $\frac{1}{2}$ to 1 millimeter high. Color orange, sometimes with a greenish cast. A typical specimen is shown in Plate LVIII, figure 13.

The oscula are mostly located at the ends of the vertical lobes and at the ends of tapering, more or less conical, outgrowths from the lobes. The pores, which in an alcoholic specimen measured from 20 to 45 μ in diameter, are irregularly scattered in great abundance over the dermal membrane. The dermal membrane (Pl. LIX, fig. 18) is translucent. Beneath it may be seen a richly developed system of conspicuous subdermal canals 3 to 4 millimeters and less in diameter.

Spicules (Pl. LXVI, fig. 53a, b, c).—The only spicules present are smooth styles, slightly curved or sometimes straight. The range of size is 120 to 350 μ by 4 to 9 μ . In addition, there are present some very slender styles measuring 115 to 225 μ by 2 μ or less. These are scattered in the parenchyma and are doubtless young stages of the skeletal spicule.

Skeletal framework (Pl. LIX, figs. 18, 19).—The spicules of the interior are irregularly scattered. Here and there they cross one another so as to give rise to meshes, or they may combine to form spiculo-fibers or tracts (fig. 19). A small amount of spongin is present in the spiculo-fibers and at some of the points where the spicules cross. The spicular tracts are commonly present in the trabeculæ between the larger canals. They often fray out in a brush-like fashion at the surface. In the ectosome are abundant, more or less radially arranged styles, some slightly projecting.

In the dermal membrane the styles very generally project more or less radially, frequently forming the dense brush-like groups referred to above, but between these they are scattered more or less tangentially (fig. 18).

Stylotella Lendenfeld was diagnosed by its author (1888, p. 185) as follows: "Heterorrhaphidæ of very soft texture. Megasclera styli, in bundles and scattered. No microsclera." Dendy (1896, p. 231) deletes the genus as not distinguishable from *Hymeniacion* Bowerbank, which he places in the Axinellidæ. Topsent (1899, p. 109) retains the genus and thinks its relationship is with *Esperella* (Mycale). He gives the following diagnosis: "Esperellinæ with reticular skeleton. Fibers (at least the primary ones) multispicular. Megascleres: styles. No microscleres." Lindgren (1898, p. 313) follows Dendy, merging the genus in *Hymeniacion*. Kirkpatrick (1900, p. 137) retains the genus. Topsent (1904, p. 224) criticises Dendy's treatment of the genus and retains it, placing it in the *Esperellinæ*. Dendy (1905, p. 185) again records his opinion that

the genus is not distinguishable from *Hymeniacion*, which he continues to place in the Axinellidæ. Hentschel (1912, p. 355) retains the genus and follows Topsent in placing it in subfamily Mycalinæ (*Esperellinæ* auct.) in the Desmacidonidæ (= *Poeciloscleridæ* Tops.). It seems to the writers that Topsent's treatment is the correct one.

Esperiopsis Carter.

Habitus varies; incrusting, amorphous, and more or less upright forms occur; the latter may be leaflike or subcylindrical and branching. Spongin commonly present, the amount varying. Skeleton varies from a state in which there are well-developed spiculo-fibers, with abundant spongin, to a renierine or halichondrine condition. Megascleres, styles, some of which may undergo the strongylate modification, often with tylostyles. Microscleres, isochelæ, which may be accompanied by stigmata, toxæ, or forcipes.

Esperiopsis obliqua n. sp. (Pl. LX, figs. 20 to 23; Pl. LXVI, fig. 58a, b, c, d, e, f.)

Five specimens; three collected on Fort Macon beach; one dredged just outside Beaufort Inlet; one dredged on the "Fishing Bank" off the inlet.

Sponge is ramose; the branches cylindrical or subcylindrical, smooth or knotty, sometimes distinctly compressed, commonly 4 to 6 millimeters in diameter. The main branches arise from a base and themselves branch. Fusion takes place sometimes between contiguous branches. Sponge may be vertical, or the branches may extend out in various directions from the base. The upright specimens range in height from 60 to 200 millimeters. A specimen with spreading branches has a greatest diameter of 50 millimeters. Sponge firm, but compressible and elastic. Color bright red.

The known specimens show three fairly distinct types of habitus. But as no definable skeletal peculiarities are associated with these differences of the exterior, the types are, doubtless, only individual forms, reached as a result of particular growth and differentiation responses that are called out by the local environment. In one type (Pl. LX, fig. 21) the habitus is chaliniform. The branches, in general, are long, slender, cylindrical, smooth, and taper terminally. In one of the two specimens of this type a few lobes are slightly knotty here and there. In a second type (Pl. LX, fig. 20) the distinguishing features are the knotty character of the branches and the biseriate arrangement of the oscula. In a third type the branches are smooth but enlarged terminally, clavate or spatulate. This type is represented by the specimen with spreading branches and less well by a small specimen 60 millimeters high, which, perhaps, was vertical.

Dermal membrane thin, perforated everywhere with pores which lie in the meshes of the dermal skeletal reticulum. Actual diameter of pores in preserved specimens varying, often 20 to 50 μ . Dermal surface shows to the eye or lens the outer ends of small cylindrical afferent canals which pass radially inward; these appear as circular areas, mostly 175 to 300 μ in diameter, abundantly scattered over the surface and covered in by the thin dermal membrane. The area of membrane covering in such a canal usually shows about three pores.

Oscula small, 1 millimeter and less in diameter, scattered without order or arranged more or less definitely in longitudinal rows, which may be biseriate, viz. two rows on each branch opposite one another. In the larger chaliniform specimen (Pl. LX, fig. 21) only one branch shows anything of this regularity in the location of oscula. On this branch a biseriate arrangement appears, but it is vague; that is, irregular. In another specimen of the chaliniform type and in one of the clavate-spatulate type the oscula are arranged in short, irregular, longitudinal rows, but a biseriate arrangement is not present. In the specimen with knotty branches (Pl. LX, fig. 20) the biseriate arrangement is distinctly developed on almost all the branches, the oscula of a row lying 1 to 5 millimeters apart.

Embedded in the tissue of one of the specimens are numerous embryos containing many immature spicules. A good many sand grains and some large, broken, foreign monaxon spicules are embedded in the outer part of the body in the case of several specimens.

Spicules (Pl. LXVI, fig. 58a, b, c, d, e, f).—Megascleres: (1) Style, the chief megasclere, slightly curved, tapering toward base as well as toward point, generally smooth but sometimes spinulate, characteristically 110 to 150 μ by 6 to 10 μ . Slenderer ones appear, especially in the connectives. The spinu-

lation may be limited to the head, or small spines may be present over a part or a whole of the shaft. (2) Strongyle, of about same size as the style but much less abundant; obviously a modification of it. (3) Ectosomal tylostyle, commonly straight, slender, and cylindrical, sharp-pointed, head slightly tylote, 120 to $140 \mu \times 2 \mu$. Present but not at all abundant in the ectosome, where it is placed radially or obliquely, usually projecting. Microscleres: (4) Isochela with twisted axis, 9 to 11μ long; fairly abundant in the parenchyma; very abundant in spots in some specimens. When one tooth is seen in ventral view the other appears more or less in side view. Occasionally the rotation is greater, and both teeth are seen flatwise, one in ventral, one in dorsal, view. Normal chelæ, in which the axis is not twisted, also occur, but very rarely. The spicules are small and delicate, requiring to be studied with an immersion objective. In a foreshortened view the terminations appear as more or less circular cups on opposite sides of the apparently short axis. (5) Toxa, 20 to 60μ long, in parenchyma, less abundant than the chela.

Skeletal framework (Pl. LX, figs. 22, 23).—Principal fibers and connectives are distinguishable. The former are primarily longitudinal, branching as they ascend, the branches curving out radially toward the surface. These fibers are polyspicular; the spicules arranged lengthwise or somewhat obliquely, and for the most part completely embedded in spongin. A few spicules project here and there at right angles to the fiber, doubtless representing connectives that will develop.

The longitudinal fibers are about 30 to 60μ thick. They include 3 to 8 lines of spicules as seen in optical longitudinal section of the fiber. Transverse sections show that the actual number of lines of spicules ranges in different specimens from about 3 to as many as 20. The radial parts of the fibers have usually 2 to 4 lines of spicules.

The connectives are mostly one spicule in length, sometimes two, and at about right angles to the principal (longitudinal or radial) fibers. They include 1 to 2 rows of spicules, sometimes as many as three rows, when all or all but one row are quite slender. The spicules are well covered with spongin. Meshes often longer than wide, rectangular; or squarish. While the style is the chief skeletal spicule, the strongyle is very common in the connectives and perhaps predominates in them.

In the ectosomal region, including a thickness of about 350μ , the principal fibers are somewhat closer together than in the interior, and there are more connectives (Pl. LX, fig. 22). The skeleton is thus denser in this region. The radial fibers project slightly beyond the surface of the sponge, the terminal spicules diverging and projecting beyond the spongin of the fiber.

The dermal membrane is supported by the most superficial connectives, which extend between the outer ends of the radial fibers. These dermal connectives have the usual character; that is, they commonly have the length of one spicule, sometimes of two; the included spicules, one or two rows, are entirely embedded in the abundant spongin; common thickness of connective, 12 to 16μ ; mesh squarish or polygonal. Here and there a spicule with its base rooted in the connective projects, at right angles to the latter, beyond the surface of the sponge.

There is considerable quantitative variation both in the skeletal framework and the megascleres. Thus, in the same specimen the framework is somewhat denser in the older than in the uppermost part of a branch, owing largely to the fact that the connectives are more numerous and, perhaps, somewhat thicker. The differences between the several specimens in respect to these points are noticeable, although vague. In those of the chaliniform type (Pl. LX, fig. 21) the principal fibers are slenderer and the skeletal styles perhaps slenderer than in the other specimens. Thus, in one of the chaliniform specimens the range in the actual number of rows of spicules contained in the longitudinal fibers is about 3 to 8, whereas in the biseriate specimen (Pl. LX, fig. 20) it is 4 to 20. In one of the clavate-spatulate specimens the skeletal style is very often noticeably stout and fusiform. But these stout styles are accompanied by a great many quite slender ones.

The Beaufort sponge is not far from *Esperiopsis anomala* R. and D. (Ridley and Dendy, 1887, p. 84), a ramose sponge from Honolulu, in which there is a rich development of spongin, producing a chalinine appearance. Ridley and Dendy remark on this fact that it "forms a very good instance of the manner in which horny fiber may be developed in any genus." Other species of *Esperiopsis* in which horny fiber is extensively developed are *E. symmetrica* R. and D. from off Port Jackson (Ridley and Dendy, 1887, p. 79), *E. (Amphilectus) hispidula* (Ridley) from Torres Strait (Ridley, 1884,

p. 429), *E. rigida* Lambe from the Pacific coast of Canada (Lambe, 1893, p. 68). In many species of the genus the fibers consist chiefly of spicules, with comparatively little spongin.

The parallelism in habitus and skeletal framework between species of *Esperiopsis*, *Homæodictya*, and *Pachychalina* is noteworthy. Lundbeck has remarked (1905, p. 122) on the close parallelism between *Homæodictya palmata* Johnson and a species of *Pachychalina*. The parallelism is equally close with *E. obliqua*.

A similarity of another kind, involving the fundamental matter of spicule combination, is presented by *Esperiopsis* species in general to *Artemesina* Vosm. This similarity is perhaps not a case of parallelism, but one due to close kinship. And in this connection it may be recalled that Topsent (1904, p. 215) described a species of *Artemesina* in which the texture of the body differs notably from that of *A. suberitoides* Vosmaer, etc., approaching that of *Esperiopsis*. Topsent suggests that it might be well to make *Artemesina* a subgenus of *Esperiopsis*, to include forms in which the body has a texture like that of *Suberites*.

The peculiar isochelæ of the Beaufort species deserve a word. They look quite like those of *Microcionia acerato-obtusa* Carter, as drawn by Hentschel (1911, p. 349). Very small isochelæ, but not twisted, are recorded by Dendy (1895, p. 18) for *Esperiopsis turbo* (Carter); Dendy says they are very minute and difficult to detect.

The occurrence of twisted chelæ (aniso- and iso-chelæ) is regarded by Vosmaer as evidence, over and above the embryological, in favor of the idea that the chela is derived from the sigma (1902, p. 9). This is at least defensible, for the twisting of the chela is in itself a structural feature that is sigmalike; that is, the twisted chela is intermediate, in respect to the shape of the spicular axis, between the sigma and the normal chela, although in other respects it is a perfectly differentiated chela. It, then, in some small measure, controverts Hentschel's position that there are no intermediate forms between chela and sigma (1914, p. 158). Nevertheless, the spicule is "intermediate" in respect to a single point only, and this makes it very doubtful whether the point (of resemblance) is really to be looked on as a case of reversion. It is perhaps a quite new acquisition, which happens to coincide with a phylogenetically older state. Lundbeck (1905, p. 6) thinks "the fact that chelæ may be contort, a feature that is much more frequent, and may take place to a much higher degree than seems to be known by the authors, proves nothing at all" in respect to the phylogeny of the chela.

Lissodendoryx Topsent (emend. Lundbeck 1905).

Skeletal framework reticular, including sometimes well-marked fibers, or dendritic; spongin present more or less abundantly. Skeletal megascleres generally smooth styles, but sometimes spined; dermal megascleres diactinal. Microscleres isochelæ, never ancoræ, to which sigmata may be added.

Lissodendoryx carolinensis Wilson. (Pl. LXI, figs. 26, 27, 28; Pl. LXVI, fig. 62a, b, c, d, e.)

Lissodendoryx carolinensis Wilson, 1911, p. 11.

Common in the harbor, especially on the wharf piles; best collecting places, Gallant's Point, oyster cannery in Newport River, Morehead pier.

The sponge begins as an incrustation on shells, etc. As it grows ascending lobes, frequently overlapping, develop. Eventually a large amorphous mass may be produced, the body of which has been formed by the continued fusion of such lobes. The free surfaces of such masses continue to bear pro-

jecting lobes like those of the younger stages. A characteristic specimen (Pl. LXI, fig. 26) measured 100 millimeters in its greatest diameter. Masses with diameter twice as great occur.

Color white, frequently with a green or blue cast. Sponge comparatively firm and brittle, and generally dirty. It is much infested with worm tubes and overgrown with hydroids and polyzoa.

Over the entire surface are numerous tubular translucent papillæ (Pl. LXI, fig. 27), perforated by numerous pores. The papillæ may be simple or branched, often bifurcated. They are contractile and may almost entirely disappear.

Oscula 1 to 2 millimeters in diameter are scattered over the surface and often develop at or near the ends of lobes. The pores are distributed over the general dermal membrane and papillæ. Over the papillæ they are abundant and in an alcoholic specimen measure about 20 μ in diameter. In the same specimen the pores over the general surface are almost all closed. The few found open measure up to 100 μ in diameter. The dermal membrane is translucent, showing anastomosing subdermal canals, commonly about 0.5 to 0.75 millimeter wide.

Spicules (Pl. LXVI, fig. 62a, b, c, d, e).—Megascleres: (1) Style, smooth and slightly curved. Range of size, 160 to 180 μ by 5 to 8 μ . (2) Tylote, smooth. Range of size, 160 to 190 μ by 5 μ . Microscleres: (3) Isochelæ arcuatæ 12 to 26 μ long. (4) Sigmata 18 to 36 μ long.

Skeletal framework (Pl. LXVI, figs. 27, 28).—Internal skeletal framework is a loose, irregular reticulum formed by styles, which may in places develop into spiculo-fibers. Meshes of reticulum are three to five sided; side of mesh about the length of a spicule, formed by one, two, or three spicules. Spongin present at the nodes (stained sections show it). In addition to the skeletal reticulum, the parenchyma contains some scattered tylotes. These may be grouped to form loose tracts. The tylotes are especially abundant in collenchymatous regions, and are more abundant in the ectosome than elsewhere.

The megascleres of the dermal membrane are tylotes. In places they are scattered tangentially in the membrane, but very generally they project more or less radially, forming bunches or ridges. The wall of the papilla (Pl. LXI, fig. 26) is an extension of the dermal membrane, and the megascleres here, too, are tylotes, tangentially arranged and forming a reticulum, in the meshes of which are the pores.

The whole parenchyma is loaded with sigmata; isochelæ abundant, but less abundant than the sigmata. Both sigmata and isochelæ are abundant in the general dermal membrane. The wall of the papillæ contains moderately abundant isochelæ and very few sigmata.

Topsent established *Lissodendoryx* first as a subgenus of *Dendoryx* (1892) and later (1894a, p. 9) as a separate genus, for species which differ from *Dendoryx* (= *Myxilla sens. str.*, Thiele, 1903; Lundbeck, 1905; Topsent, 1913) in having smooth styles as the skeletal megascleres.

Dendy (1895, p. 29) would include the genus, and *Dendoryx* as well, under *Myxilla*, Schmidt. Topsent (1901b, p. 19; 1904, p. 173) retains the genus as originally defined.

Lundbeck (1905, p. 153) again brings up Dendy's contention (1895) that the smoothness of the styles can not be used as a generic character, since species occur with styles that are intermediate between spined and smooth ones. From this point of view the genus should be merged in *Dendoryx* (= *Myxilla sens. str.*). But the *Dendoryx* species, Lundbeck maintains, are separable into two groups, in one of which the microscleres are ancoræ, in the other chelæ arcuatæ. For the former Lundbeck reserves the name of *Myxilla (sens. str., Topsent, 1913, p. 623)*, for the latter *Lissodendoryx*.

Subfamily **PHLÆODICTYINÆ**.

Sponge body provided with fistular outgrowths. Characteristically the ectosomal skeleton is much denser than the choanosomal, constituting a sort of rind. The microscleres are often absent.

Phlæodictyon Carter.

Spongin usually present, but the skeleton is not a reticulum of distinctly chalinine spiculo-fiber. Megascleres, oxeas varying to strongyles. There are no microscleres.

Phlæodictyon nodosum n. sp. (Pl. LXII, figs. 29, 30, 32; Pl. LXVI, fig. 63.)

One specimen dredged in Beaufort Harbor.

Slender fistulæ, 30 to 35 millimeters high and 1.5 to 3 millimeters in diameter, rounded off and closed terminally, connect with a basal portion which is attached to a piece of shell. The basal portion is incomplete. As it stands it consists of an incrusting part on the upper surface and a somewhat thicker, 2 to 3 millimeters thick, torn part on the under surface of the shell. The entire sponge was probably not large. The shell is probably to be looked on as having been surrounded by, and incorporated in, the upper part of the sponge body.

Color, in alcohol, whitish brown. Wall of fistulæ thin, but firm. Many sand grains and pieces of shell have been incorporated by the sponge.

The dermal membrane of the fistular wall is perforated by pores lying in the meshes of the skeletal reticulum. Many of the pores are closed, and those that are not closed are probably only partly open. They measure 12 to 16 μ in diameter. The membrane is thin, contains only a few granular amœbocytes, and is favorable for histological study. Some few foreign incrustations cling to it, among them holothurian (synaptid) spicules such as Bowerbank has figured (1864, Pl. V, figs. 119, 120).

Pores and oscula over basal part of sponge uncertain. This part exhibits a good many small canals, 120 to 500 μ in diameter. Flagellated chambers spheroidal, or about 50, 28 μ in diameter. The ectosome of the fistular wall includes a great many small, rounded subdermal cavities, about 60 to 100 μ in diameter as seen in cross sections of the fistula (Pl. LXII, fig. 30). Internal to the ectosomal skeleton, the fistula is collenchymatous and is excavated by a large axial canal around which lie smaller canals, which yet are of good size, about 150 to 350 μ in diameter (fig. 30). These are separated by thin sheets and strands of sponge tissue.

All the fistulæ are closed terminally, showing no sign of oscula. If ordinary oscula were present in life, one would expect to see some sign of them in the preserved specimen. Perhaps the axial canal opens terminally through a sieve plate, the apertures of which, resembling pores, are now closed. As Lundbeck says (1902, p. 58), there is diversity of opinion with regard to the functioning of the fistulæ in these sponges. Living, or, at any rate, carefully preserved whole specimens need to be studied. The pores over the general surface and the subdermal cavities of the ectosome make it clear that water streams into the fistula. Nevertheless, perhaps the axial canal is efferent. It would seem that it must be so in species such as *P. elongatum* Tops., where it connects with the exterior by a terminal or sub-terminal aperture which has the appearance of being normal (Lundbeck, loc. cit., p. 60).

Spicules.—Oxeas (Pl. LXVI, fig. 63) smooth, slender, slightly curved, subcylindrical, tapering gradually to sharp points, about 100 μ by 4 to 5 μ . The strongylate modification occurs.

Skeletal framework of the fistulæ.—The ectosomal skeleton includes the usual parts, a dermal layer of tangential spicules and a subjacent layer of spiculo-fiber.

The dermal spicules intercross in all directions, constituting a layer which is, in general, single, although in places parts of two or three spicules may be superposed. The spicules form a reticulum (Pl. LXII, fig. 32), at the nodal points of which they are held in place by spongin. These nodal points in a stained preparation of the wall are conspicuous. Meshes of the reticulum triangular or polygonal; side of a mesh the length of a spicule or less and formed by one, or, in places where the spicules are more abundant, by several, about two to five, spicules. In regions of the latter character the spicules are so closely grouped that they radiate from many of the nodal points, like spokes of a wheel. Elsewhere in the same fistula the reticulum may be unispicular.

Beneath the dermal layer of the fistula and about a spicule's length from it lies the fibrous layer. The two are connected by small bundles of spicules or by single spicules, which extend radially or obliquely to the surface between the subdermal spaces (fig. 30).

The fibrous layer consists of polyspicular spiculo-fibers (figs. 30 and 32), which pursue a longitudinal course, dividing and anastomosing to some extent, interconnected by slender tracts of spicules or by scattered spicules forming a secondary reticulum. The secondary reticulum varies in character in the same fistula. The mesh may be polygonal, with a side equal to the length of a spicule, unispicular in one region, polyspicular in another; or the spicules may be thickly and confusedly crossed, giving the mesh a side less than the length of a spicule; or the mesh may still be polygonal, but its sides two or three times the length of a spicule and formed by polyspicular tracts. At the nodal points of the reticulum there is spongin. The main longitudinal fibers are 30 to 80 μ thick; spicules of a fiber arranged lengthwise, closely packed, and bound together by a very small amount of spongin, which does not form a covering for the fiber.

Internal to the fibrous layer the fistular wall contains almost no skeleton. At most a few spicules project radially and obliquely inward from the fibrous layer, and here and there a free spicule is found.

Skeletal framework of basal part of sponge.—Where the surface of this part of the sponge has been preserved, an ectosomal skeleton is found much like, nevertheless somewhat different from, that of the fistula. There is a dermal layer, two or three spicules thick, of tangential megascleres, which cross in every direction. These are united, as in the fistular wall, by spongin at the nodal points, but the spicules are so abundant that they can not be said to form a reticulum. Still they are not as densely packed as in some species; everywhere minute angular spaces, commonly about 12 μ in diameter, are left between them.

Beneath the dermal layer and visible through it spiculo-fibers, like those of the fistula, form a coarse and very irregular reticulum.

The choanosomal skeleton consists chiefly of abundant scattered single spicules, crossing one another in all directions, without spongin. Here and there the spicules are combined to form loose tracts.

The Beaufort species is nearest *P. reticulatum* Tops. from the Azores (1904, p. 238). But in the latter the spicules of the dermal layer are loosely intercrossed; the fibrous layer of the ectosome is a network with subequal, round, or oval meshes; and the oxeas are larger, 175 to 210 μ by 3 to 13 μ .

Lundbeck (1902, p. 56) dissolves Carter's group Phleodictyinae and distributes the genera (*Rhizochalina*, *Phleodictyon*, and *Oceanapia*) among the *Chalininae*, *Renierinae*, and *Gelliinae*. The treatment is logical if we regard only the spicules (and, in the case of *Rhizochalina*, the character of the spiculo-fiber). Topsent (1904) and others have followed Lundbeck. Dendy (1905), keeping in mind the presence of fistulae and the dense ectosomal skeleton, constituting a rind, retains the group, adding to it *Histoderma*, *Sideroderma*, and *Amphiastrella*, which necessitates placing it in the *Desmacidonidae*. The group, as Dendy remarks, seems to be a natural one.

Subfamily PHORIOSPONGINÆ Lendenfeld, 1888, 1889, emend.

The skeletal fibers are very areniferous, sometimes partly spicular; they may be reduced to rows of sand grains united or not by spongin. Skeleton usually reticulate, but sometimes consisting of independent fibers or of scattered sand grains. The megascleres are monaxonid, monactinal or diactinal, or both. The microscleres are chelæ and sigmata, but either or both may be lacking. The flagellated chambers are (always?) eurypylous and large.

Phoriospongia Marshall, emend.

[With the characters of the subfamily.]

Phoriospongia, Marshall, 1880.

Chondropsis (*Sigmatella* Lendenfeld), Dendy, 1894.

Psammochela, Dendy, 1916.

Phoriospongia osburnensis, n. sp. (Pl. LXI, figs. 24, 25; Pl. LXVI, fig. 60a, b, c.)

A single specimen (Pl. LXI, fig. 24) taken on the "Fishing Bank" off Beaufort Inlet by Dr. R. C. Osburn at a depth of 13 fathoms.

Sponge forms a thin incrustation over an alcyonarian coral. It is for the most part about 1 millimeter thick, thinner in places, and twice that thickness in some spots.

Color whitish in alcohol, on the salmon-pink alcyonarian. Oral ends of the alcyonarian polyps in general free of the incrustation. *Loxosoma* is scattered in abundance over the surface of the sponge.

Surface fairly smooth. Pores 50 to 80 μ in diameter, abundantly scattered over the dermal membrane, which is quite riddled with them in many places, probably everywhere when they are open. Small, rounded subdermal cavities, mostly 125 to 250 μ wide, are very abundant and give to the surface of the sponge, when examined with a lens, a porous appearance. Oscula uncertain; probably small and scattered, and now closed. Many canals, the largest about 200 μ wide, excavate the parenchyma, some passing radially through the incrustation from the surface almost to the base. Flagellated chambers uncertain. Abundant, small, compact cellular masses, doubtless embryos, occur in the parenchyma.

Spicules (Pl. LXVI, fig. 60a, b, c).—*Megascleres*: (1) Strongyles, subcylindrical with bluntly rounded ends, slender, smooth; about straight or slightly curved; 160 to 180 μ by 2 to 3 μ . *Microscleres*: (2) *Sigmata*, 10 to 20 μ long; the common and characteristic length, 14 to 16 μ . Abundant in dermal membrane; scantily present in the interior, canal walls, and parenchyma. (3) *Isochelæ*, 12 to 16 μ long; very scantily present in dermal membrane and interior. The axis is distinctly curved and the spicule is tridentate, the toothed end about one-fourth the total length. The teeth appear, under a good immersion objective, elongate-conical, but the small size of the spicule makes minute details somewhat uncertain. The spicule probably falls in the Levisen-Lundbeck (Lundbeck, 1905, p. 2) class of *chelæ arcuatæ*; that is, there is at each end only one tooth proper, the lateral "teeth" being the *alæ*, which are separated by deep bays from the shaft. These spicules were at first overlooked in the sponge, but after their discovery search revealed a few in every preparation.

Skeletal framework (Pl. LXI, fig. 25).—There is no reticulum. Instead, simple, unbranched, skeletal fibers pass more or less radially from the base of the sponge to the surface (fig. 25). They often curve a good deal, and the precise direction of the fiber frequently corresponds with that of an adjacent large canal; obviously a case of correlation. The fibers are made up of sand grains, with which some bits of foraminifer shells or pieces of foreign sponge spicules are intermingled, proper spicules (strongyles) of the sponge, and spongin.

The sand grains of the fiber and bits of shell, etc., are frequently but not always arranged in a single series. The grains may be all small, or here and there a much larger one is intercalated. Covering them sparingly are strongyles, arranged more or less lengthwise in the fiber. There are short parts of many fibers in which no sand grains are present; these are composed of compact tracts of longitudinally placed strongyles. The spongin of the fiber is scanty. Yet there is enough not only to connect but to form a thin covering over the mineral elements of the fiber. It is very transparent and easily overlooked.

The skeletal fibers in the ectosomal region are frequently made up chiefly of proper spicules, strongyles, which at the surface project slightly, often diverging. Beside these radial or obliquely radial bunches, free megascleres occur here and there in the ectosome, inclined more or less radially to the surface. The skeletal fibers, owing to their composition, vary greatly in thickness, even within the same fiber. Parts of fibers may be only 20 μ thick, other parts 160 μ thick. The fibers are abundant, frequently 175 to 350 μ apart. Between the skeletal fibers there are, in the body of the sponge, some scattered megascleres.

The dermal membrane contains a good many strongyles lying tangentially, scattered singly or in wisps; also the projecting tufts of spicules, above referred to, which represent the upper ends of skeletal fibers. Flat preparations seem sometimes to show skeletal fibers running tangentially in the dermal membrane. But sections prove there are no such fibers, and that the appearance is caused by fibers which run from base to surface as usual, but very obliquely and in regions where the sponge is quite thin.

We had at first decided to inscribe this sponge under Dendy's recent genus *Psammochela*, the diagnosis (Dendy, 1916, p. 126) of which reads: "Reticulate skeleton composed of sandy and sometimes partly spicular fibers. Magascleres styli or strongyla, or both. Microscleres isochelæ, which may be very minute and with vestigial teeth; to which sigmata may be added." But we now feel, for the following reasons, that the subdivision of the Phoriospongiæ into Phoriospongia, Chondropsis, and Psammochela is not satisfactory.

The distinction between Phoriospongia and Chondropsis (*Sigmatella*) is arbitrary. Lendenfeld (1888, 1889) based the distinction especially on the sigmata. Forms with large sigmata, 30 to 50 μ long, were put in Phoriospongia, those with very small sigmata, 5 to 10 μ long (Lendenfeld's figure indicates that the 1 μ given in the text as the length of the sigma in *Chondropsis australis* is a misprint for 10 μ . Vide Lendenfeld, 1889, p. 611.), or with none, in Chondropsis (*Sigmatella*).

Dendy (1894, p. 250) found it necessary to change *Sigmatella* (preoccupied) to Chondropsis, and further pointed out that the size of the sigmata could not justly be used as a mark by which to distribute the species of the subfamily. In recorded species the sigmata measure 5 μ , 10 μ , 16 μ , 30 μ , 35 μ , 50 μ in length, thus forming a fairly continuous series. Dendy nevertheless retains the two generic names Phoriospongia and Chondropsis, and would assign to the former species with monactinal megascleres, and to the latter those with diactinal megascleres. Hence, several forms listed by Lendenfeld under Phoriospongia are shifted by Dendy to Chondropsis.

But Dendy's basis for the distinction between the two genera can not be thought of as satisfactory since the character of the megascleres is variable in these sponges, as is borne out by the following: Lendenfeld (1889) records that the megascleres in *Chondropsis (Sigmatella) australis* are chiefly strongyles but in part styles and tylotes; in *C. turbo* they are strongyles with some styles; in *C. corticata* strongyles but also in part oxeas and styles. In Dendy's new addition to the subfamily, *Psammochela* (Dendy, 1916, p. 126), the megascleres are styles or strongyles or both. It seems therefore necessary to merge Chondropsis into Phoriospongia.

As to *Psammochela*, its distinction from Phoriospongia rests on the presence of chelæ. It does not seem justifiable, however, to separate from Phoriospongia forms like the Beaufort species in which the chelæ are so scarce as to be easily overlooked. Rather we may conclude with a good deal of probability that actual search will reveal a scanty number of chelæ in some, at any rate, of the forms hitherto listed under Phoriospongia and Chondropsis and supposed to be without these spicules. Further, it may be recalled that in one of the specimens of Ridley's *Phoriospongia fibrosa* (Ridley, 1884, p. 439) chelæ were found to be scarce, in the other abundant. This indicates that it is not rational to separate the forms with abundant chelæ from those with few or none.

Phoriospongia should therefore be emended to include forms both with monactinal and diactinal megascleres, and those in which chelæ persist either abundantly or in small number. It thus becomes coextensive with the subfamily, and some artificial grouping of the species may be desirable as facilitating reference to them.

As to the position of the genus, Lendenfeld (1888, 1889) made his Phoriospongiæ a subfamily of the Spongelidæ. Dendy (1894, p. 250) and Topsent (1894b, p. 5) transferred the genera to the Monaxonida, placing them near their supposedly closest relatives, the Gellius-like sponges. Dendy more recently (1916, p. 126) utilizing the data

afforded by his *P. (Psammochela) elegans*, has shown that the sponges belong in the Desmacidonidæ, although the chelæ have apparently been lost by many species.

The species of this subfamily, except the Beaufort form, are all known to reach a large or, at any rate, a good size. Tubular and flabelliform shapes and a massive or irregular form of body with processes are common. At least three species are known in an incrusting phase, *P. (Sigmatella) corticata papillosa* (Lendenfeld, 1889, p. 620), *P. (Sigmatella) carcinophila* on crabs (Lendenfeld, loc cit., p. 615), and *P. (Desmacidon) psammodes* (Hentschel, 1911, p. 322; Dendy, 1916, p. 126). Perhaps the Beaufort species will be found in some larger phase. That it breeds in the thin, incrusting condition is no reason for believing that this is its final state. *Microciona prolifera*, for example, breeds in Beaufort Harbor, while a thin incrustation having a skeletal arrangement much like that of *P. osburnensis* (Wilson, 1911, Pl. I, fig. 5); but, while the great majority of individuals in the harbor do not get beyond an incrusting condition, much larger and more complicated phases are reached by some. If *P. osburnensis* reaches a large size, probably its skeleton becomes reticulate. At present it is the only recorded form, except *P. solida* Marshall, which lacks recognizable fibers, in which the skeleton is not reticulate, although in *P. (Sigmatella) carcinophila* Lendenfeld (1889, p. 615) the reticulum is confined to the basal portion of the sponge, while from it isolated vertical fibers pass to the surface.

The complete loss of spongin in some forms, if it really occurs, is a remarkable fact, especially since the skeletal sand grains continue to be arranged by the sponge in bands. Perhaps the spongin is really not absent in these forms but only very scanty and transparent. Ridley (1884, p. 439) says that in *P. fibrosa* the skeletal "fibers are wholly composed of foreign bodies united by an almost colorless, not dense, substance," and, as stated above, the spongin in *P. osburnensis* is easily overlooked.

The species of the subfamily hitherto recorded are all from Australian waters. Two of the forms are, however, thought by Lendenfeld (1889, pp. 613, 620) to occur elsewhere, *P. (Sigmatella) australis* var. *tubaria* at Nassau (Bahamas) and *P. (Sigmatella) corticata* var. *papillosa* on the English coast, African coast, in the Indian Ocean, and on the Florida coast. The last-named item of distribution rests on the identification of Hyatt's *Spongelia kirkii* (Hyatt, 1877, p. 539) as a *Phoriospongia (Sigmatella)*, but I can not find that Hyatt's account justifies this step.

The chelæ in *P. osburnensis* are described (see above) as "tridentate." Dendy describes (1916) in the same way the chelæ of his *P. (Psammochela) elegans*, the smaller of which (fig. 6c, c') resembles that of *P. osburnensis*; and in *P. fibrosa* Ridley (Ridley, loc cit.) the isochelæ are said to be "tridentate." Lundbeck (1905, p. 4) criticizes the use of this term (category) as confusing, since it covers two different forms of spicule, chelæ arcuatae and ancoræ. This is undoubtedly so. On the other hand, it must be allowed that when the cheloid is very small, it is difficult to use the Levinsen-Lundbeck categories. For, assuming that the "tridentate" spicule is really either a well-defined chela arcuata or ancora with three teeth, and not some other form, the decision turns on whether the shaft has, in addition to the three teeth, alæ or not. And this is not easy to determine with certainty when the spicule is very small. Hence it would seem allowable, even necessary, to continue to use in practice the term "tridentate" for certain small spicules, although it is confessedly somewhat vague.

Levinsen and Lundbeck (Lundbeck, 1905, p. 6) regard the distinction between chela and ancora as so fundamental that they use it in distributing the species into genera, species with chelæ being assigned to one genus, species with ancoræ to another. Dendy apparently does not support this practice, for he includes in the same genus (1916, p. 126) a form, *Psammochela elegans*, with isochelæ (they are so designated, and the figures show three palmate teeth and no additional alæ) and one, *Desmacidon psammodes* Hentschel, with ancoræ. Hentschel, on the other hand, uses the distinction, at any rate in some cases, that of *Desmacidon-Homæodictya*, e. g., (Hentschel, 1911). Considering the existence of small cheloids, it seems to us that the distinction is one which can not be rigidly used in distinguishing genera.

Subfamily ECTYONINÆ.

Skeletal fibers, or spicular tracts, with echinating spicules which are characteristically spinose (acanthostyles).

Microciona Bowerbank.

Sponge body incrusting, or the incrustation may develop lobes and with continued growth become a complex, branched, ascending mass. Skeleton originally a basal plate bearing short, upright, plumose columns. In older forms the skeleton becomes an internal reticulum of spiculo-fiber, beset with short, plumose, radial fibers which represent the upright columns of the incrusting phase. Megascleres monactinal; the chief spicules smooth styles, the echinating spicules smaller and more or less spinose. Microscleres isochelæ, often accompanied by toxas and sometimes by sigmata.

Microciona prolifera Verrill. (Pl. LXII, figs. 31, 33; Pl. LXIII, figs. 35, 36; Pl. LXVI, fig. 57a, b, c, d, e.)

Microciona prolifera Verrill and Smith, 1874, p. 447.

Microciona prolifera Wilson, 1902, p. 396.

Microciona prolifera Wilson, 1911, p. 3.

The sponge when young forms thin incrustations on oyster shells, wharf piles, etc. As it grows older there rise up crooked, irregular lobes (Pl. LXIII, fig. 36). As the sponge grows older, the growth and formation of lobes may continue. This continued growth accompanied by branching and anastomosis will ultimately produce an intricately branched sponge (Pl. LXIII, fig. 35). Specimens of this type may reach a height of 150 millimeters.

The oscula are small apertures scattered here and there over the surface in general. They lead into canals which extend tangentially just beneath the dermal membrane. The pores are irregularly scattered in considerable abundance over the surface and lead into subdermal spaces. Thus the cavities which immediately underlie the dermal membrane are of two kinds, some afferent and some efferent. In the lobes of young specimens and in older branched specimens these superficial spaces communicate with abundant canals which ramify throughout the sponge interior (Pl. LXII, figs. 31 and 33).

Spicules.—Megascleres: (1) Styles (Pl. LXVI, fig. 57a, b), smooth and slightly curved, measuring 150 to 500 μ by 8 to 12 μ in an incrustation; 150 to 380 μ by 8 to 14 μ in one of the lobes of a young specimen; and 150 to 380 μ by 8 to 16 μ in an older branched sponge. The styles frequently have slightly enlarged heads and sometimes the heads are beset with very minute spines. (2) Small spinose styles 80 to 100 μ by 6 to 8 μ , which frequently have slightly enlarged heads (fig. 57c). Large numbers of very slender young megascleres are found throughout the sponge. Microscleres: (3) Isochelæ, 12 to 16 μ long (fig. 57d). (4) Toxas, 10 to 40 μ long (fig. 57e). Wilson (loc. cit.) records the microscleres, especially the toxas, as scanty in Beaufort specimens. We find that the granular sponge tissue tends to obscure the microscleres and that in partially macerated sections they may be found scattered in considerable abundance.

Skeletal framework.—The skeleton of the incrustations consists of a horny basal plate bearing closely set vertical horny columns from which megascleres project. From near the apex of each horny column a few large, smooth, and slightly curved styles project, forming a well-marked tuft. These styles measure 160 to 400 μ by 8 to 10 μ . The longest styles lie near the apex of the column, and some of them project beyond the surface of the sponge. Mingled with the mature styles are younger spicules of the same type, but slenderer and shorter. Projecting from the sides of some of the larger horny columns are a few small styles, 80 μ by 5 to 6 μ , some of them distinctly spinose, others with few and feeble spinulations. The skeleton of the incrustations contains longer styles than are found in the lobes of specimens like figure 36 or in the branches of older specimens like figure 35. In the incrustations we found a good many styles measuring 500 μ long, while in the lobes and branches of older specimens they rarely exceed 380 μ in length.

The skeleton of the constituent branches in a specimen like figure 35 consists of a reticulum of horny spiculo-fiber (Pl. LXII, figs. 31 and 33) which breaks up near the surface into independent radial fibers that extend out to and support the dermal membrane. From near the apex of such a radial fiber a few large, smooth, slightly curved styles project, forming a well-marked tuft. The longest styles are found near the surface, and many of them project beyond the surface of the sponge. These large styles average about 330 μ by 10 μ . Projecting vertically and obliquely from the sides of the radial fibers are large, smooth styles similar to those near the apex and a few small distinctly spinose styles (about 80 μ by 7 μ), together with others of about the same size but with few spinulations. It is these small styles which represent the echinating spicules of the subfamily. The spiculo-fibers of the interior bear similar echinating spicules. Wilson has pointed out that "the projecting (echinating) styles are few and scattered, spinose or smooth, the two types intergrading. The spinose type has numerous distinct though small spinulations on the shaft and a minutely tuberculate head. Spicules with only a few scattered spines occur, and, finally, quite smooth spicules with head end simply rounded and not enlarged."

The description given above applies both to the lobes of young specimens and the constituent branches of older ones. The skeleton of the older specimens (Pl. LXIII, fig. 35) differs, however, from that of the younger (fig. 36) in the following details. The spiculo-fibers in the former are considerably thicker than in the latter, due to the increased accumulation of spongin, and the styles reach a greater thickness. Some styles in the older sponge were found to measure 16 μ in diameter while the greatest thickness observed in the younger sponge was 14 μ . The small echinating styles are also more abundant in the former.

Family AXINELLIDÆ.

Sponge body ordinarily more or less upright, of a branching, lamellate, or cuplike habitus. But massive and even incrusting forms occur. Skeleton typically consists of ascending bundles of spiculo-fibers, from which arise subsidiary fibers that radiate to the surface. Skeletal fibers without spined echinating spicules, and typically plumose. The characteristic megascleres are monactinal. In addition to these, diactinal megascleres may also occur, and in some genera are the only form. Microscleres in the shape of microxeas, trichodragmata, or sigmata occur in a few genera; cheloid microscleres do not occur.

Axinella O. Schmidt.

Sponge body typically ramose; habitus varies, however, but while sometimes lamellate it is not cuplike. There is a firmer axial skeleton from which radial fibers pass to the surface. Axial skeleton not massive, but made up of ramifying and anastomosing spiculo-fibers. The radial fibers, which terminate in brushes of diverging smaller spicules, are joined by numerous short transverse connectives, the genus differing in this point from *Phakellia* in which the radial fibers are comparatively free. Skeletal fiber more or less distinctly plumose. Megascleres chiefly styles, but strongyles and oxeas may occur; scattered acanthostyles may also occur sparsely, as a vestigial feature. Microscleres generally absent, but trichodragmata are present in some species.

Axinella acanthifera, n. sp. (Pl. LXII, fig. 34; Pl. LXIII, figs. 38, 39; Pl. LXVI, fig. 59a, b, c, d.)

One specimen taken on Fort Macon beach.

Sponge body (Pl. LXII, fig. 34) lamellate, narrowing below to a stalk, expanded and divided into lobes above. Lobes in general foliaceous, separated by marginal notches; but the margin is also produced here and there into short, subcylindrical lobes. Upper part of sponge curved irregularly, so that the lobes lie in different planes. In this particular specimen growth has evidently resulted in an early division of the main axis, the two parts thus produced later on fusing at a point higher up. Height of specimen, 40 millimeters; width, 30 millimeters; thickness of lamella, 2 to 3 millimeters.

Color in alcohol gray brown with a tinge of yellow. Sponge firm, but flexible. Surface smooth and velvety.

Both surfaces are alike, appearing finely porous to the eye. The surface is depressed between the dermal brushes of projecting spicules; where greatly depressed, this is probably due to drying. Pores 60 to 85 μ in diameter are abundantly scattered between the dermal brushes. Fine canals less than 0.5 millimeter in diameter may be seen here and there beneath the dermal membrane, and parallel to the surface of the sponge. In places they radiate toward a central stripe, in which two or three minute apertures, about 0.5 millimeter in diameter, are arranged in a row. These are doubtless oscula. A very similar arrangement is described for *Axinella manus* Dendy, from the Gulf of Manaar. "The vents are small openings in the floors of stellately arranged or longitudinal grooves" (Dendy, 1905, p. 189).

Spicules.—(1) The most abundant megasclere is a smooth, slightly curved style, 160 to 260 μ long by 7 to 12 μ thick; commonly about 210 by 8 μ (Pl. LXVI, fig. 59a). This spicule makes up the bulk of both axial and peripheral skeleton. In the dermal brushes these styles, which constitute most of the brush, are thicker than elsewhere; common range, 160 to 200 μ by 10 to 12 μ . (2) A much stouter style, straight or nearly so, 160 to 240 μ by 12 to 20 μ (fig. 59b) is intermingled with the common form both in the axial and peripheral skeleton. (3) A very long and slender style, 400 to 600 μ by 6 to 7 μ (fig. 59c; Pl. LXIII, fig. 38, right side), is a characteristic element of the dermal brushes. Each brush includes a few (one to four) of these spicules, which project far beyond the others. They are broken off over much of the surface. (4) A small spinose style, 80 to 120 μ by 6 μ , with strong spines (fig. 59d), is present in the dermal brushes, in the radial fibers, in and projecting from the connectives that extend between the radial fibers. The spicule is not common anywhere, but is easily found on searching. Only those few which project from the connectives could be classified as "echinating" spicules. The bulk of them occupy positions similar to those of the common style. (5) Long and very slender raphid-like spicules occur in considerable abundance, scattered singly or in loose irregular sheaves; characteristic spicules measure 200 by 1 μ ; more abundant in the ectosome than elsewhere. The sheaves are not to be confused with trichodragmata. It is questionable whether these spicules are raphides or simply stages in the development of the megascleres. Raphides in bundles have recently been described in a related sponge, *Raspailia (Syringella) raphidophora* Hentschel from the Aru Islands (Hentschel, 1912, p. 371).

Skeletal framework.—The skeleton (Pl. LXIII, figs. 38, 39) is divisible into an axial and a peripheral part. The axial skeleton is chiefly composed of longitudinal fibers which anastomose to some extent, but the unions between which are more commonly made by transverse or oblique connectives irregularly disposed. The longitudinal fibers are polyspicular, with abundant spongin, the spicules arranged longitudinally in the fiber or obliquely, with the point slightly projecting. The fibers vary greatly in thickness and character in different regions of the sponge. In the upper part they are about 30 to 70 μ thick and well filled with spicules, the spaces between them wider than the fibers themselves. Nearer the base the axial reticulum is closer and more compact. The individual fibers are here thicker, owing to the increase in the amount of spongin around the spicules, the latter now forming only an axial core. The fibers in the basal region range from about 60 to 120 μ in thickness, the interstices between them being about the thickness of or narrower than the fibers.

The connectives between the longitudinal fibers include, as a rule, one to three spicules, which are covered with abundant spongin. The spicules of a connective are often longer than the space between the fibers that are joined, and thus cross both fibers.

The peripheral skeleton is made up of radial fibers, including their dermal terminations, and connectives. The radial fibers are prolongations of the axial fibers that curve in an obliquely radial direction to the surface. They branch to some extent. The fibers are polyspicular; the spicules held

together and just covered with spongin; the spicules longitudinal in the fiber or slightly oblique, with apex projecting. The fibers enlarge gradually as they approach the surface. At the outer end the spicules diverge somewhat, forming a dermal brush, which projects beyond the surface of the sponge.

Connectives extend between the radial bundles at about right angles to the latter. They include each one to three spicules, covered with spongin.

The dermal skeleton is made up of the projecting dermal brushes and the most superficial connectives.

Axinella is often defined as having plumose skeletal fibers. This term applies fairly well to the outer parts of the radial fibers in the Beaufort species, but not well to the rest of the skeleton, although the axial fibers and the inner parts of the radial fibers all show plenty of spicules placed obliquely, with the points slightly projecting; and after all, it is to this position of the spicule in the fiber that the "plumose" character is reducible.

In its external form this sponge closely approaches the European *Axinella frustra* (*padina*) Topsent (Topsent, 1896, p. 131; 1904, p. 139), a species which has trichodragmata about 40 μ long.

If we lay too great a stress on the presence of the spined styles, *A. acanthifera* might be removed to the Ectyoninae and put in or close to Raspailia, in some of the species of which the acanthostyles are vestigial or absent, as in subgenus Syringella (which, to be sure, certain authors separate completely from Raspailia, making it an independent genus placed in the Axinellidæ). This is the familiar form of argumentation based on the presence or absence of a particular feature which leads in its application to the establishment of "parallel genera," viz, genera assigned to different groups, which yet resemble one another except in regard to the feature in question. From one point of view such parallel genera are looked on as temporarily defensible because of their practical utility, although artificial. From another they are regarded as natural groups which owe their general similarity to independent adaptation (or "convergent evolution"). But the character of the skeleton taken as a whole (cf. Vosmaer, 1912, p. 310) leaves little doubt that the sponge belongs with the other Axinella species. The presence of the spinose styles is accordingly to be interpreted as a vestigial feature which has never been quite lost, or, possibly, as an imperfect return (incomplete reversion) to an ancestral condition which had disappeared in the Axinellids.

The sponge resembles Raspailia, or, at all events, the species which center around *R. viminalis* O. Schm. (cf. Vosmaer, 1912, p. 313), in yet another respect, viz, in the presence of long projecting styles in the dermal brushes. In the *R. viminalis* type, regarded by Vosmaer (loc. cit.) as characteristic of the genus, each dermal brush includes a single, strong, far-projecting style, surrounded at its base by a tuft of diverging small spicules, generally styles, sometimes oxeas. There are, of course, many species generally assigned to Raspailia, in which the radial fibers (or the tufts of spicules which represent them) lack the large terminal styles, and a few such as *R. irregularis* Hentschel from the Antarctic (Hentschel, 1914, p. 121) and *R. hornelli* Dendy from the Gulf of Manaar (1905, p. 172), in which each dermal brush includes not a single such style, but a bunch of them. It will be noticed that in the Raspailia species the long-projecting styles are stouter than the surrounding spicules of the brush, whereas in the Beaufort sponge they are slenderer. Nevertheless, their presence, coupled with the occurrence of acanthostyles in the Beaufort sponge, greatly strengthens the already well-supported view that Raspailia is an intermediate form, leading up from the Ectyoninae to Axin-

ellids, such as *Axinella*. Any cleavage of this close series of forms, all the members of which continue to exist, into genera is largely a matter of convention based on historical accidents; that is to say, certain terms and not others of the series came to be studied first, and so became the nuclei of genera.

As to the course of opinion with respect to the position of *Raspailia*, it may be recalled that Ridley and Dendy (1887) first gave the genus a definite position in modern classification by assigning it to the Axinellidæ. Topsent (1894*b*) removed it to the Ectyoninæ. Dendy (1895, p. 46) assented, but remarked that the genus was intermediate between the two groups, Ectyoninæ and Axinellidæ. Topsent has been followed generally, but Vosmaer (1912), without mentioning groups by name, keeps the genus in the same series with *Axinella*, *Phakellia*, *Acanthella*, etc. Dendy (1905, p. 172) apparently departs from his former view and now regards the resemblance of the *Raspailia* species to Axinellidæ as strong but "superficial." He says "it is evident from the presence of the spined echinating styli (though these may be vestigial) that they are really highly modified Ectyoninæ." The Axinellidæ are looked on as a polyphyletic group. Dendy recently (1916, p. 96) is disposed to abandon the group entirely and to include the genera such as *Axinella*, *Phakellia*, etc., in the Haploscleridæ, thus virtually returning to Vosmaer's position (1887, p. 335). Hentschel (1912, p. 413) brings out the skeletal resemblances between the Ectyonine genera centering around *Raspailia* and certain Axinellidæ, and inclines to regard it as due to kinship and not to convergent evolution (position of Dendy in 1895).

Acanthella O. Schmidt.

Form generally lamellate, consistency cartilaginous. Surface aculeate or conulose. If radial fibers are developed, they are weak, except in the basal part of the sponge, as compared with those of *Phakellia*; connectives between the radial fibers are lacking. Without microscleres.

Acanthella corrugata, n. sp. (Pl. LXIII, fig. 37; Pl. LXV, figs. 46, 47; Pl. LXVI, figs. 56*a, b, c, d, e.*)

One specimen taken on Fort Macon beach after a moderate southwest blow.

Sponge body (Pl. LXIII, fig. 37, taken obliquely from above) a folded lamella; folds tend to anastomose and inclose cuplike compartments. Only one of the cuplike spaces is completed, and this is open at the bottom; there are several other partially surrounded spaces. Below, the sponge narrows to a short peduncle; in side view the body has about the shape of an open fan. Total height, 65 millimeters, greatest horizontal diameter, 95 millimeters; common thickness of lamella about 5 millimeters, extreme basal portion of sponge about 10 millimeters thick. Above, the lamella diminishes to a fairly thin margin.

Both surfaces of the sponge are corrugated with more or less parallel ridges, about 2 millimeters apart, radial to the margin, converging and dying away toward the base. These are thickly beset with small conuli; between the ridges the surface is smooth. The extreme basal part, lacking well-defined ridges, is irregularly conulose. The surface is hispid, with spicules that project at the conuli.

Color bright orange red. Consistency firm, but not rigid, fairly elastic, of the kind known as cartilaginous.

There is no difference between the two sides of the lamella. A few scattered inconspicuous oscula about 1 millimeter in diameter were found, and open pores, about 40 μ in diameter, occur scattered over both surfaces. From the pores small pore canals pass through the outer stratum of the ectosome into subdermal canals, which extend parallel to the sponge surface. Characteristic subdermal canals measure 100 to 400 μ in diameter, the smaller sizes being the more common. From them canals lead more or less radially into the interior. Large canals are not abundant in any part of the sponge. The ectosome is

collenchymatous and about 250 to 350 μ thick. Its superficial stratum is fibrous; that is, the cells are elongated and rather compactly arranged parallel to the surface. From the ectosome wide tracts of collenchymatous tissue pass into the interior, marking out the pathways of the main canals.

Spicules.—The megascleres (Pl. LXVI, fig. 56*a* to *e*) are styles which fall in two very distinct classes, although intergrades can be found.

(1) A stouter form (fig. 56*a*), smooth, cylindrical, usually slightly curved; the characteristic spicule of the peripheral skeleton. In the upper part of the sponge this spicule generally measures 400 to 600 μ by 10 to 12 μ . In the lower basal part of the body it is larger, reaching 700 μ by 20 μ . The oxeate modification sometimes occurs (fig. 56*b*). Intermediate forms, between style and oxea, with irregular, imperfect ends, also occur (fig. 56*c*, *d*, *e*).

The stouter form of style is present in small number in the mesial skeleton, sometimes projecting from the individual fibers. A short form, often bent, about 200 to 350 μ by 16 to 20 μ occurs with some frequency.

(2) A slender form of style 400 to 500 μ by 3 to 8 μ , the commonest thickness being about 4 to 6 μ , is the characteristic spicule of the axial (mesial) skeleton. This spicule is smooth, cylindrical, usually slightly curved, sometimes exhibiting more than one bend. The oxeate modification occurs.

Skeletal framework.—The framework includes an axial portion, which, since the sponge is essentially lamelliform, is better designated mesial, and a peripheral portion.

The mesial skeleton is a reticulum made up of longitudinally coursing (i. e., extending from base to free margin of sponge) fibers, which branch and anastomose (Pl. LXV, figs. 46 and 47). In the basal part of the sponge this portion of the skeleton becomes quite thick; everywhere it occupies all but the superficial zone of the body. The fibers are cylindrical and plurispicular, with abundant spongin; the spicules arranged more or less longitudinally. Common range in thickness of individual fibers, 40 to 100 μ .

The peripheral skeleton consists chiefly of obliquely radial fibers, into which the mesial skeleton is produced (figs. 46 and 47). They are slender in the marginal region of the lamella, but become thicker below, in the basal region becoming strong and plumose. The fibers include but little spongin, only enough to hold the spicules together. The radial fibers branch to some extent, and at the distal end the spicules fray out, forming a bunch or bunches, generally divergent in character. These outermost spicules are embedded in spongin only at their very base. The radial fibers extend into the conuli. If, as often happens, the conulus is subdivided into secondary conuli, each of these receives a spicule or two or a bunch of spicules.

The peripheral skeleton includes also radial megascleres, which beset the mesial skeleton on its outer surface, between the radial fibers. They extend out toward the surface, and are especially conspicuous in the depressions between the ridges or other conulose elevations. These spicules belong to the stouter form of style.

Vosmaer has recently (1912) made an attempt to establish the genera *Axinella*, *Phakellia*, *Acanthella*, and *Raspailia* on more definite anatomical grounds. He finds that a new genus, *Phacanthina*, must be made for Schmidt's *Acanthella obtusa*.

Vosmaer finds that the species which he has studied; representing the above five genera, differ in definite points as to the character of the skeletal framework, and he therefore concludes that, in the diagnosis of the genera, the character of the framework should play an important part. How well the numerous species hitherto grouped under the above genera, when studied anatomically, will fit into the five skeletal schemes described by Vosmaer is, of course, a question. But there is no doubt that the distinguished spongologist, whose recent death entails such a loss upon zoological science, should be followed in the resolve to learn more definitely about the skeletal framework of these sponges and to use the data in classification.

According to Vosmaer's generic schemata, *Acanthella* and *Phacanthina* lack the radial fibers (extraaxial funiculi) which are found in *Axinella*, *Phakellia*, and *Raspailia*. The Beaufort sponge would therefore fall in *Phakellia*. But it seems not impossible that

some of the peculiarities of the skeletal framework which Vosmaer has brought out in his stimulating paper are such as distinguish species rather than genera.

In listing the sponge under *Acanthella* we rely for the present on the assumption that the cartilaginous consistency, and especially the aculeate surface, when coupled with a lamellate form and the general type of Axinellid skeleton, are signs of kinship.

Species of *Acanthella*, in the usual sense, are known from the Red Sea: *A. aurantiaca* Keller (Keller, 1889-91; Topsent, 1906b; Row, 1911); Mediterranean: *A. acuta* Schmidt, *A. obtusa* Schmidt (O. Schmidt, 1862; Topsent, 1901a); Australian waters: *A. stipitata* Carter, *A. tenuispiculata* Dendy (Dendy, 1896); Gulf of Manaar: *A. carteri* Dendy, *A. flabelliformis* Keller (Dendy, 1905); Torres Straits: *A. pulcherrima* Ridley (Ridley, 1884; Ridley and Dendy, 1887); Aru and Kei Islands: *A. euctimena* Hentschel, *A. sp.* Hentschel (Hentschel, 1912).

It would seem that *Acanthella* flourishes in warm waters, although Vosmaer some time ago (1885) referred a sponge taken in the Arctic Ocean, *A. multiformis*, to this genus.

KERATOSA.

Family DARWINELLIDÆ (APLYSILLIDÆ auct.).

Keratosa with eurypylous and large flagellated chambers; with a skeleton composed of separate horny fibers that ascend from the base of the sponge and are simple or branched, or the skeleton may be reticulate; spicules of spongin may also occur; the spongin fibers contain a medulla or pith and lack foreign mineral particles.

Aplysilla F. E. Schulze.

Incrusting or lamellar forms; skeleton nonreticulate, composed of separate fibers; without spongin spicules.

Aplysilla longispina, n. sp. (Pl. LXIV, fig. 42; Pl. LXV, figs. 45, 48; Pl. LXVI, fig. 64a, b, c, d.)

One large, incrusting specimen taken on the piles of the Morehead railroad pier, near the town end, just below low-water mark.

Sponge (Pl. LXIV, fig. 42) 1 to 20 millimeters thick, covering an area 150 millimeters in diameter, apparently with unlimited lateral growth. The surface is covered with numerous slender, sharp conuli several millimeters high (the range is 1 to 5 millimeters, the common height about 3 millimeters) and a variable distance apart (often about 3 to 5 millimeters), frequently but not always connected by thin, sharp-edged ridges or folds. Conuli in general simple, but not uncommonly bifid or trifid at the apex. Surface very uneven because of numerous ascending portions, all of which are low, irregular, and so vaguely delimited as not to merit the name of lobes. A few oscula, 1 to 3 millimeters in diameter, are scattered over the surface.

Color, sulphur yellow, turning instantly in alcohol to an indigo blue. Sponge soft and elastic; interior cavernous (Pl. LXV, fig. 45).

The skeletal fibers are simple, or branched somewhat in elk-horn fashion (Pl. LXVI, fig. 64a, b, c). At the under surface of sponge they expand into thin, basal, horny plates, which sometimes, at any rate, connect with one another. The fibers extend vertically upward into the conuli, reaching the apex of the latter (Pl. LXV, fig. 45). The simple fibers support each a single conulus, and each terminal division of a branched fiber supports a conulus or one of the subdivisions of a primary conulus. The more complex fibers thus support a number of conuli.

The fibers measure 100 to 250 μ in diameter just above the basal plate and 15 to 30 μ near the tip. The pith, which consists of successive thimble-shaped segments of varying length, forms about half of the fiber in the basal portion. The spongin wall is clearly stratified (Pl. LXVI, fig. 64d). The fibers are generally smooth and have no inclusions, but occasionally foreign bodies are found in them.

The surface of the sponge is formed by a dermal membrane 20 to 40 μ thick, the body of which consists of not very closely packed mesenchyme cells, which are elongated parallel to the dermal surface and the neighboring spaces. The dermal membrane is traversed by closely set, short, radial canals, 75 to 125 μ in diameter and about 30 to 60 μ apart. These open internally into large subdermal spaces. At the outer dermal end these canals are now closed in by thin membranes, each of which in life is probably perforated by several pores. In the actual specimen the pores are closed. The subdermal spaces are wide just beneath the dermal membrane, but, descending vertically from the surface, they become gradually narrower, terminating in the inhalent canals, which are not marked off by any definite limit from the subdermal spaces. The subdermal spaces and the inhalent canals open directly by small prosopyles, about 4 to 8 μ in diameter, into the flagellated chambers, which are generally, but not invariably, longer than wide, 80 to 130 μ long, 60 to 100 μ wide, and which open directly by wide mouths into the exhalent canals.

The Beaufort sponge is probably to be looked on as a migrant from the coast farther south. A Bahama species of *Aplysilla* is known, *A. compressa* (Carter), but this is an erect lamellar form (Lendenfeld, 1889, p. 704).

The Mediterranean species, *A. sulfurea* F. E. Schulze, recorded also from Australian seas, the European coast of the North Atlantic, and from Juan Fernandez (Thiele, 1905, p. 488), resembles the Beaufort sponge in color, the yellow turning to violet in alcohol (Topsent, 1904, p. 56), or gradually becoming blue as the sponge dies in the air (F. E. Schulze, 1878). The conuli are much lower than in the Beaufort sponge, only 0.5 to 1 millimeter high and about 1 millimeter apart.

The Beaufort sponge is nearer to an Australian form, *A. violacea* (Lendenfeld, 1889, p. 704). This is an incrusting species with unlimited lateral growth and conuli about as high as in the Beaufort species. The conuli are, however, more closely set, and the natural color is dark violet. Moreover, there is a basal spongin plate which contains large sand grains, and the flagellated chambers are smaller (60 to 100 μ long by 30 to 40 μ wide) than in *A. longispina*.

Recent writers (Topsent, 1905; Dendy, 1905 and 1916; Row, 1911; Hentschel, 1912) do not separate the Darwinellidæ and Aplysillidæ of Lendenfeld's monograph (1889), but combine them in one family, for which Topsent uses the heading, Darwinellidæ, thus following in essentials Merejkowsky (1879) and Vosmaer (1887). The other authors cited above use the name Aplysillidæ. Topsent is obviously in the right, since the type genera of the families combined, *Darwinella* F. Müller and *Aplysilla* F. E. Schulze, were established in 1865 and 1878, respectively.

Family SPONGELIDÆ.

Keratosa with eurypylous and large flagellated chambers, with a skeleton composed of separate horny fibers that ascend from the base of the sponge and are simple or branched, or the skeleton is more commonly reticulate. Horny fibers without pith, generally containing abundant foreign mineral particles. Skeleton may be reduced, then consisting of foreign particles usually held together by a little spongin, but the latter may be absent.

Pleraplysilla Topsent.

Thin, incrusting forms, with low conuli, supported by separate areniferous fibers ascending from base of sponge and characteristically undivided.

Pleraplysilla latens n. sp. (Pl. LXIV, fig. 40.)

Sponge occurs in the shape of thin, colorless incrustations on oyster shells, commonly along with *Microciona prolifera*. Under the piers along the "town front" proved to be the best collecting ground. The sponge is not nearly so abundant as *Microciona*, but is not rare. It is, however, inconspicuous. It contains abundant embryos during July and August.

Surface covered with small, sharp conuli, commonly 0.5 to 1 millimeter apart. Thickness of sponge from base to apex of conulus about 1 millimeter, usually something less; body of sponge itself about one-half that thickness. Upper ends of the skeletal fibers extending into conuli are conspicuous, reflecting the light. The fiber in some cases extends an appreciable distance beyond the substance of the conulus; but this may be an effect due to contraction.

The dermal membrane in stained preparations exhibits narrow bands, which prove to be linear thickenings about 20 μ wide, due to aggregations of mesenchyme cells on the under surface of the membrane. The mesenchyme cells are elongated in the direction of the bands. The bands radiate from the apices of the conuli, often about eight from a conulus, soon branching and passing into a network of similar bands which occupy the sides of, and the areas between, the conuli. The meshes of this network are polygonal, irregular in size, the diameter ranging from 70 μ to 250 μ . The network is easily seen with a lens in a lightly stained preparation in alcohol. The bands are sometimes so arranged that primary meshes of the reticulum are subdivided. The meshes themselves are riddled with small pores 12 to 24 μ in diameter. In the actual specimens examined the pores were open in some regions, closed in others.

The dermal reticulum of bandlike thickenings just described is a structure similar to that found in *Aplysina aerophoba*, *Aplysilla sulfurea*, species of *Spongelia*, and other horny sponges (F. E. Schulze, 1878, 1879a). It is of the same general character as that found in *Aplysilla longispina* nobis (Pl. LXV, fig. 48), but in the latter species the bands are relatively very thick and strongly developed, so much so that they constitute lateral walls of distinct, though short, canals, which may be said to traverse the dermal membrane radially.

Beneath the dermal membrane there is a nearly continuous subdermal space from which canals, presumably afferent, pass vertically downward into the sponge interior. These canals are numerous, often about 0.5 millimeter apart, although there is no regularity in their distribution. The mouths of the canals, reaching about 300 μ in diameter, are easily seen through the dermal membrane. With the lens they look like surface apertures and give to the sponge a porous appearance.

Numerous tangential canals, presumably efferent, extend just below the dermal membrane. These are long and branching, the larger about 0.5 millimeter wide. The membrane covering them is without conuli, and lacks or nearly lacks the system of bandlike dermal thickenings. It is in general aporous, but a few scattered pores occur of about the same size as those found elsewhere. Open oscula 200 to 250 μ in diameter were observed scattered over the surface of the sponge.

The flagellated chambers are longer than wide, commonly ellipsoidal, often about 100 to 120 by 70 to 90 μ . They may be larger, reaching 175 by 100 μ , sometimes slightly curved in the direction of the greater axis. Still longer tubular chambers occur here and there, sometimes with indications of branching. These bespeak the primitive nature of the canal system. The chambers are perforated by numerous prosopyles 8 to 10 μ wide, and open by wide apopyles directly into the efferent spaces. The chambers are abundant below the general subdermal space, except in the regions of the main tangential canals, below which there are, however, some.

The skeleton consists of simple independent fibers, 40 to 60 μ thick at about the middle, ascending from the basal surface of the sponge into the conuli. They are made up of spongin and mineral particles, the latter including sand grains, fragments of sponge spicules, occasional entire spicules, and diatom shells. The mineral particles, except at the base of the fiber, nearly or completely fill it. Close to the base the mineral matter tapers away to a thin core, leaving the surrounding spongin very evident. In this region and at other points also along the course of the fiber it is possible to see that the spongin is laminated. At the very base the fiber expands into a thin basal plate of spongin. The fibers sometimes extend vertically, or nearly so, from base to conulus. But usually they extend obliquely from the base upward, often occupying throughout a large part of their course a more or less horizontal position. They are sometimes fairly straight, but frequently curved or bent. They are characteristically simple, neither branching nor connecting. Rarely a fiber is found with a lateral branch; and, again, rarely two fibers may come in contact and fuse, thus producing the appearance of a fiber that divides basally.

Topsent some years ago (1905, p. CLXXXV) described a new and interesting sponge for which he created the genus *Pleraplysilla*. Topsent's sponge, *P. minchini*, was dredged off the French channel coast at a depth of 30 meters. The sponge is incrusting, about 1 millimeter thick, except in spots where the thickness reaches several millimeters. The color is chocolate. The largest specimen measured 25 centimeters in diameter. The surface is beset with conuli 1.2 to 2 millimeters or more apart. The skeletal fibers are characteristically simple but, especially in the thicker parts of the sponge, may send out two or three branches; they are 100 to 110 μ thick below. The flagellated chambers are eurypylous and measure about 90 by 35 μ . The Beaufort sponge is evidently another species of this genus.

For *Pleraplysilla* and another sponge *Igernella* (*Darwinella*) *joyeuxi*, from the Gulf of Mexico, Topsent, *loc. cit.*, creates the family Pleraplysillidæ. *Igernella* having horny spicules would be a good *Darwinella* if the fibers of its skeletal reticulum were not areniferous. But this latter characteristic excludes it from the Darwinellidæ (Aplysillidæ of some). Its horny spicules, on the other hand, exclude it from the Spongelidæ. The sponge is an intermediate between the Darwinellidæ and Spongelidæ, and Topsent's family provides a place for it, although, if *Pleraplysilla* is removed, as we suggest (see below), the name of the family will have to be changed.

Pleraplysilla, while it will not go in the Darwinellidæ because of its areniferous fibers, can not, it seems to us, be excluded from the Spongelidæ. It takes its place at the base of the latter family, its very simple fibers leading up to the more complicated, but still independent, ones of *Spongelia spinifera*. It is generally recognized that the separation between the Darwinellidæ and the Spongelidæ is not a sharp one. Dendy (1905, pp. 203, 207) points out that *Spongelia spinifera* F. E. Schulze and *Megalopastas* Dendy are intermediate forms. *Igernella* and *Pleraplysilla* are also intermediates, although not intermediate in respect to the same points.

Family SPONGIDÆ.

Sponges with small flagellated chambers, 20 to 50 μ wide, and a skeleton, generally in the shape of a reticulum, composed of solid or pithed, horny fibers.

Subfamily STELOSPONGINÆ.

Spongidæ in which main fibers and connectives are generally distinguishable in the skeletal reticulum. The main fibers may be simple but are generally more or less fascicular. Between the fascicular fibers, or between the simple main fibers in species without fascicles, the skeletal meshes are much larger than in the Eusponginae.

Hircinia Nardo.

Stelosponginae with filaments in the ground substance and in which the connectives are characteristically attached to the main fibers by diverging roots which extend along the main fiber in one plane.

Hircinia ectofibrosa, n. sp. (Pl. LXIV, figs. 41, 43, 44; Pl. LXVI, fig. 61.)

Taken several times on Fort Macon beach after moderate gales; six specimens available for study; probably growing on the "Fishing Bank" off Beaufort Inlet and in similar places, and to be looked on as an outlying member of the Florida-West Indian fauna.

The chief characteristics of the species, as brought out through the comparison of specimens, no two of which agree in detail, are: The predominantly simple character of the main fibers and the connectives; the existence of dermal connectives; the tendency for the outer ends of the radial fibers to become fascicular through the extension of, and union between, the roots of the surrounding dermal connectives.

The shape of the body in most of the specimens is platelike, the plate probably standing more or less vertically; the platelike body may be produced into lobes. The platelike shape is not universal, for in the type specimen (Pl. LXIV, fig. 41) there is simply a common basal part dividing above into a few subcylindrical or flattened lobes. The specimens vary in total height from 50 to 130 millimeters; in thickness from 10 to 35 millimeters.

The sponge is beset with sharp conuli connected by thin interconular ridges, which divide the surface into rounded or polygonal, depressed areas. The conuli project 1 millimeter or less above the ridges but 1.5 to 3 millimeters above the level of the depressed areas. They are 2 to 4 millimeters apart, these distances representing usually the diameters of the interconular depressed areas, but the bounding ridges are sometimes absent, with the result that interconular areas are produced larger than the normal. The ridges themselves vary in height from a fraction of 1 millimeter to 2 millimeters. The specimens studied all being beach specimens, although fresh and in good condition, it is quite probable that in them the conuli and interconular ridges are sharper, and the depressed areas deeper, than in the living sponge, owing to contraction incident upon partial drying.

Over a part of one specimen the radial fibers (see below) project from the summit of the conuli. But this is a condition obviously pathological (in a wide sense) and of no classificatory value.

The conuli are generally vertical to the surface, but on parts of several of the platelike specimens they incline obliquely upward toward the free margin of the sponge. Thus several interconular ridges, together with the depressions between them, are combined along lines that radiate toward the free margin. This leads to the appearance of ridges and furrows, radial to the margin, that may be 15 millimeters long, a type of surface architecture which approaches that shown in some of Hyatt's specimens of *H. campana* (Hyatt, 1877, Pl. XVII, fig. 28). In such regions the dermal connectives (see below) in a ridge are combined to form continuous fibers which extend the length of the ridge; these are connected by transverse, simple fibers, and thus a ladderlike dermal skeleton is produced.

Foreign mineral particles are present in considerable abundance on the surface and in the ectosome, which thus sometimes to a depth of 180 μ appears dense and whitish as compared with the light yellowish-brown interior. The particles include the usual sand grains, spicule fragments, and foraminifer shells or bits of the same. They are scattered; that is, are not abundant enough to be massed together so as to form a continuous sand cortex. The particles for the most part are small, but in several specimens large sand grains, up to 250 μ in diameter, are abundant among the smaller bits.

A surface reticulum consisting of pore areas separated by trabeculae containing closely packed sand grains is not present in these specimens. But this reticular appearance, which is so common in horny sponges and, because of the sand grains in the trabeculae, so conspicuous in some *Hircinias*, is, as has been shown (Wilson, 1902, p. 405), greatly influenced by the physiological state; that is, whether the pores are open or not. There are in several specimens of the present species indications that in the active state pore areas will be found, 150 to 250 μ in diameter, each containing one or more pores 25 to 70 μ in diameter, and separated by interareal trabeculae of thicker dermal membrane full of mineral particles. Actually only a few pores are open.

Subdermal cavities 2 to 3 millimeters wide are abundant, more so in some specimens than in others. The sponge interior is porous, with canals up to about 3 millimeters in diameter. The flagellated chambers measure about 36 by 28 μ . Oscula, 1 to 4 millimeters in diameter, are scantily scattered over both surfaces in the tabular specimens.

The filaments (Pl. LXVI, fig. 61) are very abundant. They are about 6 μ in diameter at the middle, 3 to 4 μ near the ends. The terminal enlargements are oval and about 9 μ thick. The filaments are smooth and for the most part colorless and unspotted, but in one of the specimens some of the filaments are "spotted," others not. The "spotted" or "unspotted" condition is obviously of no classificatory value. The filaments in some regions, especially around some of the canal walls, are arranged in more or less distinct tracts.

The surface color varies from whitish to a dull purple. The natural color has probably in part faded out. The sponge is firm, but compressible and elastic.

The skeleton includes main fibers and connectives. The main fibers ascend in the middle of the plate, or lobe, and branch, the branches curving outward in the usual way as radial fibers, which terminate in the conuli. The ascending and radial fibers are alike, and both are referred to here, in accordance with the general usage, as main fibers. The radial fibers, in macerated skeletons, are 1.2 to 2 millimeters apart.

The main fibers (Pl. LXIV, figs. 43, 44) are characteristically simple, solid fibers, 100 to 200 μ thick, well filled with mineral particles (sand grains, bits of sponge spicules, and foraminifer shells), all comparatively small in size, there being no large sand grains or shells to swell out and distort the fiber. The spongin is stratified. In some specimens, but not in others, the outermost ends of the main fibers, and the dermal connectives as well, are composed of a much paler spongin than the rest of the skeleton, in which the spongin is yellow. This difference is probably associated with some individual difference in growth activity.

Whenever the main fibers appear in any degree fascicular, this is due to one of two causes, as follows:

(1) Two or even three main fibers may be closely approximated, or a main fiber may branch obliquely, the two or three branches continuing to run more or less parallel and close together. Between such fibers or such branches, respectively, the connectives are, of course, very short, and the several fibers, together with their connectives, constitute a compound fiber such as is characteristic of *Stelosporgia*. Such compound fibers have a total thickness of about 0.5 millimeter. This condition is found here and there in the specimens studied, but is comparatively rare. In the literature on the *Stelosporgia* when the term "fascicular fiber" is used, writers seem usually to have in mind a compound fiber of this kind.

(2) A connective unites with a main fiber by several roots, the middle about transverse to the fiber, the upper and lower oblique to the fiber. Thus the roots of a connective attach themselves to a considerable extent of the main fiber, forming altogether a sort of triangular plate. If now, as often happens, several connectives attach to the same immediate region of a main fiber, but on different sides, the main fiber in that region is surrounded by several sets of roots, and thus may appear "fascicular," although in a different sense from that understood under (1). Between any two successive sets of roots which meet it the main fiber is, as a rule, obviously simple (fig. 44), but in places the roots spread up and down the fiber so far that successive sets meet one another. The main fiber then appears not as an independent fiber, but as an axial tract, distinguishable because of its mineral contents, extending through an elongated, and close, reticulum. Such a condition is found here and there in the interior of the sponge. It is commoner in the outer layer of the body, between the dermal connectives and the most superficial of the inner connectives, which usually lie about 1 millimeter below the former.

In its outermost part, within a conulus, the main fiber often remains simple; but in this region the fibers vary considerably, and the variants need to be described. They are as follows:

(1) The outer end, intraconular portion, of a main fiber is, as said, often simple and so full of mineral particles as to show very little spongin. In a typical case it extends 500 μ beyond the attaching roots of the dermal connectives and ends in a slight enlargement, each dermal connective meeting the fiber by several roots. The terminal portion of the fiber may show a perforation or two, due probably to the fact that mineral particles here have only recently been surrounded by the spongin of the fiber.

(2) The roots of the dermal connectives may extend very obliquely upward (and downward) along the main fiber. These roots, thus entering a conulus from several sides and extending up toward the apex, become interconnected by short fibers, and so may give rise to a very perfect trellis, suspended like a tent, as it were, from the uppermost part of the main fiber. This is, perhaps, the commonest condition of the intraconular portions of the main fibers in the specimens studied.

(3) In exceptional cases the main fiber, near its outer end, may divide, the two branches extending into the same conulus. They are connected in a close and complex way, the connectives themselves being so united as to constitute reticula. Terminally the two branches may end in a common enlargement, which maceration shows is a spongin reticulum very full of mineral fragments. In such a case the intraconular skeleton is fairly to be classed as "fascicular" in the sense of being a compound, *Stelosporgia*-like fiber. A variant of this condition is found where two or three main fibers which, in the periphery of the sponge, at least, are not branches of a common fiber, converge and enter the same conulus, within which they are united by short connectives.

The most superficial, or dermal, connectives lie in the ectosome just below the dermal surface, passing from the outer end of one main fiber to that of another. Except where interconular ridges are not developed, they lie in and close to the free edge of the latter. In general they are single, simple

fibers connecting with the main fibers by several roots. They are commonly united by other dermal fibers that may be called interconnectives, but these are few in number and irregular in distribution. The result is that the dermal skeletal reticulum has, in general, large meshes that approach the squarish or rectangular shape. Characteristic meshes measure 1.6 millimeters by 1.9 millimeters, 2.2 millimeters by 2.5 millimeters, 2.5 millimeters by 2.5 millimeters, 2 millimeters by 4 millimeters. The dermal connectives in some specimens are very different in appearance from the internal connectives, in that they are slenderer than the average internal connective and of very pale spongin well filled with mineral particles. In other specimens they differ from the internal connectives only in containing more mineral particles, while in still other specimens the dermal connectives do not differ in appearance from the internal ones. The difference in appearance between dermal and internal connectives is thus inconstant. It is, perhaps, in part correlated with a difference in growth activity.

In one specimen the dermal connectives depart, over much of the surface, from the type. Typical connectives are developed, but the surface as a whole offers the following deviations from the type:

(a) Instead of a few interconnectives, a comparative abundance of fibers develop between and around the principal connectives, thus producing reticula which encroach upon the interconular areas. Such reticula may be very fine.

(b) In this specimen as in some others a good many large sand grains are scattered through the ectosome and on the surface; but, whereas in the other specimens they have not been incorporated in the skeletal fibers, in this specimen a great many of the dermal connectives include large grains that measure up to $250\ \mu$ in diameter. The grains lie in a longitudinal series in the connective and are surrounded by a thin layer of spongin. They may form a continuous series or be separated by intervals in which the connective remains of the usual thickness, about 40 to $50\ \mu$. Such fibers resemble those of the species grouped together by Lendenfeld under the subgenus *Psammocinia* (1889, p. 579).

(c) A further complication is present in that some of the dermal connectives that have incorporated large sand grains are fascicular. Such "fascicular" fibers consist of several simple connectives that lie close together and are interconnected. Sometimes all the longitudinal components of such a fiber apply themselves to the same sand grain. Fascicular connectives of this kind may be $350\ \mu$ wide, the constituent being strands only $20\ \mu$ thick.

The peculiarities of the dermal skeleton in this specimen are probably no more than individual differences. The specimens form a series, at one end of which are those without large sand grains; in the middle, those with large sand grains in the ectosome but not in the skeletal fibers; at the opposite end, the specimen in which many dermal connectives have incorporated the sand grains in question.

The internal connectives are composed of yellow spongin and in general are without, or have only scanty, mineral contents. Close to the surface they may exceptionally contain more, but even then the mineral contents can not be said to be abundant. They range in thickness from about $35\ \mu$ to $175\ \mu$. The connectives are characteristically simple, the meshwork correspondingly coarse. The skeletal meshes in the macerated skeleton, which with the most careful treatment shrinks in some degree, may reach 2 millimeters in diameter. Common sizes for the largest meshes are: Width 1.5 millimeters, with a radial diameter of 1.2 millimeters; width 1.2 millimeters, with a radial diameter of 1 millimeter; width 1.2 millimeters, with a radial diameter of 500 to 600 μ . In the case of such meshes neighboring connectives are not united together. But very commonly neighboring connectives are united together by a few other fibers—"interconnectives," as they may be called. The size of the mesh is thus correspondingly reduced, although characteristically it still remains large, typical diameters ranging from 300 to 600 μ .

The interconnectives often become so numerous and complex that they, together with the connectives, form reticula that extend between the main fibers, thus making an approach to the condition characteristic of *Hircinia fatida* (Schulze, 1879^b, Pl. III, fig. 3), although the reticula in question are coarser and more irregular than in the latter species.

Position of H. ectofibrosa in the genus.—The Beaufort species is in that group of forms which center around the Mediterranean sponges described by F. E. Schulze as *Hircinia variabilis*, in which the main fibers are simple or only slightly fascicular and the connectives characteristically simple. Lendenfeld combines these forms into a subgenus, *Euricinia*. In his definition of this subgenus the following clause must now

be omitted: "but no large sand grains joined by slender short fibers occur" (1889, p. 554).

In the possession of a dermal skeleton the Beaufort species appears to be nearly unique in the subfamily. Lendenfeld says (loc. cit., p. 477) that the species of *Stelosporgia* are destitute of a special dermal skeleton, by which he must mean one that lies in the ectosome, close to the surface and above the level of the subdermal cavities. So, too, the described species of *Hircinia*, in general, lack a dermal skeletal reticulum, which is, however, present in *H. (Oligoceras) conulosa* (Ridley) (Ridley, 1884, p. 599; Lendenfeld, loc. cit., p. 535).

The presence of large sand grains in the skeletal fibers is the central fact on which Lendenfeld bases his subgenus *Psammocinia* (loc. cit., p. 579). As to whether *Psammocinia* is a natural group or an assemblage of phænotypes we are not in a position to form an opinion, although it is certain that the mineral content of the skeleton is exceedingly variable, both in total amount and kind, in what must be regarded as a single species. F. E. Schulze long ago pointed out how variable is the amount of mineral content in the ectosome of *H. variabilis* (1879b, p. 14).

The resemblance of *H. ectofibrosa* to some of the Mediterranean specimens of *H. variabilis* involves surface details. These are the sponges now assigned to var. *hirsuta*, in which the conuli are high and sharp and often in rows: "gewöhnlich in kurzen unregelmässigen Kämmen, welche Bogen bilden und in einander übergehen" (Schmidt, 1862, p. 33). They are evidently very similar to the Beaufort species.

The Beaufort sponge is doubtless an outlying member of the Florida-West Indian fauna. Several species of the genus have already been recorded from the Florida-West Indian waters: *Hircinia campana* (Lamarck), *H. arbuscula* (Schmidt), *H. acuta* (Duchassaing et Michelotti), *H. cartilaginea* (Esper), *H. purpurea* Hyatt, by Hyatt (1877); several under "Polytherses" by Duchassaing and Michelotti (1864, p. 67); *H. caracensis* Carter (Carter, 1882, p. 273), *H. tubulosa* Carter (Carter, 1884, p. 203); *H. purpurea* Whitfield, and *H. atra* Whitfield (Whitfield, 1901); *H. acuta* (Duchassaing et Michelotti), *H. variabilis* F. E. Schmidt, *H. fætida* (Schmidt) var. *cuspidata* Wilson, by Wilson (1902). Not all of these species are recognizable.

One of the West Indian forms just recorded offers resemblances to the Beaufort species. This is *H. campana* var. *fixa* Hyatt (Hyatt, 1877, p. 546, Pl. XVII, fig. 28). The case of *H. (Spongia) campana* (Lamarck) as occurring in the West Indies is as follows: Duchassaing and Michelotti (1864, p. 68) identified certain forms as belonging to this species. Hyatt (loc. cit.) grouped under the same heading a variety of West Indian sponges. He tells us that the variation in his specimens is great, involving not only habitus and size of the interconular depressed areas, but the skeleton also. In the absence of more detailed structural data it is uncertain how far Hyatt was justified in grouping these forms together. With respect to some of them, varieties *typica*, *fixa*, and *felix*, his account intimates that the main fibers are fascicular, in the sense of being compound fibers. Lendenfeld (loc. cit., p. 561) refers others of Hyatt's specimens, var. *columnaris* to *H. variabilis*, evidently concluding (on what grounds is uncertain) that the main fibers in these are simple.

With respect to *H. campana*, we venture to say that possibly the vase shape is assumed by several West Indian *Hircinias*, or there may be a West Indian species (*H. campana*) which under certain conditions becomes vase shaped, but which may be of

almost any habitus; in which the skeleton is very variable and imperfectly known; and in which the interconular areas vary greatly in size, from 2 to 10 millimeters in diameter; the species remaining recognizable in spite of its variability. Coues and Yarrow (1878) record under this name a specimen collected in the Beaufort region.

Schmidt (1870, p. 30) had also before him West Indian specimens which he identified as *H. campana*, but he frankly confesses that the wealth of Hircinia "forms" in the West Indian waters is so great that he can not divide them into species. This entanglement of "forms" still waits for its satisfactory analysis. Familiarity with considerable numbers of the living sponges in several localities and some breeding experiments are doubtless necessary for real success.

Lendenfeld (loc. cit., p. 569) classes *Spongia campana* as a *Sarcotragus* (= Hircinias with distinctly fascicular main fibers), and to this species assigns the vase shaped and flabellate sponges from the West Indies and Florida named *Polytherses campana* by Duchassaing and Michelotti (loc. cit.), *Hircinia campana* by Schmidt (loc. cit.), *H. campana* varieties *typica* and *fixa* by Hyatt (loc. cit.).

Discussion of the genus.—Lendenfeld in defining Hircinia (loc. cit., p. 545) lays stress, justly, we think, not only on the presence of filaments but on the way in which the connectives attach to the main fibers. He says: "The fascicular nature of the connecting fibers and their mode of attachment to the main fibers by numerous diverging roots, which extend in one plane, distinguish most species of Hircinia sufficiently from *Stelospongia* and from all other genera." He goes on to say that there are forms without this peculiarity, but these are plainly very close to the sponges with the peculiarity. Possibly this reasoning justifies Lendenfeld's inclusion under Hircinia of forms with dendritic fibers instead of a reticulate skeleton, such as *Cacospongia collectrix* Polejæff and *Oligoceras conulosum* Ridley.

The fascicular main fibers of Hircinia deserve a few words. They are structures that are somewhat vaguely treated in the literature and probably are not always understood in the same sense. The fact that the connectives are united to simple main fibers by diverging roots, which may extend in one plane along the fiber for a considerable distance, leads to the formation of a type of fascicular fiber different from that which is characteristic of *Stelospongia* (ante under description of this species). An examination of the literature indicates that it is widespread among the species now recorded under Hircinia. This type of fascicular fiber owes its existence, we believe, (1) to the extension of roots along the main fiber such that roots of successive connectives join one another, and (2) to the fact that several sets of roots which surround the main fiber at about one level but on different sides combine to form a close-meshed reticulum through the axis of which runs the original main (simple) fiber. The fascicular fibers appear to have this character in *H. favosa* and *H. fætida* (Lendenfeld, loc. cit., pp. 571, 577), although Lendenfeld regards the fascicular fibers of this subgenus (*Sarcotragus*) as composed of several individual fibers joined at frequent intervals to one another (loc. cit., p. 533); that is, as compound fibers. But in *H. favosa* the sand grains are restricted to the most axial fiber of the fascicle, the whole structure appearing to consist of an axial fiber "surrounded by garlands of slender fibers" (loc. cit.). The structure appears to be the same in *H. fætida*. Again, in describing the connectives of several species of subgenus *Sarcotragus*, Lendenfeld (p. 534) says the roots of the connectives "appear as continuations of the fibers which form the garlands in the main fascicles."

The size of the flagellated chambers has been adduced as a differential feature marking off *Hircinia* and *Stelospongia* (Lendenfeld, loc. cit., p. 484). The chambers are said to be larger in *Stelospongia*, the diameter being given as 41 to 48 μ . But in *Hircinia variabilis* F. E. Schulze, the diameter may be as much as 40 μ . In such a case this generic differential can not be applied, although it may hold for the majority of the species of the two genera.

The fundamental character of the fascicular fibers appears to be constant in *Stelospongia*. They are compound fibers (Lendenfeld, loc. cit., p. 478; Pl. XXXI, fig. 7; Pl. XXXII, figs. 7, 8, 9, 10). Lendenfeld sometimes calls them "plexus bands" (Pl. XXXI, figs. 4, 10, 12, 14; Pl. XXXII, figs. 9, 10). The constituent parallel fibers may be well apart, or may come together so closely as to fuse (Pl. XXXI, fig. 14). The width of the compound fiber thus varies greatly from less than 200 μ to several millimeters. It is unimportant whether the several main fibers of a "fascicle" arise as branches of a common fiber or not. Farther in the interior doubtless they often unite, although separate peripherally. Compound fibers of this kind, as we have seen, undoubtedly occur here and there in *Hircinia ectofibrosa*, but in this species certainly, and probably in the genus at large, when the main fibers become fascicular the characteristic formative method practiced is that of incorporating the roots of the connectives. The characteristic fascicular fibers of the two genera are thus probably quite different structures.

Since in Lendenfeld's system both under *Hircinia* and *Stelospongia* there are forms with single main fibers, *H. variabilis* and *S. (Cacospongia) vesiculifera*, for example, we are driven back in the separation of these forms, and hence in the separation of the genera, to the presence or absence of filaments and of "root plates" formed by the divergent roots of the connectives.

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EXPLANATION OF PLATES.

[Pls. LVI-LVX, from photographs; Pl. LXXVI, from drawings.]

PLATE LVI.

- Fig. 1. *Poterion atlantica*. Vertical section, including cortex of outer surface and adjacent choanosome. $\times 21$.
- Fig. 2. *Cliona celata*. Section through oyster shell showing included sponge trabeculae extending beyond the surface in shape of oscular papilla, which is cut tangentially. $\times 15$.
- Fig. 3. *Spirastrella andrewsii*. Section vertical to the cloacal surface between oscula. $\times 15$.
- Fig. 4. *Cliona celata*. Pore papilla. Expanded cap is shown cut in vertical section. The section, below, is tangential and shows the surface of the wall of papilla. $\times 40$.
- Fig. 5. *Cliona celata*. On oyster shells. $\times 1$.
- Fig. 6. *Spirastrella andrewsii*. Side view of piece shown in fig. 7b. The dermal surface is at top of figure. Large incurrent canals, between which lie comparatively thin septa of sponge tissue, extend radially inward from dermal surface. $\times 1$.
- Fig. 7a. *Spirastrella andrewsii*. Small part of cloacal surface. Oscula contracted. $\times 1$.
- Fig. 7b. *Spirastrella andrewsii*. Small part of outer surface showing incurrent apertures. $\times 1$.

PLATE LVII.

- Fig. 8. *Suberites undulatus*. Whole sponge, from the side. Base of sponge, to the left in the figure. $\times 1$.
- Fig. 9. *Suberites undulatus*. From a section showing fibrous skeleton of the interior. $\times 10$.
- Fig. 10. *Suberites undulatus*. Entire transverse section through a lobe. The dark patches in the choanosome represent the longitudinal skeletal fibers cut across. $\times 10$.
- Fig. 11. *Suberites undulatus*. From a transverse section through a lobe. Surface of sponge, above and to the left. $\times 15$.
- Fig. 12. *Reniera tubifera*. Dermal surface of an oscular tube. $\times 21$.

PLATE LVIII.

- Fig. 13. *Stylotella heliophila*. Whole sponge. $\times 1$.
- Fig. 14. *Tetilla laminaris*. Side view of a small specimen. $\times \frac{3}{4}$.
- Fig. 15. *Reniera tubifera*. Whole sponge. $\times \frac{3}{4}$.

PLATE LIX.

- Fig. 16. *Reniera tubifera*. Longitudinal section through a branch, including both surfaces. $\times 21$.
- Fig. 17. *Tetilla laminaris*. From a section vertical to one of the flat surfaces of the sponge. The long fiber in the interior ascends toward the upper edge of the sponge. $\times 15$.
- Fig. 18. *Stylotella heliophila*. Dermal membrane, in surface view. $\times 15$.
- Fig. 19. *Stylotella heliophila*. Section vertical to surface. $\times 21$.

PLATE LX.

- Fig. 20. *Esperiopsis obliqua*. Biseriate habitus. $\times \frac{1}{2}$.
- Fig. 21. *Esperiopsis obliqua*. Chaliniiform habitus. Part of a macerated specimen, including the base. $\times \frac{1}{2}$.
- Fig. 22. *Esperiopsis obliqua*. From a longitudinal section through a branch of the macerated specimen shown in Fig. 21. $\times 21$.
- Fig. 23. *Esperiopsis obliqua*. From a transverse section through a branch of the macerated specimen shown in Fig. 21. $\times 21$.

PLATE LXI.

- Fig. 24. *Phoriospongia osburnensis*. Sponge incrusting on alcyonarian. $\times 1$.
 Fig. 25. *Phoriospongia osburnensis*. From a section through the incrustation, vertical to the surface. Alcyonarian colony cut twice. $\times 28$.
 Fig. 26. *Lissodendoryx carolinensis*. Whole sponge. $\times \frac{3}{4}$.
 Fig. 27. *Lissodendorynx carolinensis*. Papilla. $\times 15$.
 Fig. 28. *Lissodendoryx carolinensis*. Interior of sponge. From a section vertical to the surface. $\times 15$.

PLATE LXII.

- Fig. 29. *Phlæodictyon nodosum*. $\times 1$.
 Fig. 30. *Phlæodictyon nodosum*. Transverse section of a fistula. $\times 37$.
 Fig. 31. *Microciona prolifera*. From a longitudinal section through a branch of the sponge shown in fig. 35. $\times 50$.
 Fig. 32. *Phlæodictyon nodosum*. Ectosomal skeleton of fistular wall as seen in a surface preparation. Beneath the fine dermal reticulum appear the fibers. $\times 21$.
 Fig. 33. *Microciona prolifera*. From a transverse section through a branch of the sponge shown in Fig. 35. $\times 21$.
 Fig. 34. *Axinella acanthifera*. Whole sponge. $\times 1$.

PLATE LXIII.

- Fig. 35. *Microciona prolifera*. Older, branched, form. $\times 1$.
 Fig. 36. *Microciona prolifera*. Incrusting specimen, with lobes; on oyster shells. $\times 1$.
 Fig. 37. *Acanthella corrugata*. Whole sponge, viewed obliquely from above. $\times 1$.
 Fig. 38. *Axinella acanthifera*. Transverse section of lobe showing axial skeleton and radiating fibers. $\times 15$.
 Fig. 39. *Axinella acanthifera*. Longitudinal section through subcylindrical lobe, including both surfaces. $\times 21$.

PLATE LXIV.

- Fig. 40. *Pleraplysilla latens*. Thick section through the sponge, vertical to the surface. Only the more superficial part of the sponge appears distinctly. Three fibers are seen to terminate in conuli. The transparent area between two of the fibers is a large canal extending radially inward from just below the surface. The large flagellated chambers are shown. $\times 50$.
 Fig. 41. *Hircinia ectofibrosa*. Whole sponge. $\times \frac{3}{4}$.
 Fig. 42. *Aplysilla longispina*. Part of the surface. $\times 1\frac{1}{4}$.
 Fig. 43. *Hircinia ectofibrosa*. Skeleton as seen in a macerated slice, vertical to the surface; principal fibers and connectives showing. The maceration was carried too far, and the superficial skeleton was injured. $\times 9$.
 Fig. 44. *Hircinia ectofibrosa*. From a section radial to the surface, showing a principal fiber with attached connectives. $\times 38$.

PLATE LXV.

- Fig. 45. *Aplysilla longispina*. Section vertical to the surface and through a conulus. A fiber is seen terminating in a conulus. The flagellated chambers are shown in the interior. $\times 21$.
 Fig. 46. *Acanthella corrugata*. Section vertical to the surface and radial to the margin; including margin and both surfaces of the sponge. $\times 21$.
 Fig. 47. *Acanthella corrugata*. From a section vertical to the surface and radial to the margin; below extreme marginal region. Mesial part of lamella and one surface are shown. $\times 21$.
 Fig. 48. *Aplysilla longispina*. Surface view of dermal membrane. Preparation photographed in water. $\times 21$.

PLATE LXVI.

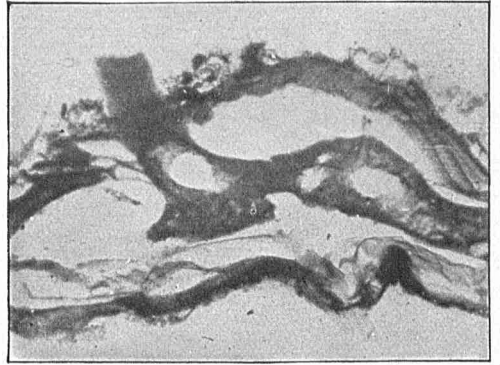
[All figures reduced in reproduction to one-third original size.]

- Fig. 49. *Spirastrella andrewsii*. *a, b, c*, megascleres, $\times 385$; *d*, spirasters, $\times 1,380$.
 Fig. 50. *Cliona celata*. Tylostyles. $\times 385$.
 Fig. 51. *Poterion atlantica*. *a, b, c*, tylostyles. $\times 385$.

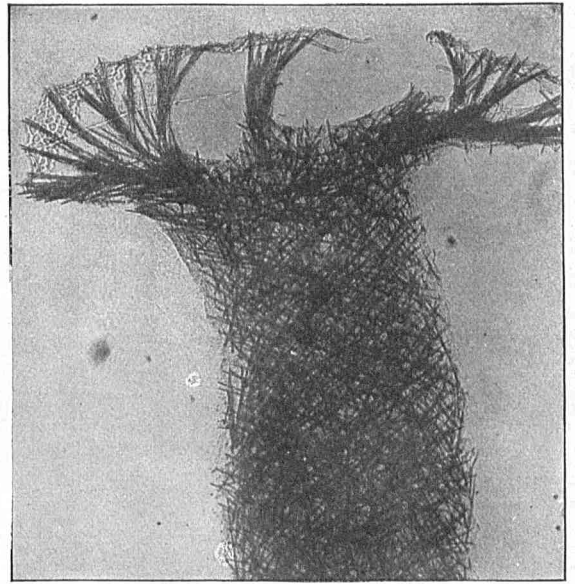
- Fig. 52. *Suberites undulatus*. Tylostyles. $\times 385$.
- Fig. 53. *Stylotella heliophila*. *a, b, c*, styles. $\times 385$.
- Fig. 54. *Tetilla laminaris*. Spicules *a* to *g*, $\times 310$; *h*, $\times 800$; *a*, stouter form of skeletal oxea; *b*, long slender form of skeletal oxea; *c*, inequidended oxea of ectosomal brushes; *e*, stout protriæne of lower part of body; *f*, protriæne from oscular margin; *g*, hair-like protriæne of general surface; *h*, sigmata.
- Fig. 55. *Reniera tubifera*. *a*, characteristic oxea and young stage; *b*, style; *c*, strongyle. $\times 640$.
- Fig. 56. *Acanthella corrugata*. *a*, style of the radial fibers, $\times 138$; *b*, oxeote modifications of the same, $\times 138$; *c, d, e*, megascleres with irregular ends, $\times 640$.
- Fig. 57. *Microciona prolifera*. *a, b*, skeletal styles, $\times 385$; *c*, spinose styles, $\times 385$; *d*, isochela, $\times 1,380$; *e*, toxæ, $\times 1,380$.
- Fig. 58. *Esperiopsis obliqua*. Spicules *a* to *d*, $\times 640$; *e* to *f*, $\times 1,380$; *a*, smooth style; *b*, spinose style; *c*, strongyle; *d*, slender tylostyle; *e*, toxæ; *f*, twisted isochelæ.
- Fig. 59. *Axinella acanthifera*. *a*, style, common form; *b*, style, stouter form; *c*, style, longer slendered form, projecting at surface; *d*, spinose style. $\times 360$.
- Fig. 60. *Phoriospongia osburnensis*. *a*, strongyles, $\times 385$; *b*, tridentate isochelæ in side, dorsal, and ventral views, $\times 1,380$; *c*, sigmata, $\times 1,380$.
- Fig. 61. *Hircina ectofibrosa*. Ends of filaments. $\times 1,380$.
- Fig. 62. *Lissodendoryx carolinensis*. *a*, style, $\times 640$; *b*, tylote, $\times 640$; *c, d*, isochelæ in face and side views, $\times 1,380$; *e*, sigmata, $\times 1,380$.
- Fig. 63. *Phloeodictyon nodosum*. Oxeas. $\times 640$.
- Fig. 64. *Aplysilla longispina*. *a*, simple skeletal fiber, $\times 138$; *b*, upper end of dendritic fiber, $\times 138$; *c*, dendritic skeletal fiber, including base of fiber and apex of one branch, $\times 138$; *d*, part of fiber, showing pith, $\times 640$.



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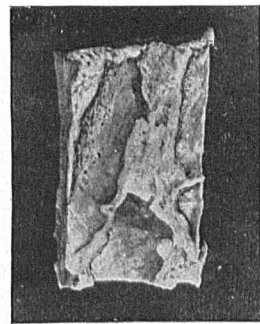
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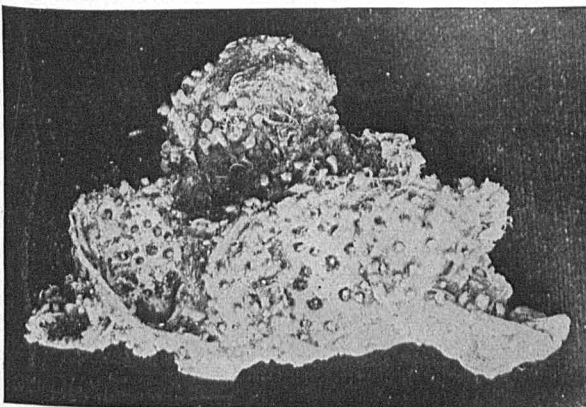
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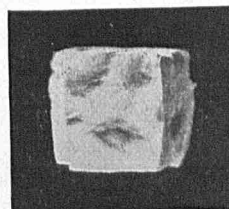
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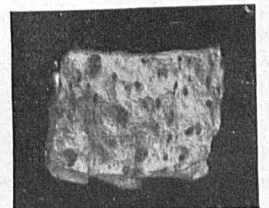
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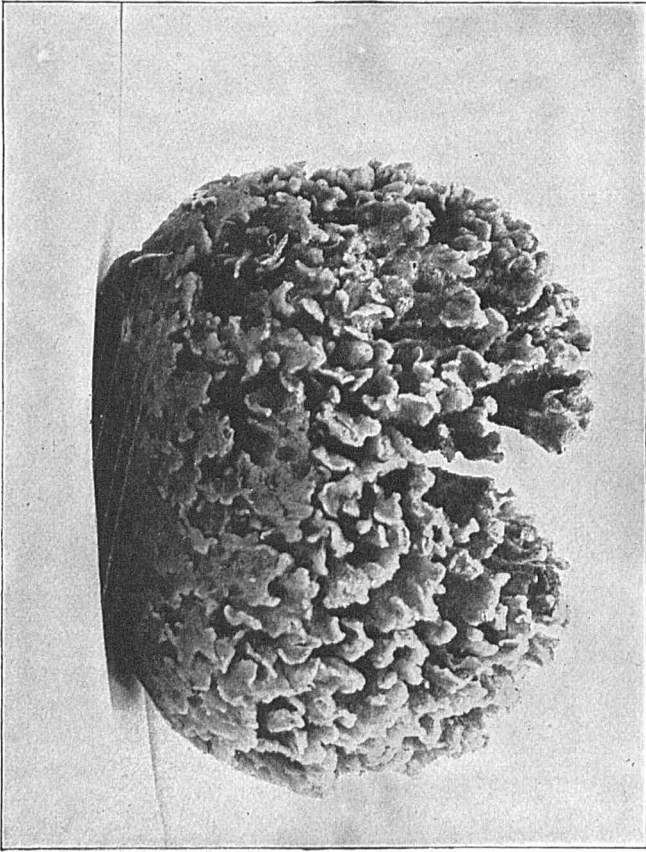
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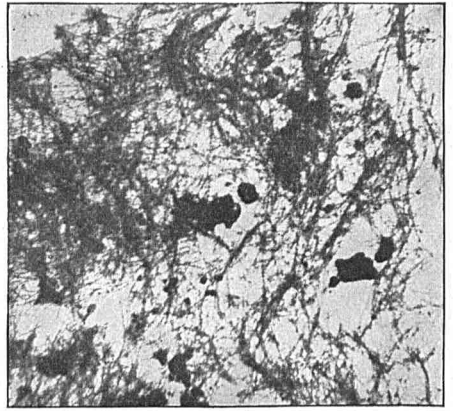
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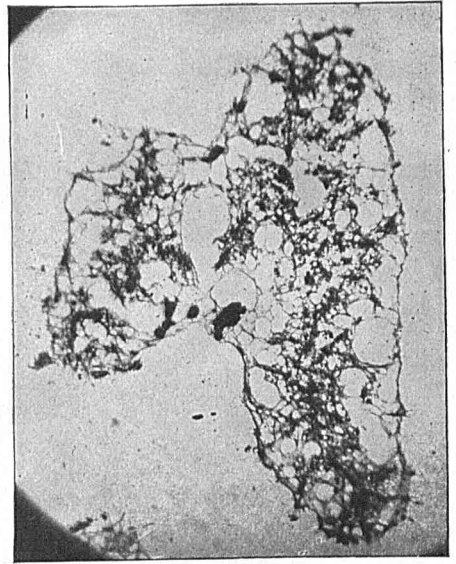
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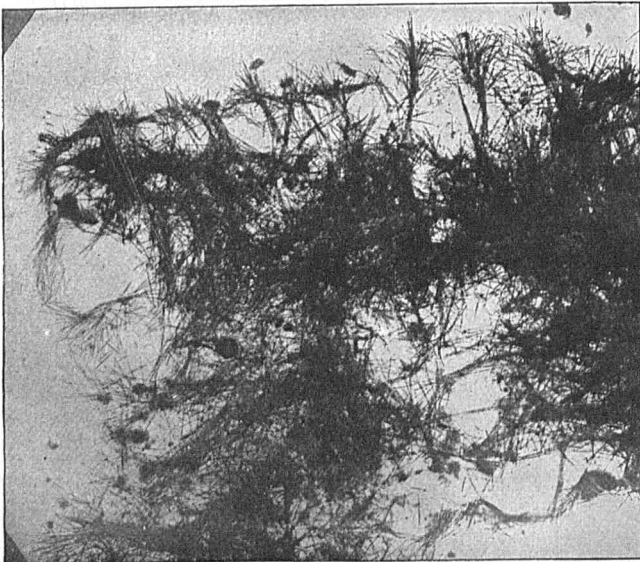
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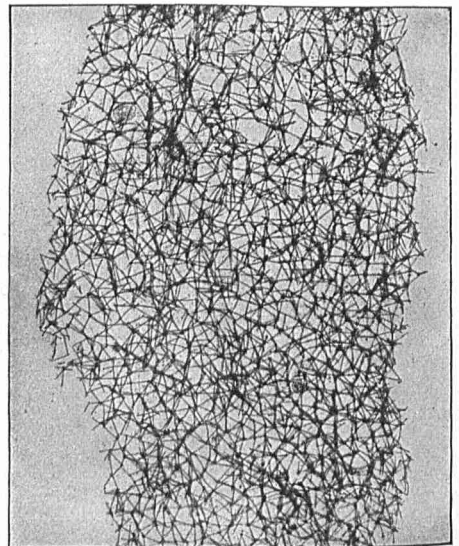
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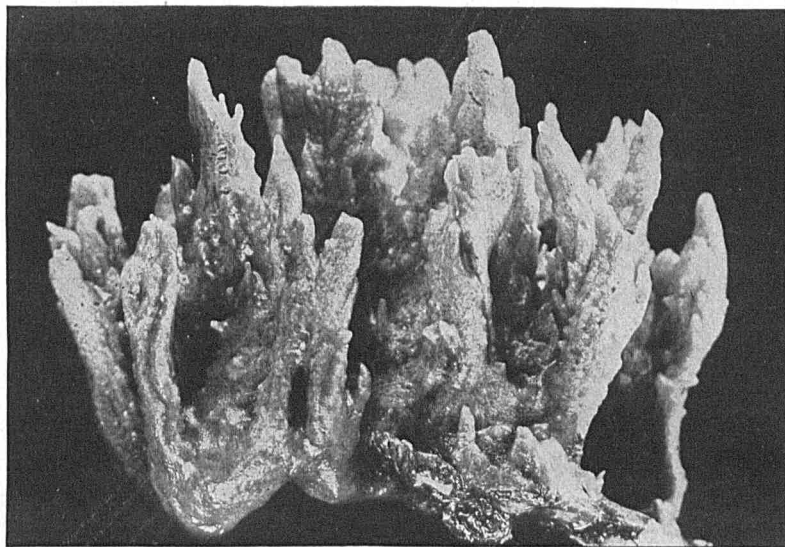
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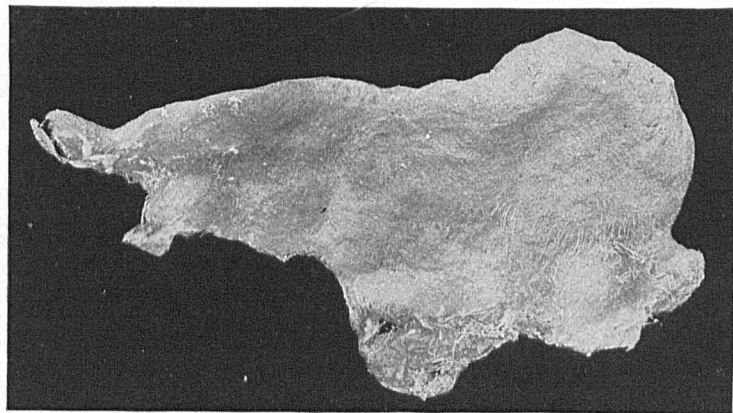
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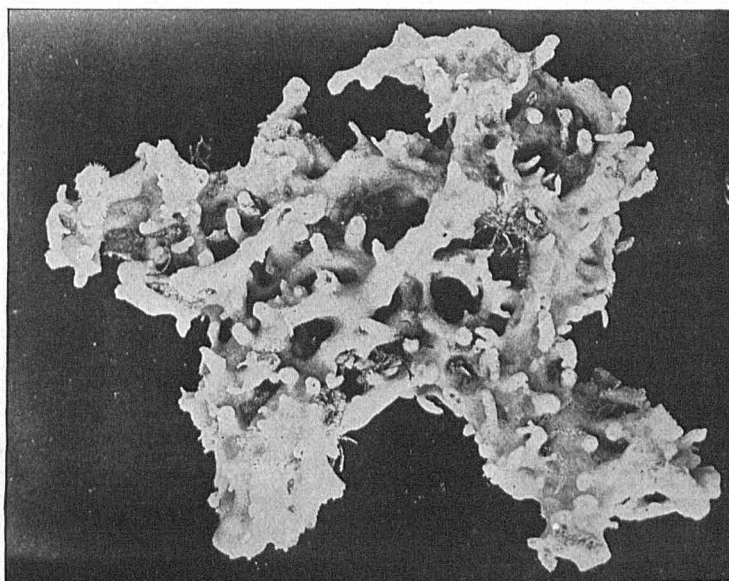
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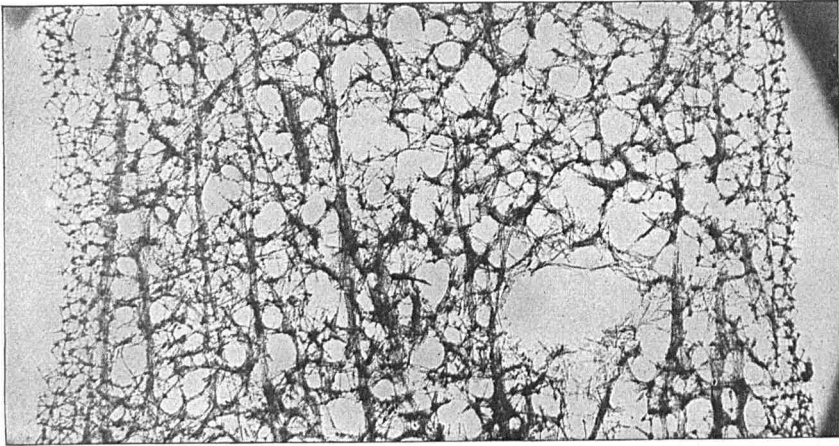
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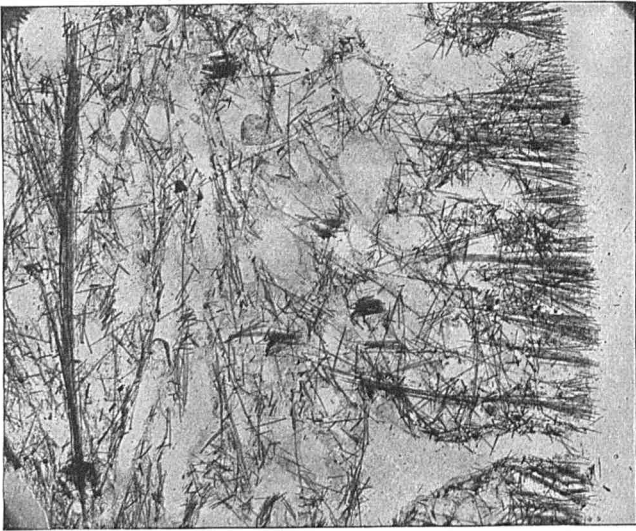
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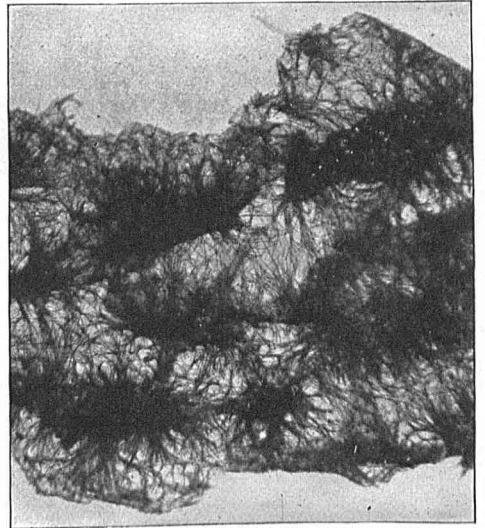
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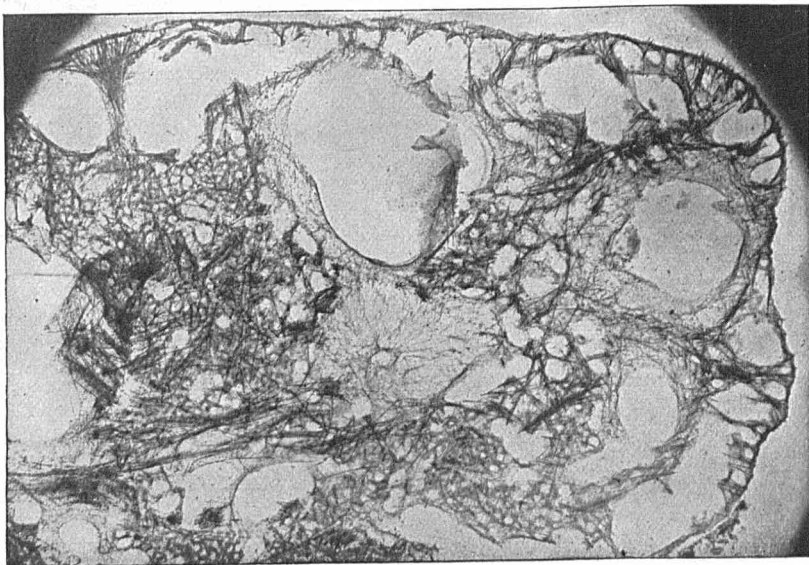
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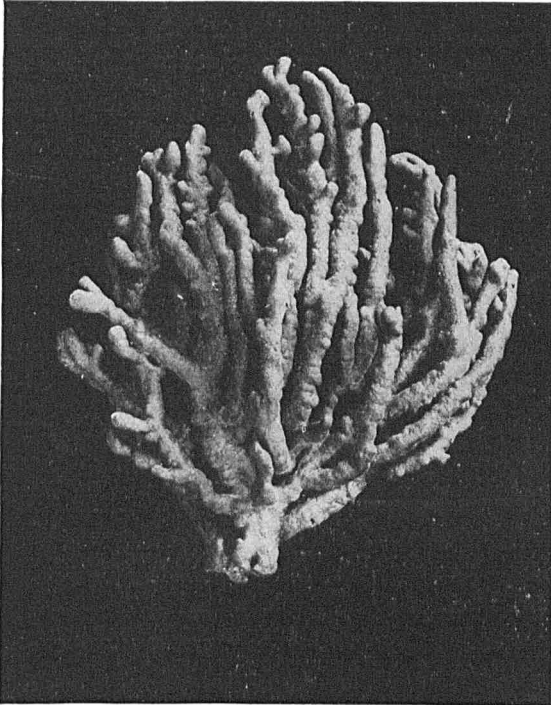
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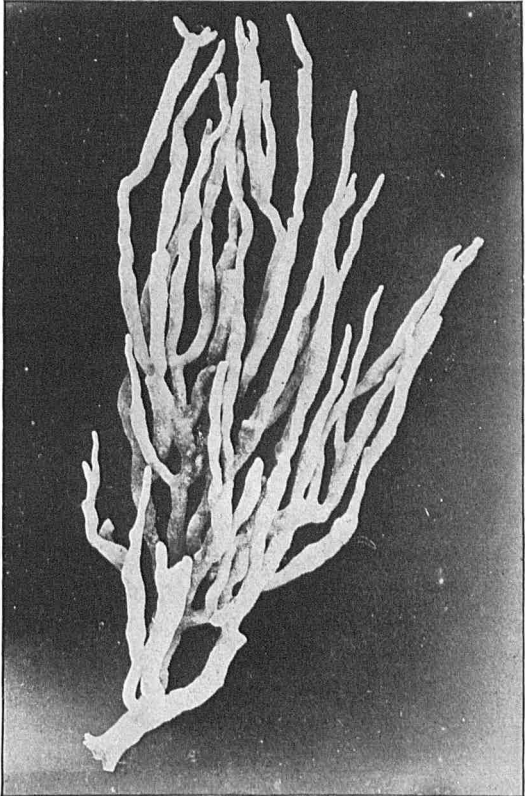
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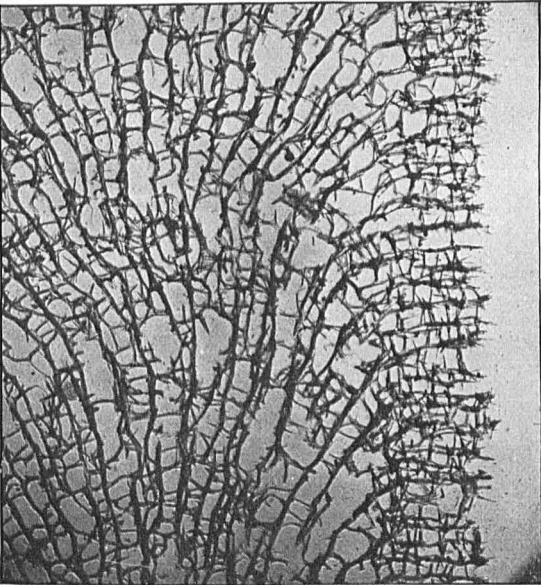
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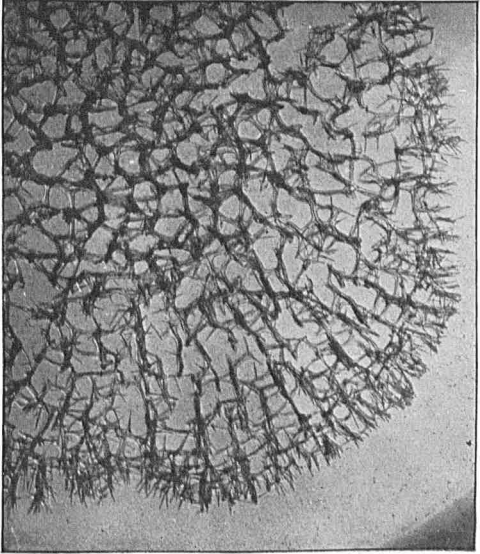
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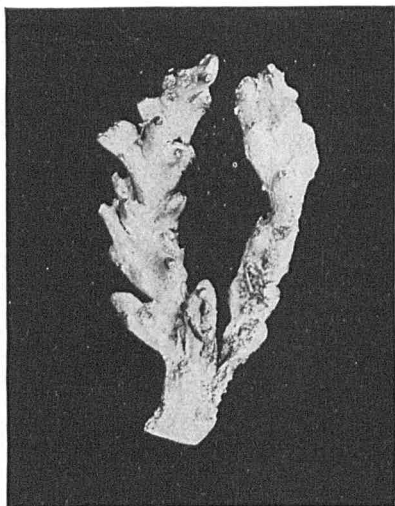
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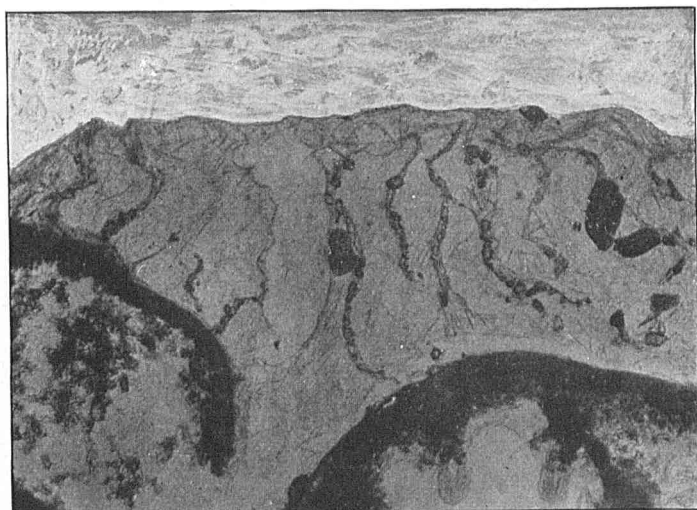
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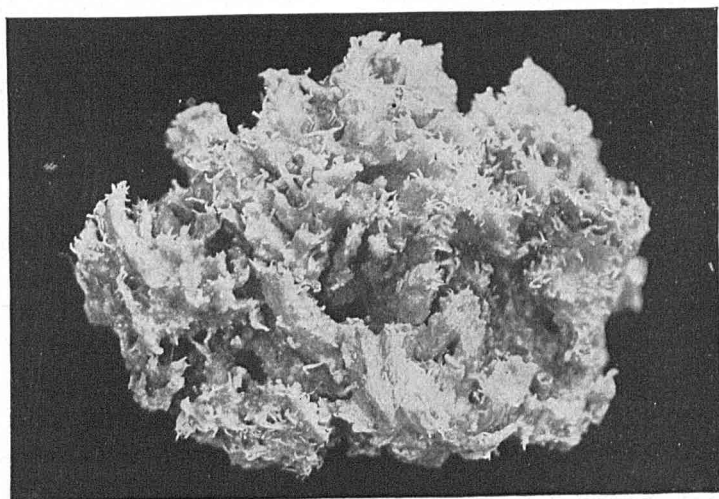
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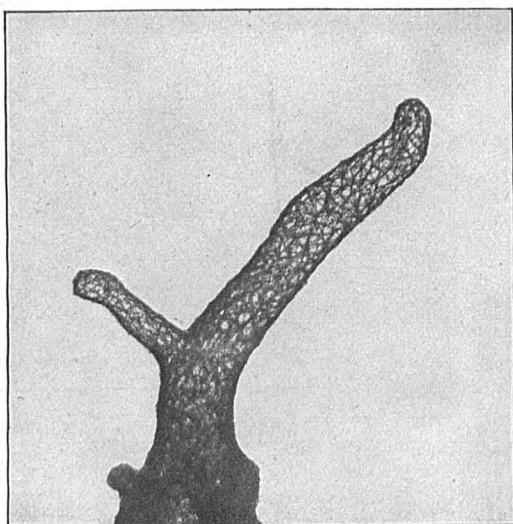
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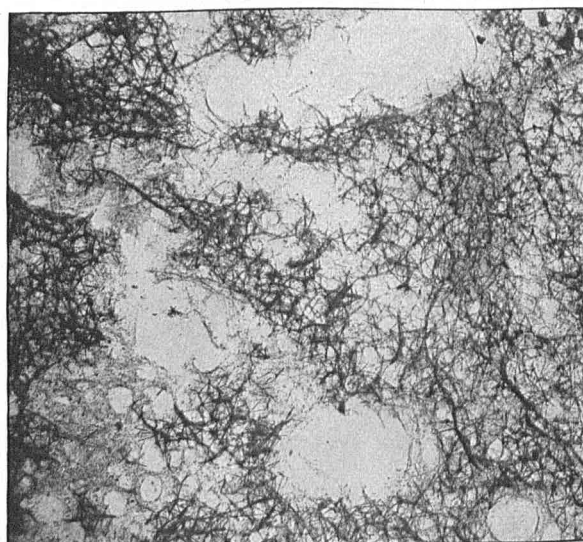
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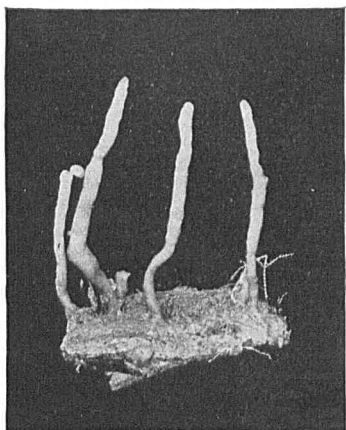
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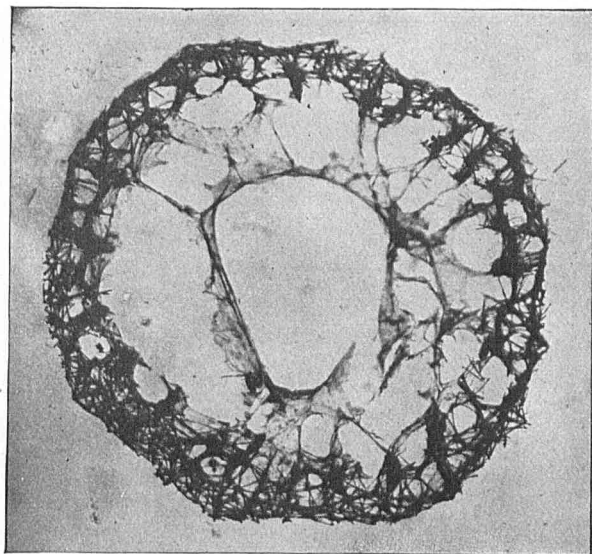
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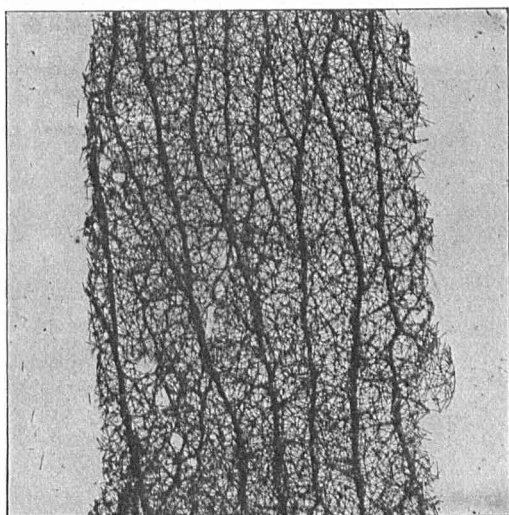
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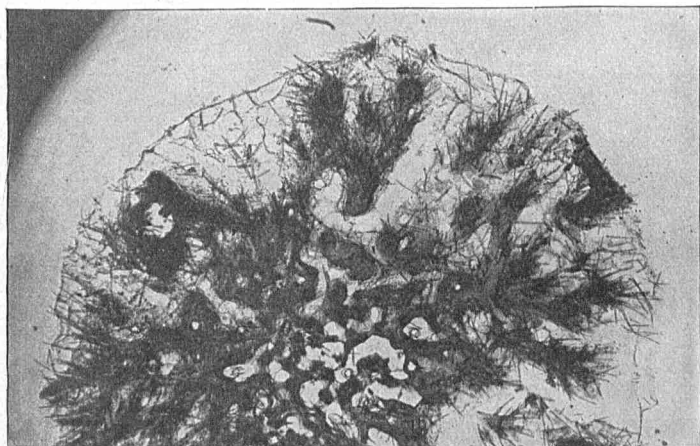
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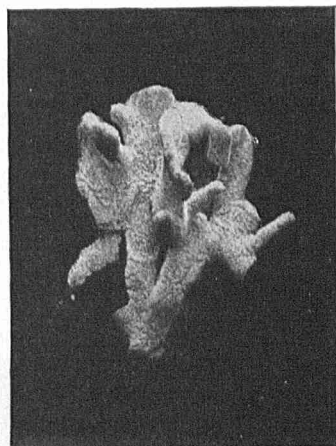
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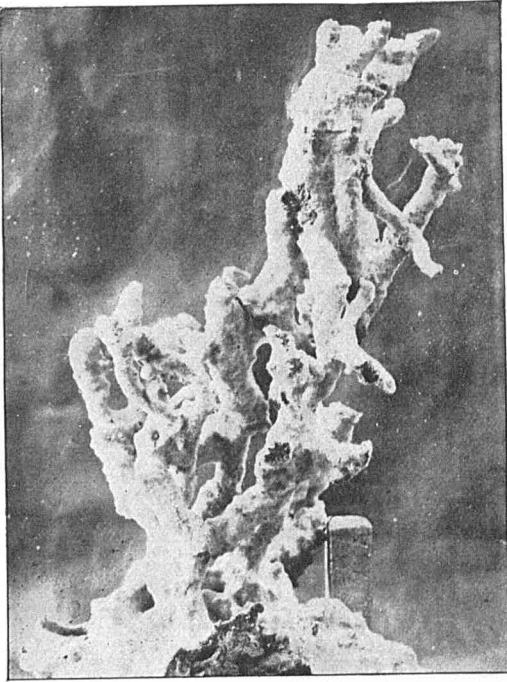
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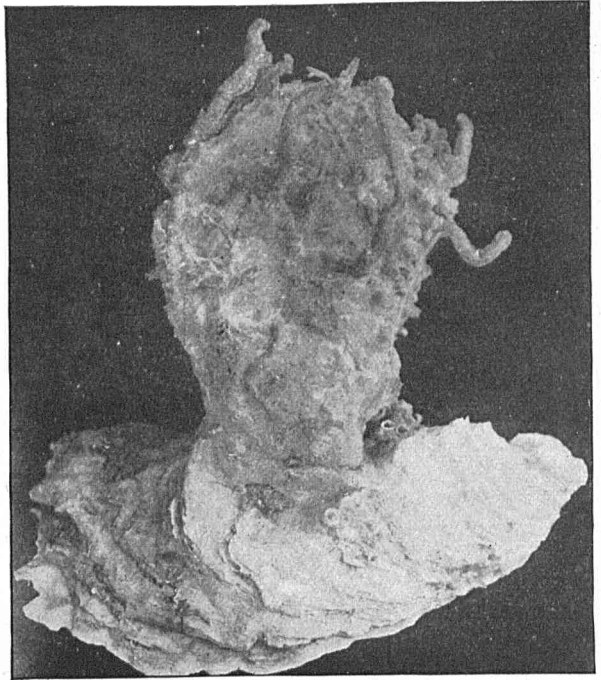
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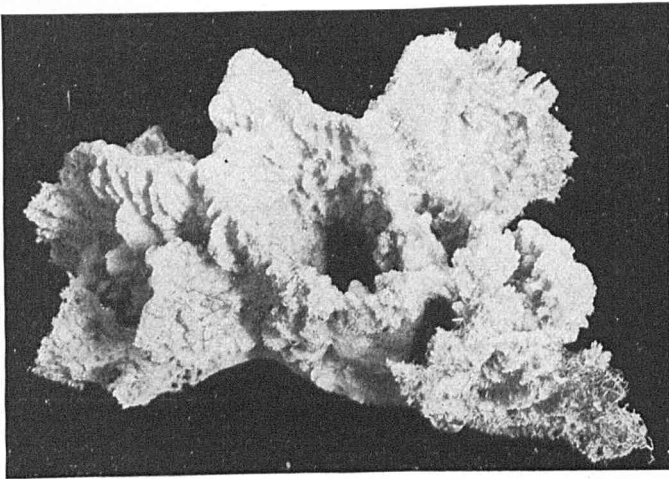
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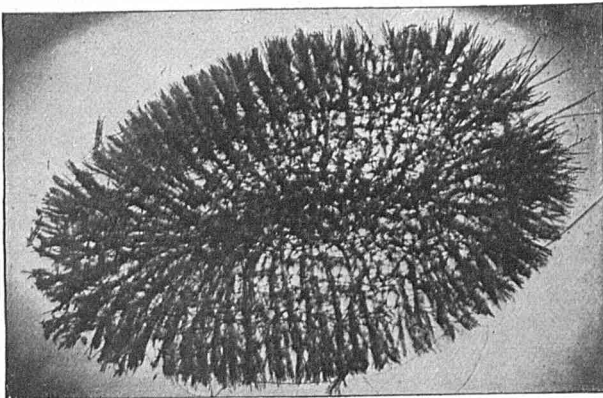
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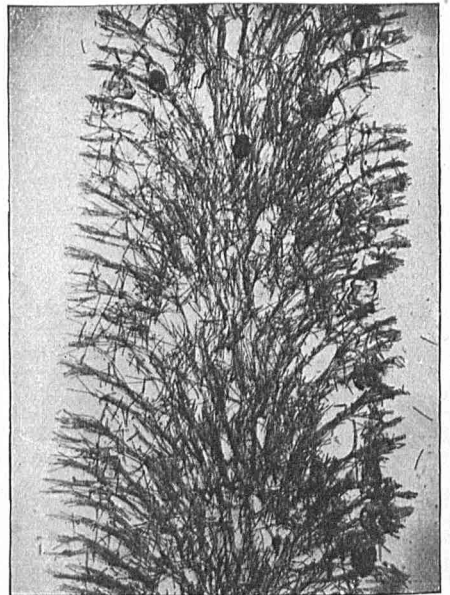
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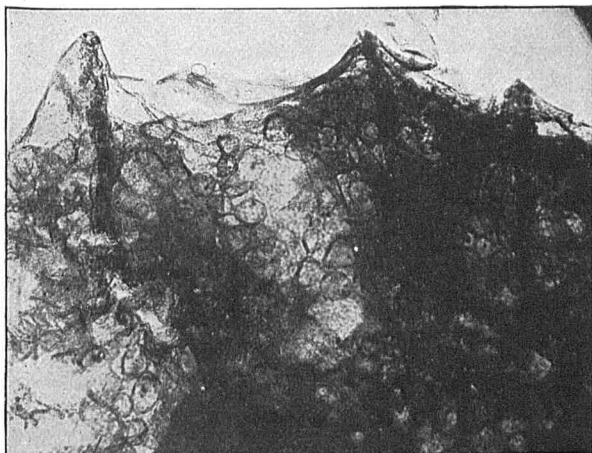
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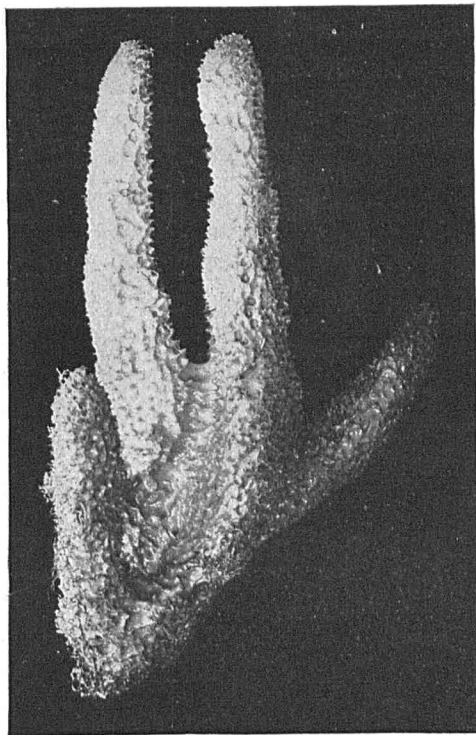
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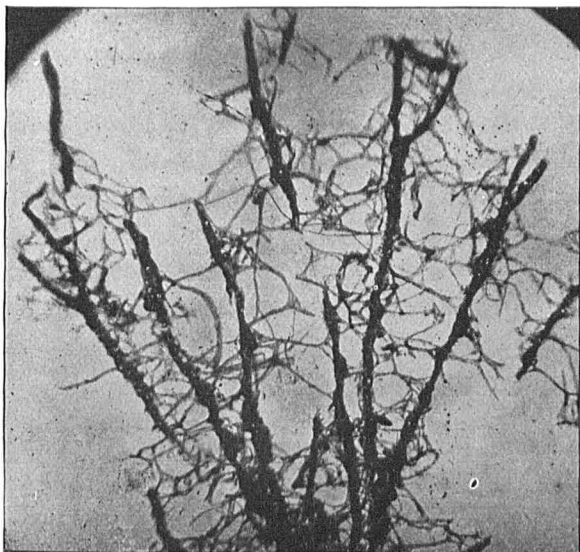
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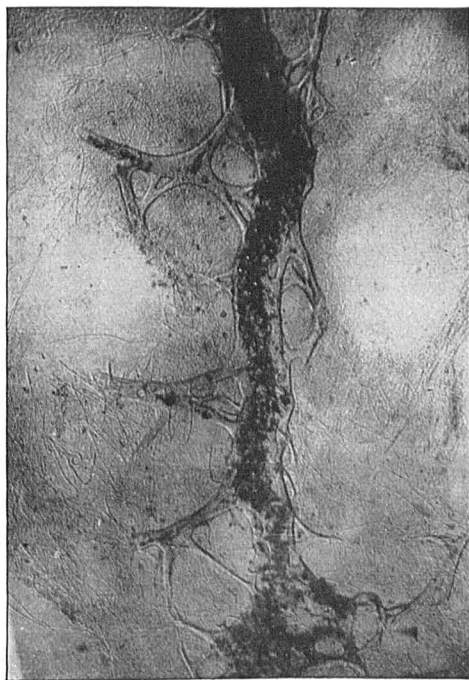
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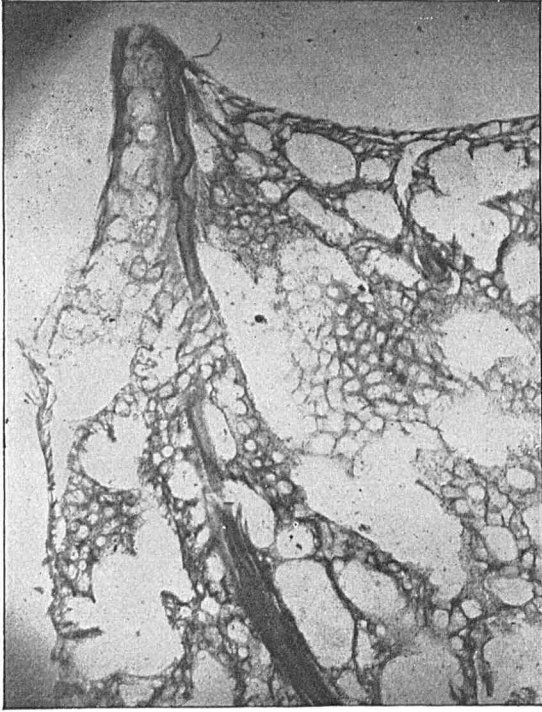
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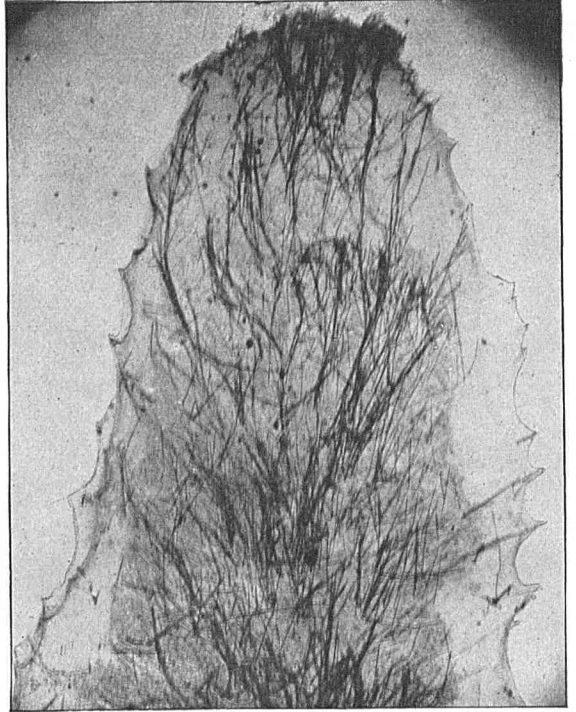
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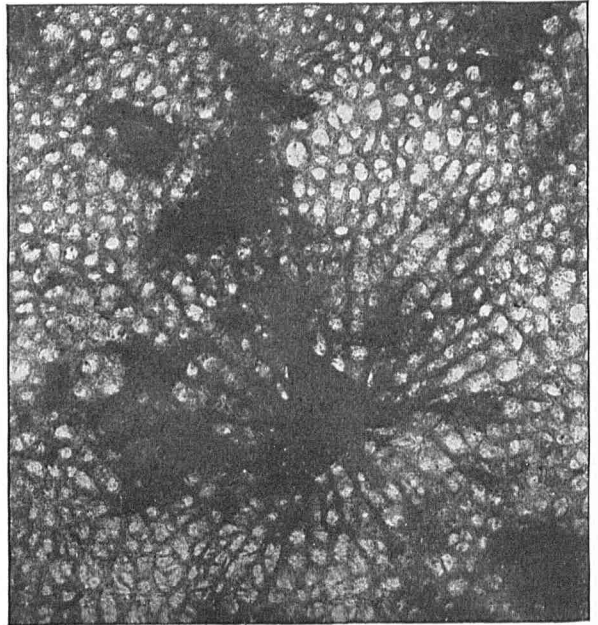
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