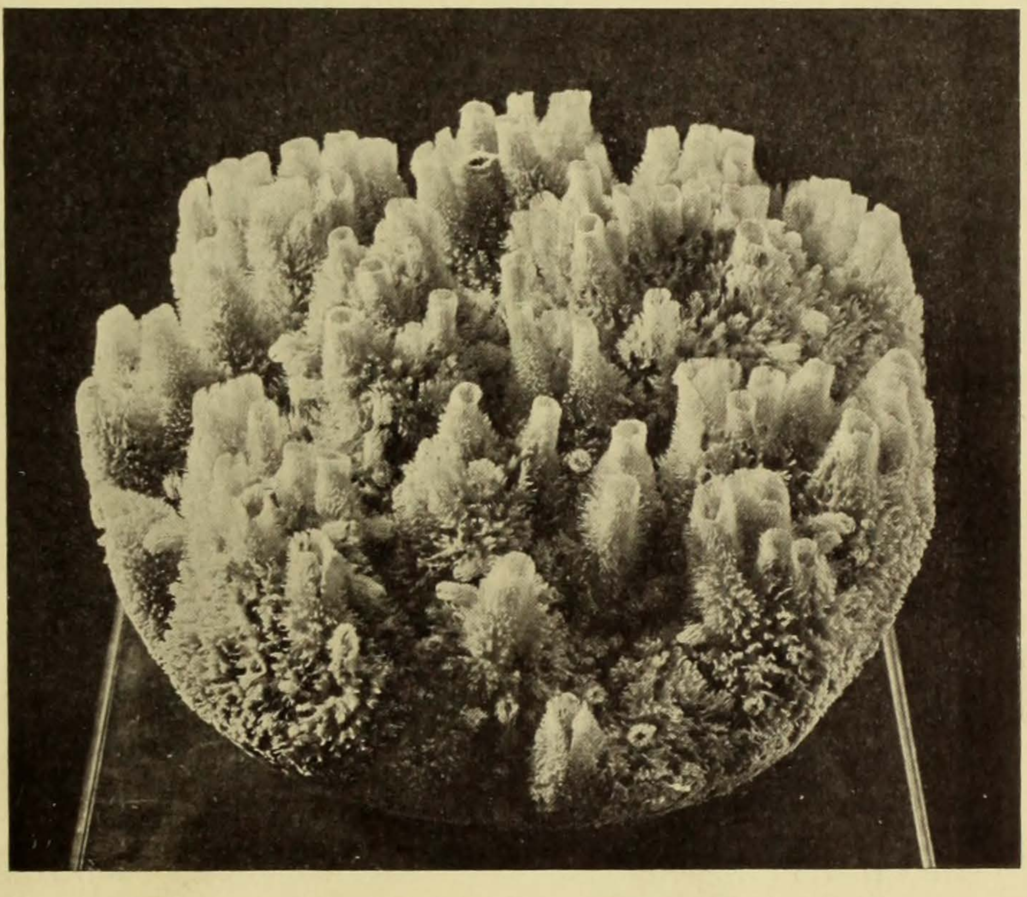
AMERICAN MUSEUM OF NATURAL HISTORY

A Guide to the Sponge Alcove



By Roy Waldo Miner

Assistant Curator of Invertebrate Zoölogy

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Guide Leaflet No. 23

American Museum of Natural History

Seventy-seventh Street and Central Park West, New York City

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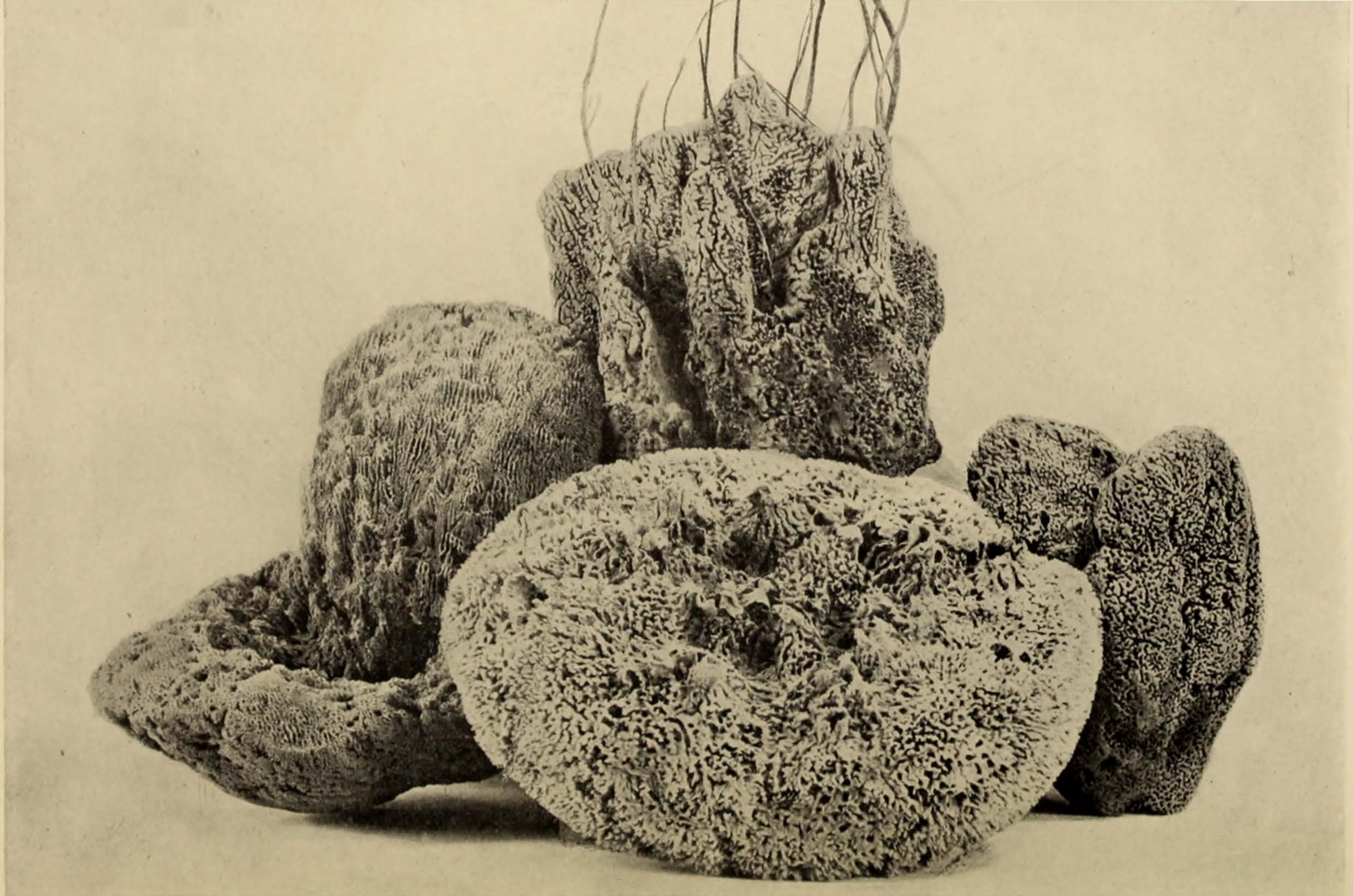

A GROUP OF LARGE BAHAMA SPONGES

The sponge in front measures 2 feet across. The upper specimen has grown around a tree-like colony of *Gorgonia*, a branching Hydroid. The peculiar chair-like shape of the specimen at the left is noteworthy.

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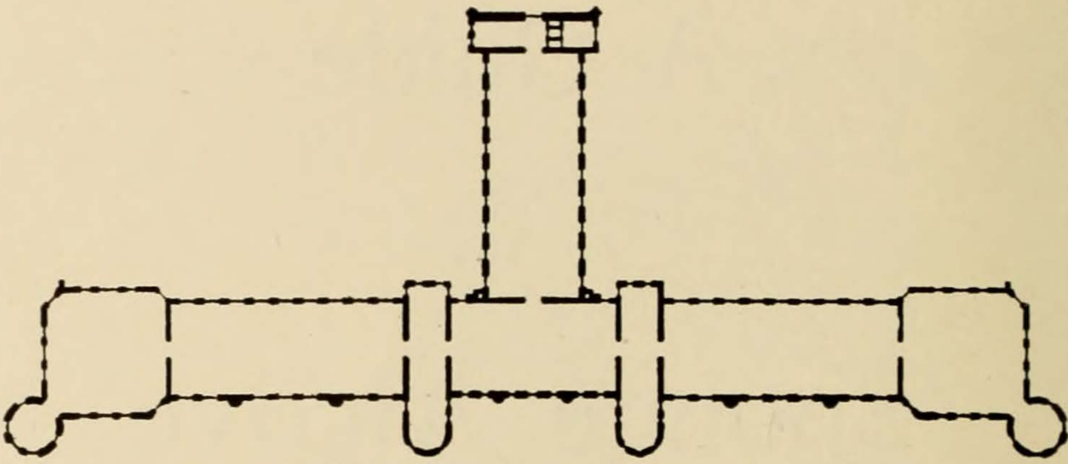

THIRD, OR GALLERY FLOOR.

Key-plan of the Museum building, showing the location of the hall in which the specimens may be found to which references are made in this Guide Leaflet

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A GUIDE TO THE SPONGE ALCOVE IN THE AMERICAN MUSEUM OF NATURAL HISTORY.[1]

By Roy Waldo Miner,

Assistant Curator Department of Invertebrate Zoölogy.

SPONGES are among the most abundant and most widely distributed of sea-animals. With the exception of one family, the fresh-water sponges, they are found in all seas of the globe ranging from shallow waters to beyond a depth of 1,300 feet. The bath-sponges of commerce, with which the word "sponge" is associated in the minds of most people, although from a commercial point of view the most important of the group, form but a single family, *i. e.*, the Spongidæ. The rest of the subkingdom with its great multiplicity of forms is doubtless comparatively unknown to the average person. Even the commercial sponge as it reaches us gives but little idea of what a sponge really is, as it is only the supporting or skeletal part of the animal colony denuded of its fleshy coat of living tissue.

The living sponge is either a single animal or a colony of animals. It is always sessile, that is, attached to the sea bottom, and incapable of locomotion. For this reason it has often been regarded as a plant. But since, in more recent years, its life processes and larval history have become better known, especially since it has come under the eye of the compound microscope, its animal nature has become clearly established.

Sponges show all variations of form, size, and color. There are cake-like sponges, dome-shaped sponges, and fan-shaped sponges. Some are branched like trees; in others the branches reunite to form a complicated network. Some are shaped like huge cups or goblets; some gather in clusters of trumpet- and

[1] Issued also in separate form as Guide Leaflet No 23.

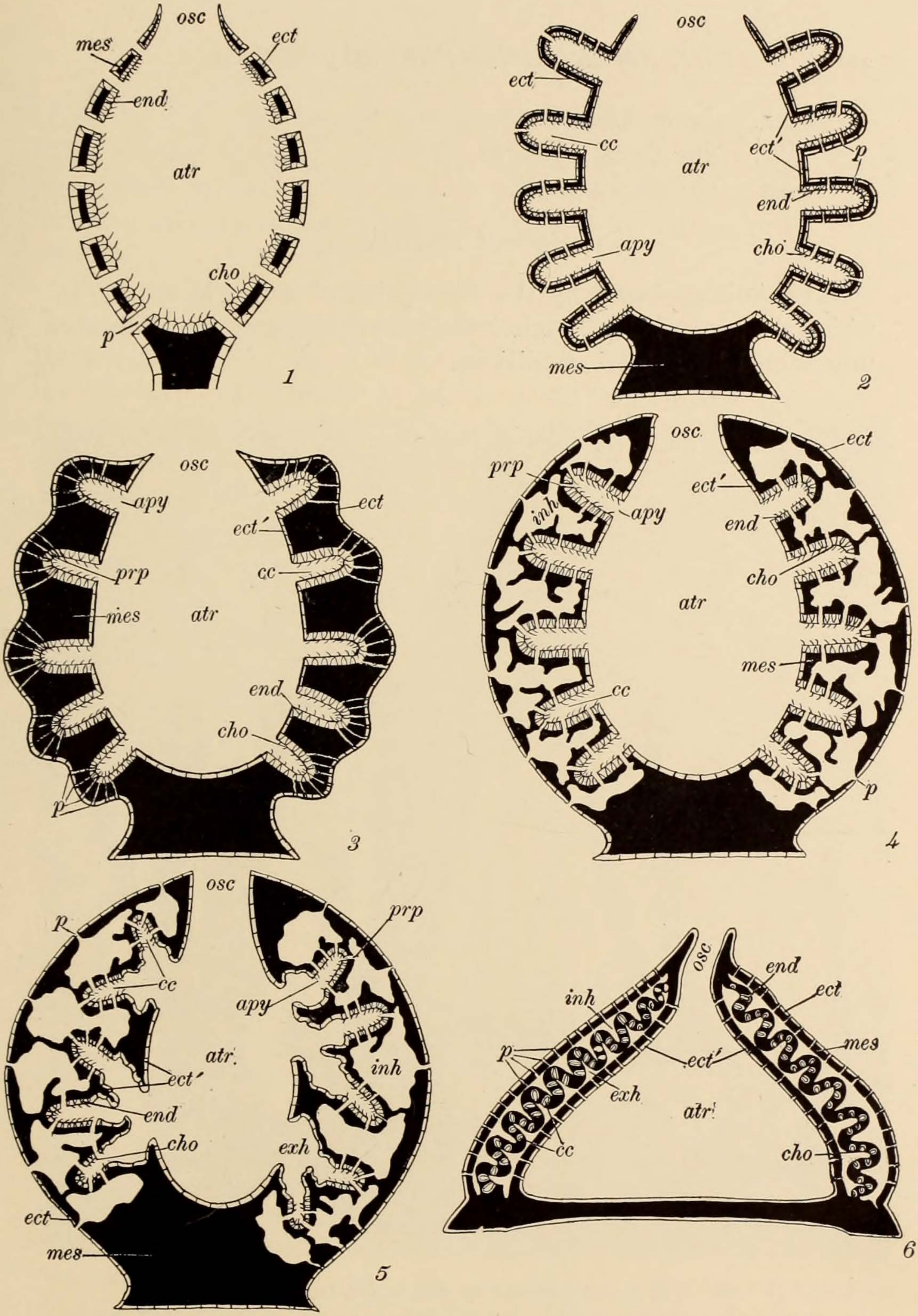
tube-like forms, and even the simplest and most primitive sponges are often shaped like graceful vases. All these forms are found in sizes varying from that of a pinhead to the height of a man.

Their color is as varied as their shape and size. They run through the whole chromatic scale from brilliant red, yellow, and green to the most delicate blue and the deepest violet, in every gradation of shade and tint. Some are pure white, others are shining black, while still others reflect from their opal spicules all the colors of the rainbow.

As the form and color of sponges, however, may vary as much among members of the same species as among those of different species these factors cannot be depended on for classification. The same sponge which in deep water shows the branching habit, in shallower water appears as a flat encrusting colony; or a sponge which has a symmetrical vase-like form, many feet below the surface of the sea, where it is little disturbed by outer influences, may be of the same species as an irregular one-sided mass growing in shallow water or in the crevice of a rock. Again a sponge usually dome-shaped may send out a finger-like process from its upper surface which becomes branched and unites with the branches of other finger-like processes. In other words external form in sponges is not a constant or essential factor. It is purely a matter of environment, in which gravity plays an important part. This tendency to vary has made the arrangement of sponges in an orderly and natural system, a difficult task, much complicated by the fact that for many years classification has been wrongly based upon these very factors. Since, however, the microscope has been developed to its present perfection, it has been found that the arrangement of the skeleton and the form of the spicules or skeletal units, together with the structure of the canal system, furnish more constant data for classification. This can be brought out more clearly in discussing the anatomy of the sponge.

ANATOMY.

In considering the anatomy of sponges it is sufficient for our purpose to concern ourselves with:



FIGS 1.—6—DIAGRAMS ILLUSTRATING CANAL SYSTEMS IN DIFFERENT TYPES OF SPONGES (after Schulze).

1. Ascon type ; 2–5. Variations of Sycon type ; 6. Rhagon type ; *ect.*, ectoderm of exterior; *ect′*, ectoderm of atrial cavity ; *mes.*, mesoderm ; *end.*, endoderm ; *osc.*, osculum; *atr.*, atrial cavity or cloaca ; *cho.*, choanocyte layer ; *cc.*, flagellate chambers ; *p.*, pores ; *prp.*, prosopyles ; *apy.*, apopyles ; *inh.*, inhalent cavities; *exh.*, exhalent cavities.

1. General Structure,
2. The Canal Systems,
3 The Skeleton.

1. *General Structure.*

This is best shown by the description of a simple sponge in which the general characteristics of the subkingdom predominate, unmodified by special conditions.

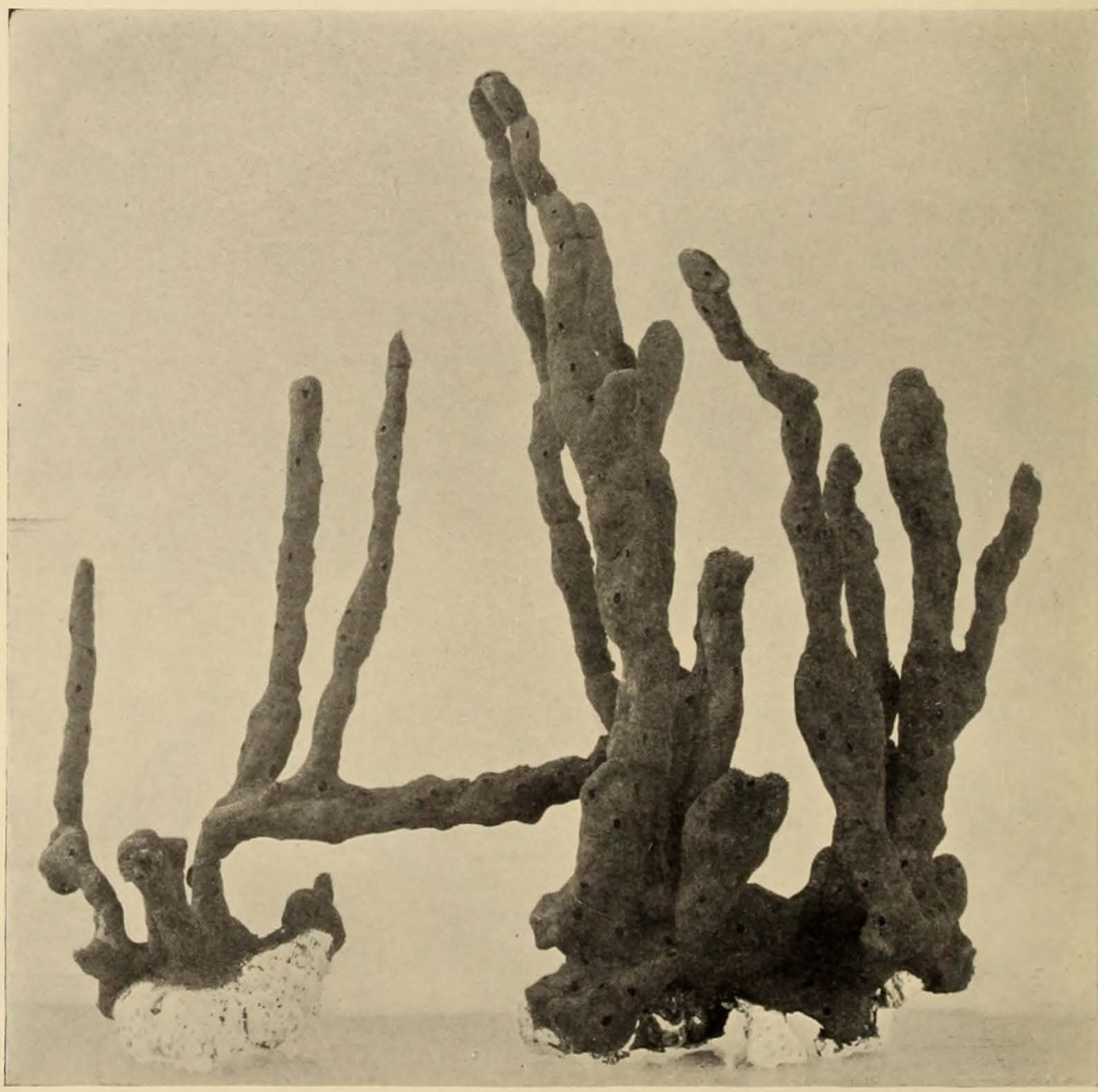


FIG. 7.—AN EXAMPLE OF THE BRANCHING HABIT

The simplest, most primitive, and at the same time most typical sponge is *Ascetta primordialis*, first described by Häckel

(See Fig. 1.). This sponge is typically vase-like in external form. The circular opening at the top of the vase is known as the *osculum* (*osc.*) in spite of the fact that it is excretory and has neither structurally nor functionally the characteristics of a mouth.

The walls of the vase are perforated with numerous regularly arranged openings or pores (*p.*) which open directly into the hollow interior of the sponge—called the *paragastric* or *atrial cavity* (*atr.*). The walls are made up of three layers: 1st, the ectoderm, or outer layer; 2d, the endoderm, or inner layer; 3d, the mesoderm, or middle layer.

The *ectoderm* (*ect.*) is a thin layer of cells, generally arranged in mosaic form and known as "pavement cells." In the case of this species, however, the walls of the cells have disappeared and left the protoplasmic cell-contents continuous over the entire surface of the animal. Such a layer is called a *syncytium.*

The *endoderm* (*end.*) lines the paragastric cavity and is made up of a layer of peculiar and characteristic cells called "collared cells," or *choanocytes* (*cho.*), found nowhere else among many-celled animals. They are so called from a collar-like rim around the outer edge of the cell out of which extends a long whip-like

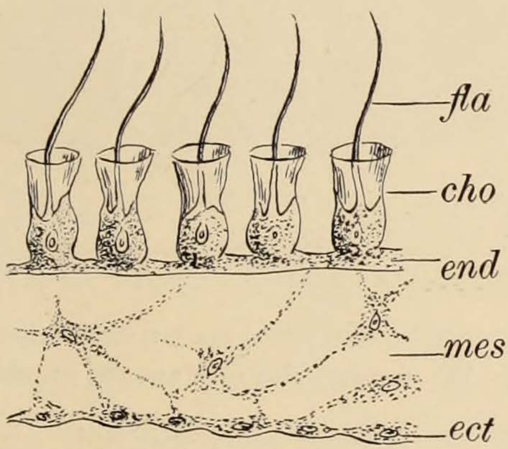


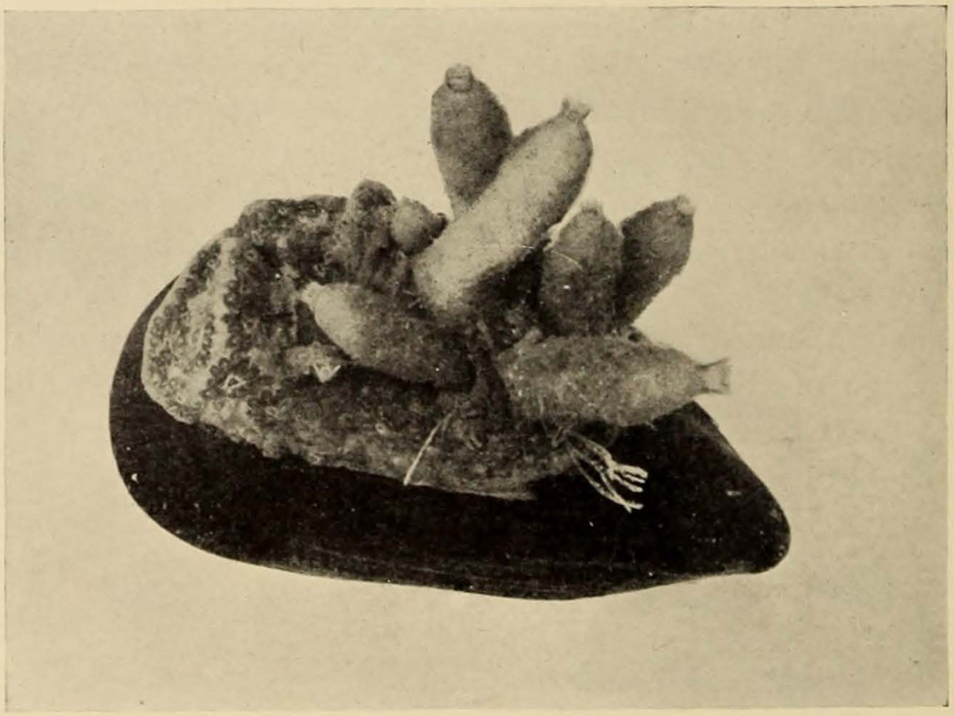
FIG. 8.—SECTION THROUGH SPONGE WALL
ect., ectoderm ; *mes.*, mesoderm ; *end.*, endoderm ; *cho.*, choanocytes or "collared cells"; *fla.*, flagellum.

filament or *flagellum* (*fla.*). The continuous vibration of these flagella produces a current by means of which the sea-water, with its multitude of tiny animal and plant forms, is sucked in through the pores. The organisms are then seized upon by the choanocytes and their digestible parts absorbed. What is left is discarded and flows with the current out through the osculum at the summit of the vase.

The *mesoderm* (*mes.*) is a thin jelly-like layer between the ectoderm and endoderm. It contains scattered amœboid cells and the reproductive elements, and is the origin of the skeleton.

2. *The Canal Systems.*

In the form of sponge just described the mesoderm is extremely thin, but if, as in the majority of sponges, there is a greater or less thickening of this layer, the pores will no longer be perforations, but will become transformed into tubes or canals



[FIG. 9.—A SYCON SPONGE (*Grantia ciliata* Fleming) GROWING ON A MUSSEL SHELL
Star-shaped colonies of the Ascidian *Botryllus* are also growing on the same shell.

(See p. 221, Fig. 3), which may branch and be modified in various ways. This gives rise to three general types of sponges which are therefore based mainly on the arrangement and variations of the pore- and canal-systems. These are known as

(a) The Ascon Type,
(b) The Sycon Type,
c) The Rhagon Type.

(a) *The Ascon Type* (p. 221, Fig 1.). This type is characterized by sponges having walls with a thin layer of mesodermal tissue (*mes.*), and therefore, with pores (*p.*) opening directly from the outside into the paragastric cavity (*atr.*). The endoderm (*end.*) is always continuously lined with choanocytes or "collared cells" (*cho.*). *Ascetta primordialis*, therefore, is the representative of this group. Another example is *Leucosolenia*, of which a specimen may be seen in this alcove. A complication of this type is shown by *Homoderma*, which differs from *Ascetta* in having its surface broken up by a multitude of radially arranged thimble-like prolongations or diverticula, each with a central cavity of its own, opening into the main paragastric cavity of the sponge and lined with a continuation of the endoderm with its collared cells. In this case the pores are found only in the walls of the diverticula.

(b) *The Sycon Type* (p. 221, Figs. 2–5; p. 224, Fig. 9). In this type, as in the example just described (*Homoderma*), the walls of the paragastric cavity are prolonged into radially arranged branches called *radial tubes* (*cc.*) but the choanocytes, instead of lining both the paragastric cavity and the radial tubes, are found only in the latter, while the former is invested with a layer of epidermal "pavement cells" (*ect.*) like the outside of the sponge. The mouth of the radial tube by which it opens into the central cavity is called the *apopyle* (*apy.*). In the simpler sponges of the Sycon type, such as *Sycon ciliatum*, the pores open directly into the radial tubes (Fig. 2) and the outer surface of the sponge is covered with papillæ corresponding to the cavities within. In these forms, the mesoderm (*mes.*) continues to be thin. In other forms, however, the mesoderm becomes greatly thickened and completely fills the spaces between the radial tubes (Fig. 3) so that the outer surface appears comparatively smooth and free from papillæ. Under these circumstances the pores cannot open directly from the outside into the radial tubes, so they lengthen into *inhalent canals* traversing the mesoderm. In still other forms (Fig. 4) the canals have enlarged to wide cavities or *inhalent lacunæ* (*inh.*) opening to the outside by the pores and into the radial tubes by openings called *prosopyles* (*prp.*). Another complication occurs in the Leucons where the walls of the paragastric cavity become folded in such a manner that the radial tubes lose their radial position and open into the folds or their branches (Fig. 5, *cc.*). The openings by which the folds communicate with the paragastric cavity may then become narrowed and thus large irregular spaces called *exhalent lacunæ* (*exh.*) are formed, with the result that the radial tubes become mere tubular chambers (*cc.*) communicating at the open end with the paragastric cavity (*atr.*) only by the intervention of the inhalent lacunæ (*inh.*), which in turn communicate with the outside by the pores. As both the inhalent and exhalent lacunæ are lined

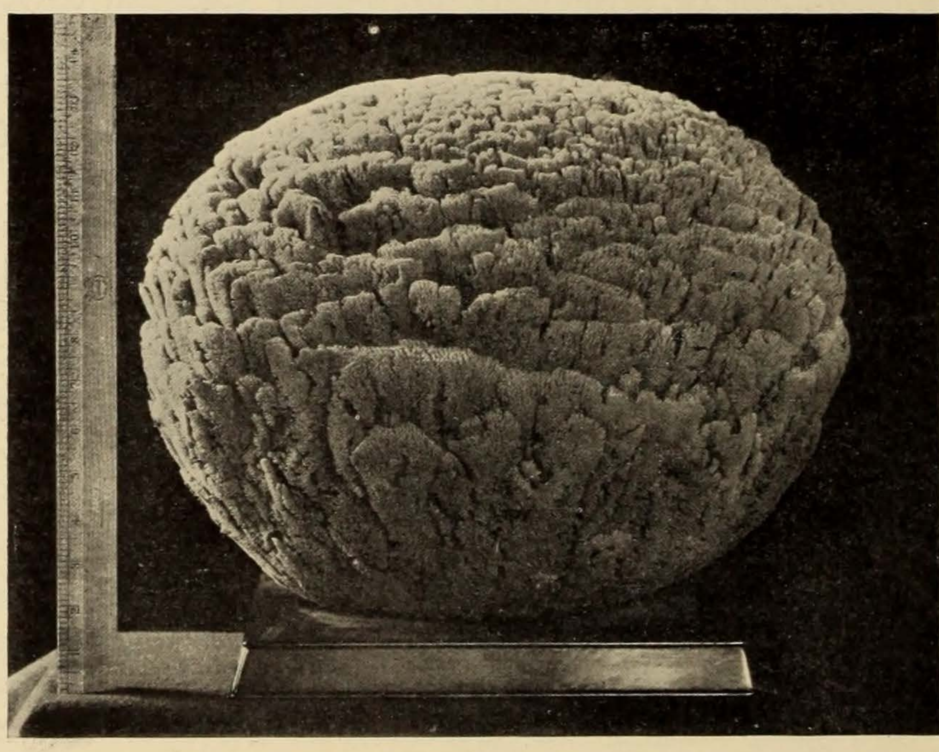


FIG. 10.—A LARGE BAHAMAN SPONGE (*Hippospongia cerebriformis* D. & M.)

with "pavement cells" (*ect.*) the choanocytes become restricted to the tubular *flagellate chambers*, as the radial tubes are now called.

(c) *The Rhagon Type* (p. 221, Fig, 6). The two preceding types of canal arrangement are peculiar to the sponges having a calcareous or carbonate of lime skeleton. The great majority of sponges, including those having "glass" skeletons, horny skeletons or no skeletons at all, belong to the Rhagon type. In this case the flagellate chambers (*cc.*) are very small and numerous and, instead of being tubular, are spherical. The mesoderm varies

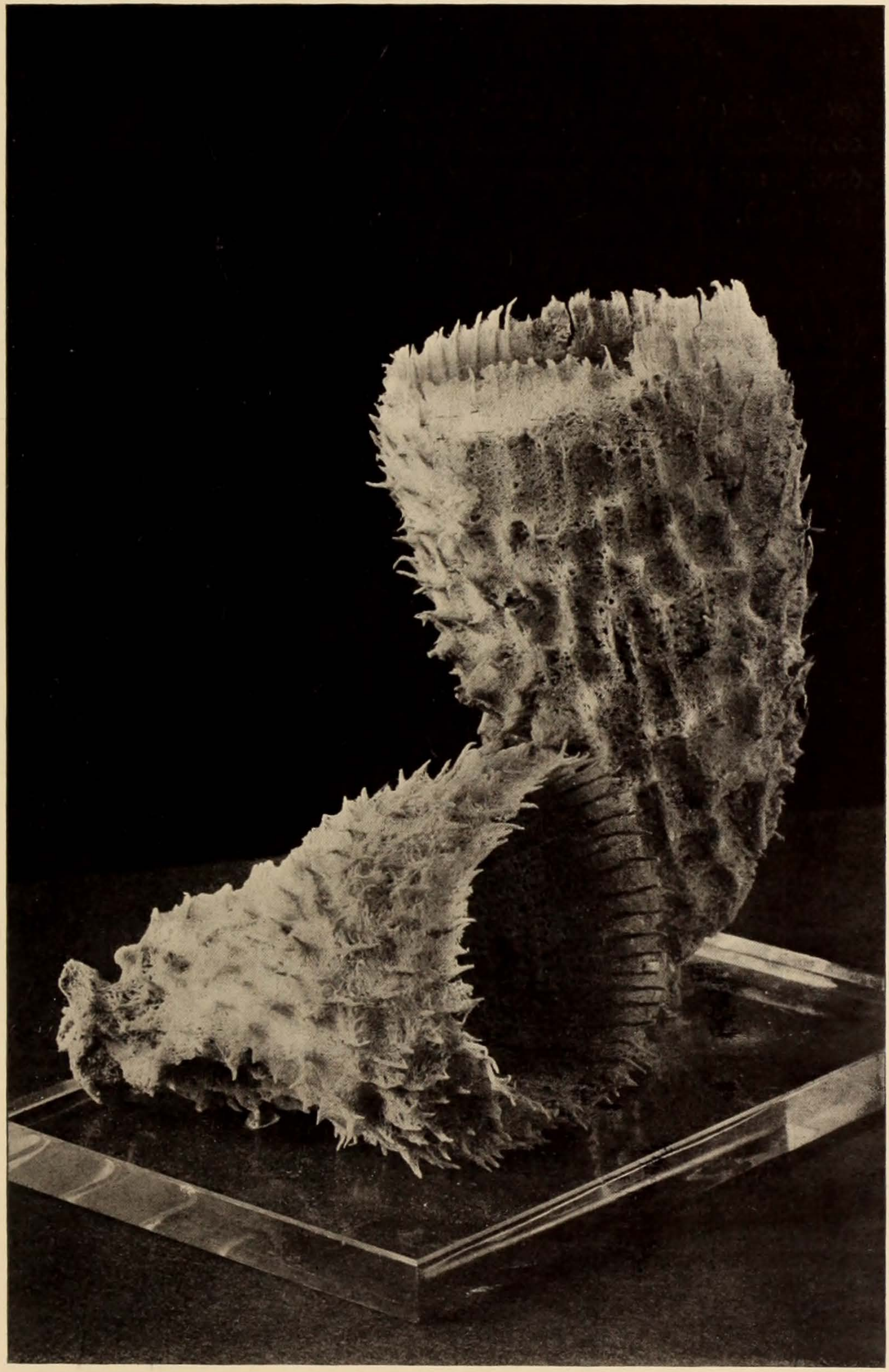


FIG. 11.—NON-COMMERCIAL HORNY SPONGES (*Stelospongia* sp.)
A trumpet-like form showing plainly the *principal fibers* projecting around the rim, and the *oscula* or excurrent openings lining the cavity of the specimen.

greatly in thickness, and the canal system may become much complicated through the folding of the walls of the paragastric cavity and the development of wide mesodermal cavities (*inh.* and *exh.*).

3. *The Skeleton.*

One of the most remarkable features of sponge structure is the skeleton. It is by far the most reliable basis for classifying the sponges yet discovered, inasmuch as it is comparatively unaffected by the external surroundings of the individual and

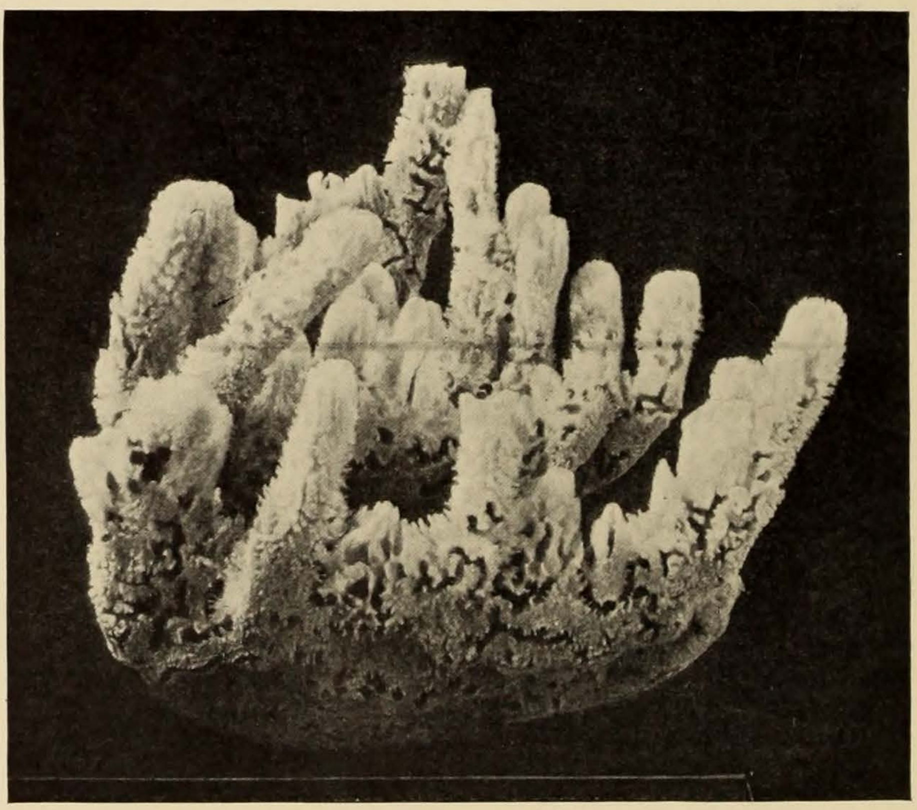


FIG. 12.—A BAHAMAN COMMERCIAL SPONGE (*Hippospongia sp.* Hyatt)
Showing colony of tube-like individuals

therefore its peculiar features remain constant to the groups of which they are characteristic. It may be composed either of fibers or spicules, and it is secreted by the mesoderm. Its function is to furnish a rigid supporting framework for the body and to act as a protection against the enemies of the sponge.

The fibrous sponges include among others those known to commerce. The skeleton is, in most cases, made up of interlacing and anastomosing fibers of a horny substance called *spongin*, closely akin to silk in chemical composition. It is secreted by the mesoderm and is arranged so as to be a supporting basis to the layers of cellular tissue composing the soft parts of the animal. The fibers are of two kinds,—first, a set of long stout *principal fibers* (see Fig. 11), from $\frac{1}{2}$ to $\frac{1}{10}$ mm. in diameter, radiating from the base of the sponge to its surface, and secondly, a complicated network of fine *connective fibers* interlacing between the principal fibers and supported by them. The connective fibers are extremely delicate, having a diameter of only .01 to .02 mm. and with meshes scarcely as large as their diameter. Grains of sand are often found imbedded in the principal fibers, in some cases forming a considerable part of the skeleton, in others the entire substance. The spongin fiber is made up of a soft central core

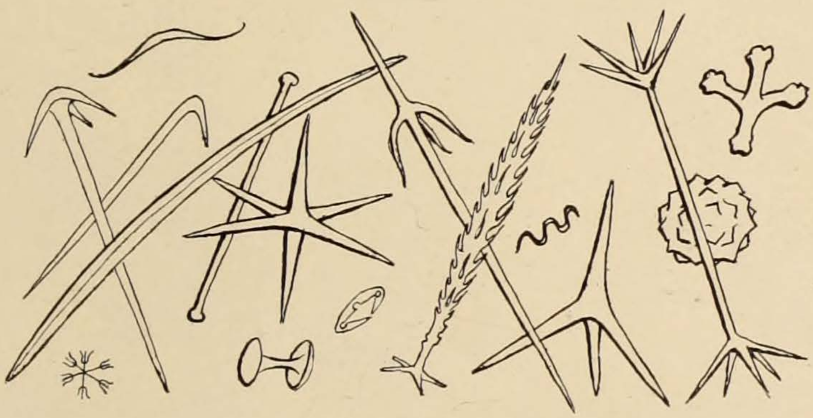


FIG. 13—SOME TYPICAL FORMS OF SPONGE SPICULES

or *medullary axis*, surrounded with successive layers of the spongin substance. The classification of the horny sponges is based upon the minute characters of the network. A few sponges of small size have no skeleton at all, being supported by whatever rigidity their tissues may possess, but with these exceptions all except the horny sponges have skeletons made up of *spicules* instead of fibers. These are small needle-like bodies composed of either carbonate of lime or silicon. The latter is found combined with water in such proportions as to form a substance chemically resembling opal, and of transparent glassy appearance. Hence spicular sponges may be classified as calcareous or silicious according to the nature of their skeletons. Spicules may have one or two axes, or their axes may radiate in 3, 4, 5, 6, or even 8 different directions, and are found in a great variety of forms, some of which are shown in Fig. 13. Those having one or two axes may be straight, curved, or bent at various angles. They may be pointed, rounded or knobbed at one or both ends. They may be smooth or spined. Spicules having a greater number of axes may also have their arms pointed, rounded or knobbed, or each arm may be branched, either once or twice, or to such a degree as to present a great variety of star-like figures. Spicules occasionally assume extremely odd shapes. Some look like tiny cuff-buttons, others like anchors, horseshoes and hooks of peculiar design, while still others are coiled like springs. As regards size they may be divided into two classes:

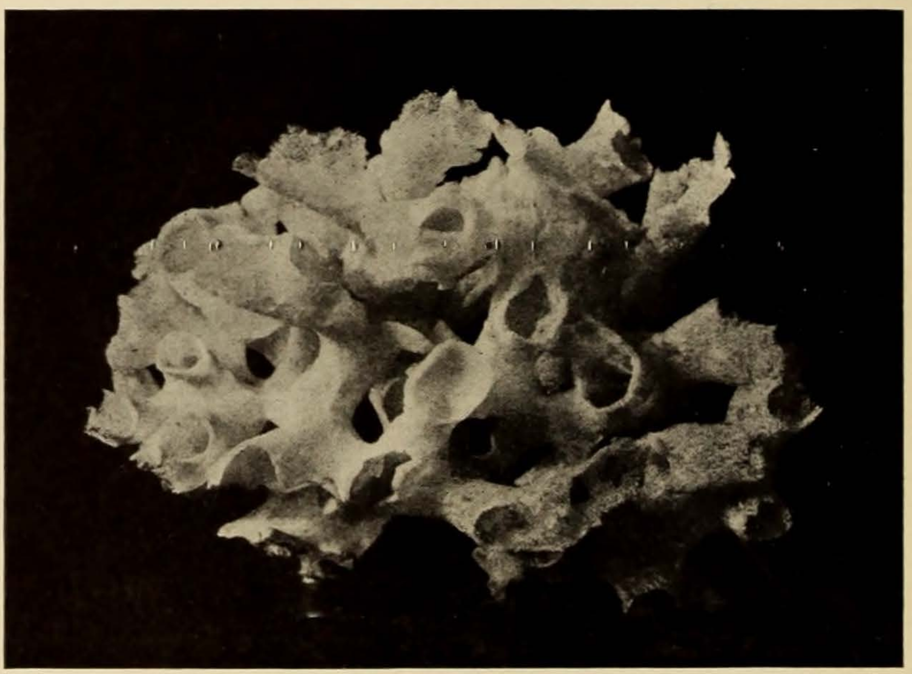


FIG. 14.—A DICTYONID SPONGE (*Farrea occa* Carter)
With rigid lattice-like skeleton.

megascleres, or large spicules, and *microscleres*, or small spicules. The megascleres form the main supporting structure of the skeleton and are bound together in long fiber-like bundles which are either parallel, or cross each other so as to form triangular or square meshes. They are sometimes entangled and interlaced in all directions like felt, clinging to each other with their hooks and projections. In the Dictyonid sponges (Fig. 14) the megascleres are of three axes at right angles to each other and are arranged with points overlapping During the life of the sponge these grow together and finally form a perfectly rigid network. The microscleres on the other hand are not supporting in function. In fact in most cases their use is unknown. They are found embedded in the fleshy parts of the sponge and are so minute as to be distinctly visible only under a high power of the microscope. They are extremely valuable in determining species.

REPRODUCTION AND DEVELOPMENT.

Sponges may reproduce either by budding (*asexual reproduction*), or by means of eggs (*sexual reproduction*). Reproduction by budding is brought about by an outgrowth of cells from the side of the sponge involving all three layers. This finally develops

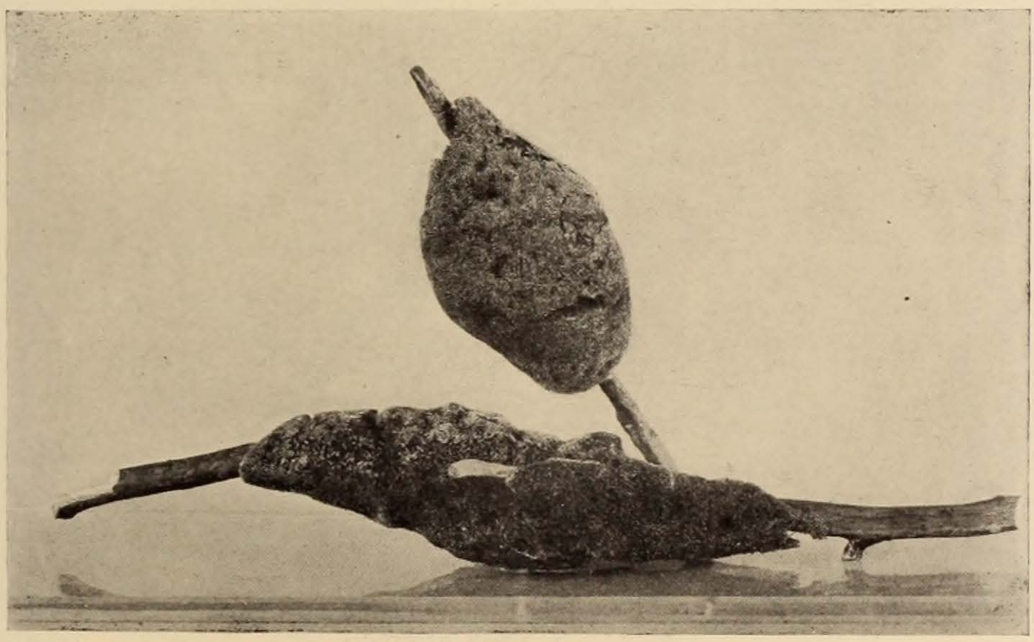


FIG. 15.—FRESH WATER SPONGES (*Spongilla* sp.)

into a miniature of the parent sponge, as far as structure is concerned, becomes narrowed at the base until it is only attached by a stem, and finally drops off. It then becomes fixed to the sea-bottom and grows to maturity. Sexual reproduction on the other hand is only effected by the union of sexual elements within the tissues of the parent sponge. The male and female reproductive cells originate in the mesoderm of the same individual and unite to form the fertilized unicellular egg. The larva is developed from the one-celled stage, by a process of cell division or cleavage. It passes through 2-, 4-, and 8-celled stages by vertical divisions, at the end of which time it appears as a circular disc divided into eight equal segments. These again divide into a 32-celled stage by means of a horizontal or *equatorial* cleavage, and then, by repeated divisions of the eight upper cells, a hollow sphere is formed composed of eight large granular cells and many small cells, each of the latter bearing a long flagellum or whip-like filament. The eight large cells divide more slowly, always remaining comparatively large, and are not provided with flagella.

At this so-called *blastula* stage the larva issues from the

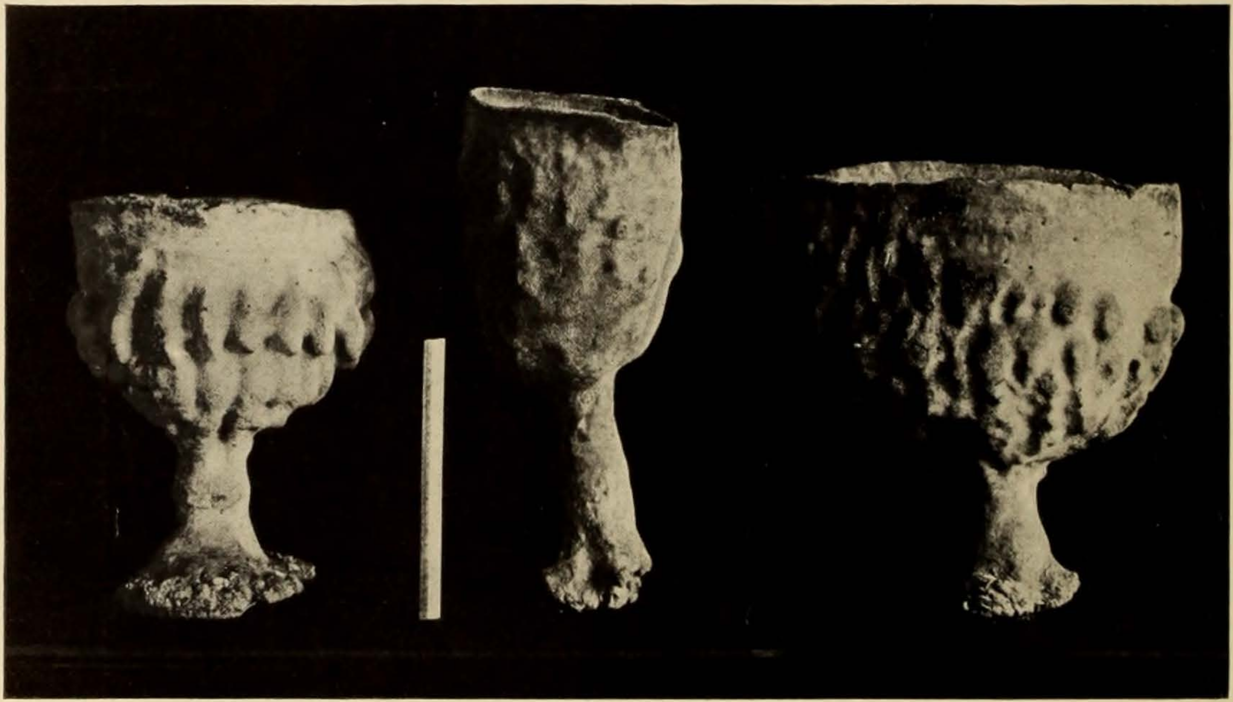


FIG. 16.—A GROUP OF NEPTUNE'S GOBLET SPONGES (*Poterion neptunei* Harting.)
The tallest specimen is 33 inches high.

endoderm of the parent and finally passes out through the osculum of the sponge. It swims rapidly about with its flagellate portion in front, and after a time the large granular cells grow around and enclose the flagellate cells. Soon a sup-chaped body is formed, known as the *gastrula*, which is covered with non-flagellate cells, and lined with a multitude of flagellate cells. The opening of the cup, or *blastopore*, now narrows and almost immediately the larva settles down and becomes fixed by the rim of the blastopore to a rock or some other object. The development is now very rapid. The blastopore closes; the flagellate cells develop collars and become choanocytes; the osculum or excretory opening perforates the free end; the side walls are pierced with pores; traces of the skeletal spicules begin to show in scattered mesodermal cells as tiny needles of glass or carbonate of lime; and the body assumes a somewhat cylindrical shape. From now on the animal possesses all the elements of a true sponge, and growth proceeds according to its nature and environment.

PHYSIOLOGY.

This subject, in its application to sponges, is very imperfectly known.

The following facts, however, can be definitely stated:

The adult sponge is attached and is incapable of locomotion. Its only outward movements seem to be a slow dilatation and contraction of the pores and the osculum.

The choanocytes, however, are very active. The flagella are in constant vibration, and the collars are continually expanding and contracting. These cells are the chief organs of nutrition and respiration. The motion of the flagellum creates a whirlpool, by means of which the sea-water and the organisms it contains are sucked down within the collar. The cell then seizes upon, and absorbs the digestible organisms, while the constantly renewed sea-water, being brought into closer relation with the absorbing tissues, causes the necessary oxygenation to take place.

Excretory products are, without doubt, cast out by these cells and together with the indigestible organisms are borne out through the osculum by the main current of sea-water.

It is also said that during the winter many choanocytes disappear, to be restored in the spring-time. Thus a kind of hibernation seems to occur.

The growth of sponges is slow, five or six years being necessary to bring them to their full size. This, however, is very variable.

There is no muscular or nervous system. Instead, there is what has been called a "vague general sensibility" of the whole sponge. This shows itself particularly in the movements of the osculum and pores.

Sponges may grow together if placed in contact, or, on the other hand, fragments cut from a sponge can be made to live and grow separately. This peculiarity is utilized in connection with the artificial propagation of the commercial sponges. Sponges do not, however, regenerate parts which have been cut off, although the original sponge may go on growing as if nothing had happened.

POSITION OF SPONGES IN THE ANIMAL KINGDOM.

The relation of sponges to other animal forms has always been very uncertain. The choanocytes of the endoderm seem to connect them with a group of colonial Protozoa known as *Choanoflagellates.* These are the only other animal forms which have "collared cells." In fact certain colonies of Choanoflagellates (*Proterospongia*) very much resemble primitive sponges. On the other hand sponges have often been grouped with the Cœlenterates, on account of the resemblance of the planula and gastrula larval stages to those of the Jellyfishes; because of the fixed condition of the adult, the simple structure and the sac-like internal cavity; as well as the supposed resemblance of the osculum to the Cœlenterate mouth. The latter resemblance is only apparent, however, as the osculum does not function as a mouth, nor does it have the same embryological history. Sponges, moreover, differ widely from Cœlenterates in their lack of tentacles and "sting-cells," or *nematocysts*, and are peculiar in having pores, "collared cells," and spicular skeletons. These differences are so important that it has been necessary to recognize the sponges as a separate subkingdom, most probably having a common ancestry in some group immediately derived from the Protozoa.

CLASSIFICATION.

On account of the difficulties besetting sponge classification many very widely differing schemes have been proposed. The earliest were based largely on external forms and the chemical

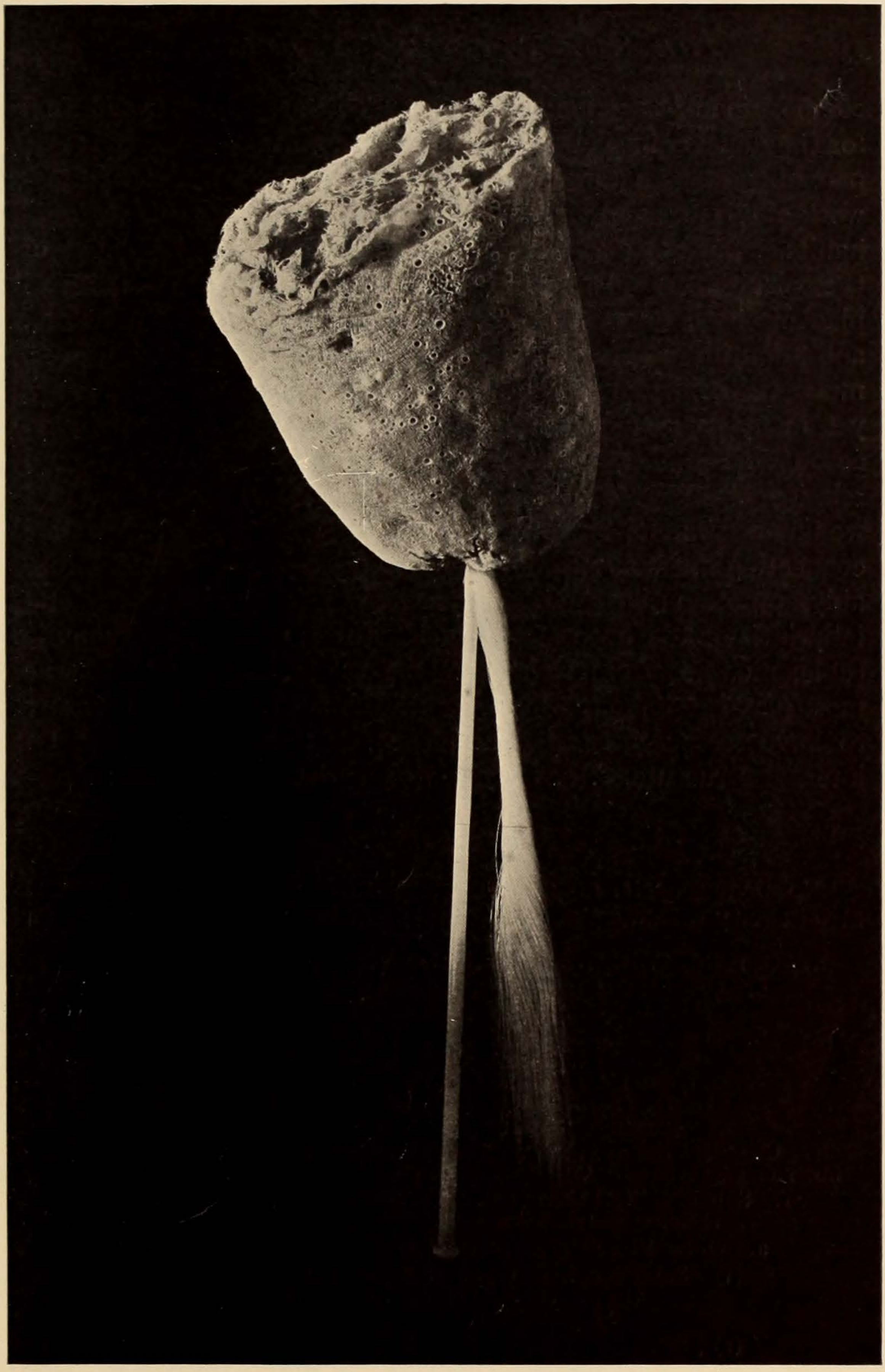


FIG. 17.—A GLASS ROPE SPONGE (*Hyalonema sieboldii* Gray)
The twisted rope-like bundle of opal spicules projecting from the base of the sponge, forms a supporting structure in life, the lower end being embedded in the mud.

composition of the sponge skeleton. The latter basis is still used for the division into classes, but the former has been for the most part abandoned on account of the plastic nature of the framework of sponges and the consequent variability of their growth-habits. Such internal features as the form and arrangement of the spicules, the extent of the choanocytic layers, and the general plan of the canal system, seem to be more constant characters, and are utilized in all recent classifications. There is, however, much variability among internal characters also, and there are yet many perplexing problems to the spongologist, especially on account of the great number of intermediate forms and unexpected relationships. In fact a genealogical diagram of the sponges would not so much resemble a branching tree, as a network with connecting fibers anastomosing in all directions, and most probably approximating in its appearance the bewildering skeletal labyrinth of the fibrous sponge itself. The following synoptic table, modified from Delage and Herouard, seems to be for the most part in harmony with recent researches, and as likely as any to have some degree of permanence, as it is largely based on internal structure, *i. e.* the skeleton and canal systems:

PORIFERA.

No nematocysts, no mouth, but with inhalent pores; a cloacal atrial cavity with a simple or multiple osculum; a mesoderm.

A. Class CALCAREA. Spicules calcareous; choanocytes large.

- a. Order **HOMOCŒLIDA**. Atrial cavity lined with choanocytes. (*Leucosolenia,* Ascetta, Ascyssa, Homoderma.*)
- b. Order **HETEROCŒLIDA**. Atrial cavity lined with pinacocytes (pavement cells), the choanocytes being withdrawn into radial diverticula or ciliated chambers. (*Sycon, Grantia,* Ute, Barroisia, Leucilla, Leucandra, Eilhardia, Eudea, Petrostoma.*)

B. Class NON-CALCAREA. Skeleton of silicious spicules, or of spongin fibers or no skeleton. Choanocytes small.

1. Subclass TRIAXONIÆ. Ciliated chambers large, elongated; skeleton of triaxial spicules or none.
   - a. Order **HEXACTINELLIDA**. Skeleton formed of spicules.
     - (1) Suborder LISSACINA. Spicules independent during growth. (*Euplectella,* Askonema, Rosella, Lophocalyx, Hyalonema,* Semperella.**)
     - (2) Suborder DICTYONINA. Spicules united during growth to form a rigid trellis-work. (*Farrea,* Aphrocallistes,* Hexactinella,* Dactylocalyx, Ventriculites, Cœloptychium.*)

* Represented in Museum Collection.

b. Order **HEXACERATIDA.** Skeleton formed of fibers, or no skeleton. (*Darwinella, Aplysilla, Halisarca.*)

2. Subclass DEMOSPONGIÆ. Ciliated chambers small; skeleton formed of spicules of one or four axes; or no skeleton.

a. Order **TETRACTINELLIDA.** Skeleton formed of tetraxial megascleres, rarely reduced to microscleres, or no skeleton at all.

(1) Suborder CHORISTINA. Skeleton flexible, without interlocking desmas.

(i) Family **Sigmatophoridæ.** Megascleres present. Microscleres in the form of sigmaspires, or none. (*Tetilla, Cinachyra.*)

(ii) Family **Astrophoridæ.** Megascleres present. Microscleres in the form of asters. (*Thenea, Stelletta, Disyringa, Geodia, Pachymatisma.*)

(iii) Family **Microsclerophoridæ.** No microscleres. (*Plakina, Oscarella, Chondrosa.*)

(2) Suborder LITHISTINA. Skeleton rigid, formed of interlocking desmas

(i) Family **Triænidæ.** Ectosome containing triænes. (*Theonella, Desmanthus, Siphonia, Corallistes, Pleroma.*)

(ii) Family **Rhabdosidæ.** Ectosome containing microstrongyles, free or in desmas. (*Neopelta.*)

(iii) Family **Anoplidæ.** Ectosome without spicules. (*Azoriea, Vetulina.*)

b. Order **MONAXONIDA.** Skeleton formed of megascleres of only one axis.

(1) Suborder HADROMERINA. Ordinarily with a cortex; megascleres in radial bundles; microscleres in asters or absent, never in the form of spires or sigmas.

(i) Family **Aciculidæ.** Diactinous megascleres. (*Tethya, Hemiasterella, Stylocordyla.*)

(ii) Family **Clavulidæ.** Monactinous megascleres. (*Spirastrella, Suberites,* Polymastia, Cliona.*)

(2) Suborder HALICHONDRINA. Ordinarily no cortex; megascleres entirely oxeas arranged in a network. (*Spongilla*, Chalina*, Reniera, Halichondria, Tedania, Esperella, Cladorhiza, Myxilla, Clathria, Axinella.**)

c. Order **MONOCERATIDA.** Skeleton formed of spongin fibers with or without microscleres. (*Euspongia,* Hippospongia,* Aplysina,* Druinella, Stelospongia,* Hircinia,* Spongelia,* Phoriospongia.**)

* Represented in Museum Collection.

TYPICAL SPONGES IN THE MUSEUM.

A. CALCAREOUS SPONGES (CLASS CALCAREA)

The most conspicuous characteristic of this class is the calcareous or carbonate of lime skeleton. The class is divided into two groups, the first containing those sponges whose hollow interior (paragastric cavity) is entirely lined with "collared cells" (order Homocœlida), the second comprising those in which the "collared cells" are confined to thimble-like prolongations of the paragastric cavity (order Heterocœlida).

An example of the **Homocœlida** is the Ascon sponge *Leucosolenia primordialis* Häckel. The genus to which this species belongs is found in all seas to a depth of 6000 feet. Its manner of growth varies from solitary, erect, cylindrical sponges to encrusting colonies of serpent-like tubes ramifying in a complicated network. Sometimes the whole colony assumes an erect vase-like form with walls made up of entwining tube-like individuals. The sponge on exhibition is of the encrusting type, growing in this instance on a colony of barnacles.

The Sycon sponge, *Grantia ciliata* Fleming, represents in the exhibition the order **Heterocœlida**. This is a common species found all along the New England sea-coast. It is a small tubular sac with the osculum surrounded by a circle of finger-like spicules, as shown in the illustration on page 224. It grows from an inch to an inch and a half in length, in small cluster-like colonies attached to sea-weed, submerged timbers, shells, etc. The specimens in the glass jar are growing on a mussel shell which is also partly encrusted with small star-shaped colonies of the interesting Ascidian, *Botryllus*.

B. THE NON-CALCAREOUS SPONGES (CLASS NON-CALCAREA).

The sponges of this class have no traces of carbonate of lime in their skeletons. Instead some contain silicious spicules

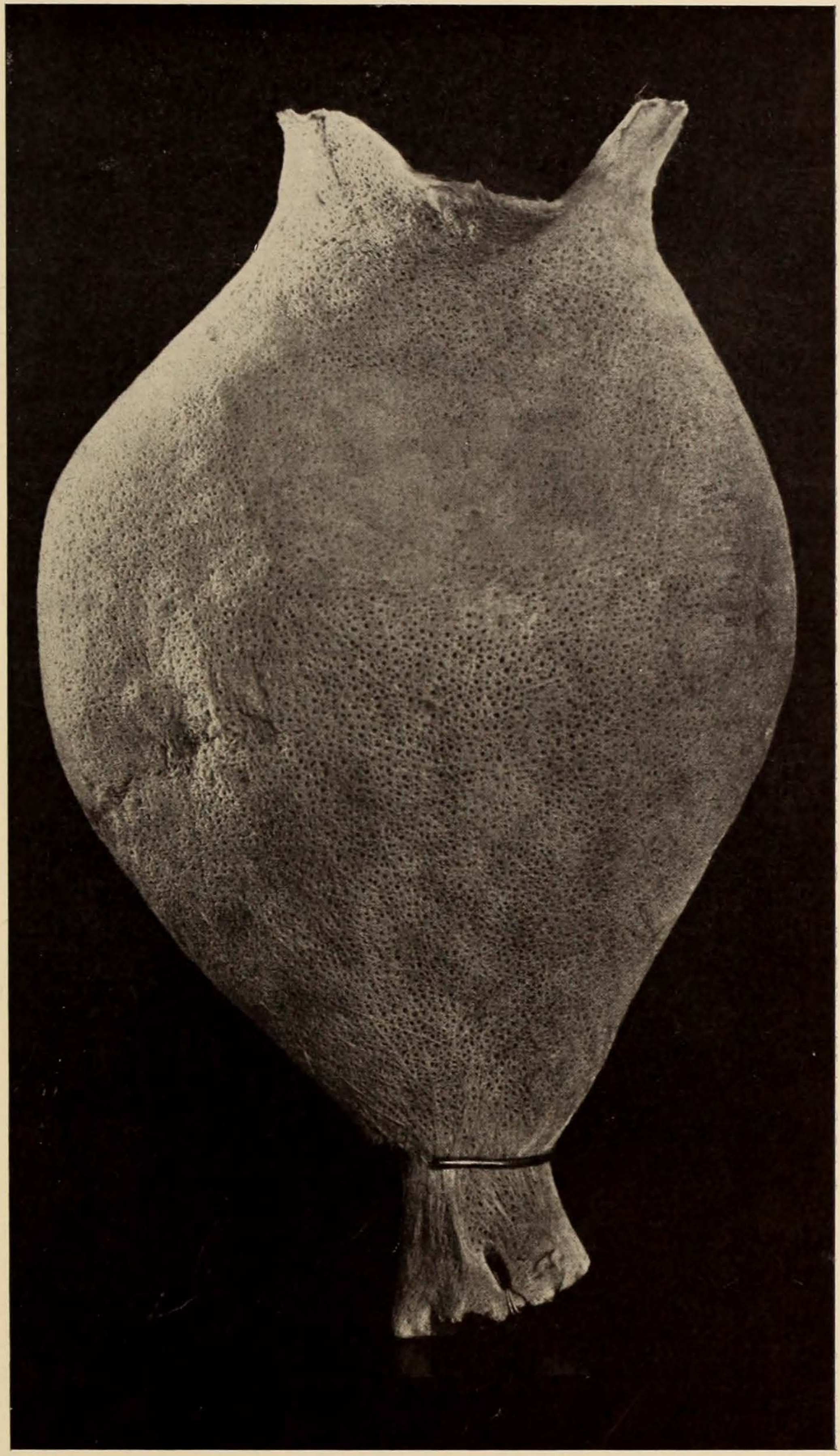


FIG. 18.—A RARE "GLASS" SPONGE (*Hyalascus similis* Ijima)
This graceful specimen illustrates the vase-like growth of many sponge colonies
(Height, 15 inches.)

(the so-called "glass" sponges), or their skeletons may be partly or entirely made up of a network of spongin fibers. A few sponges have no skeletons at all.

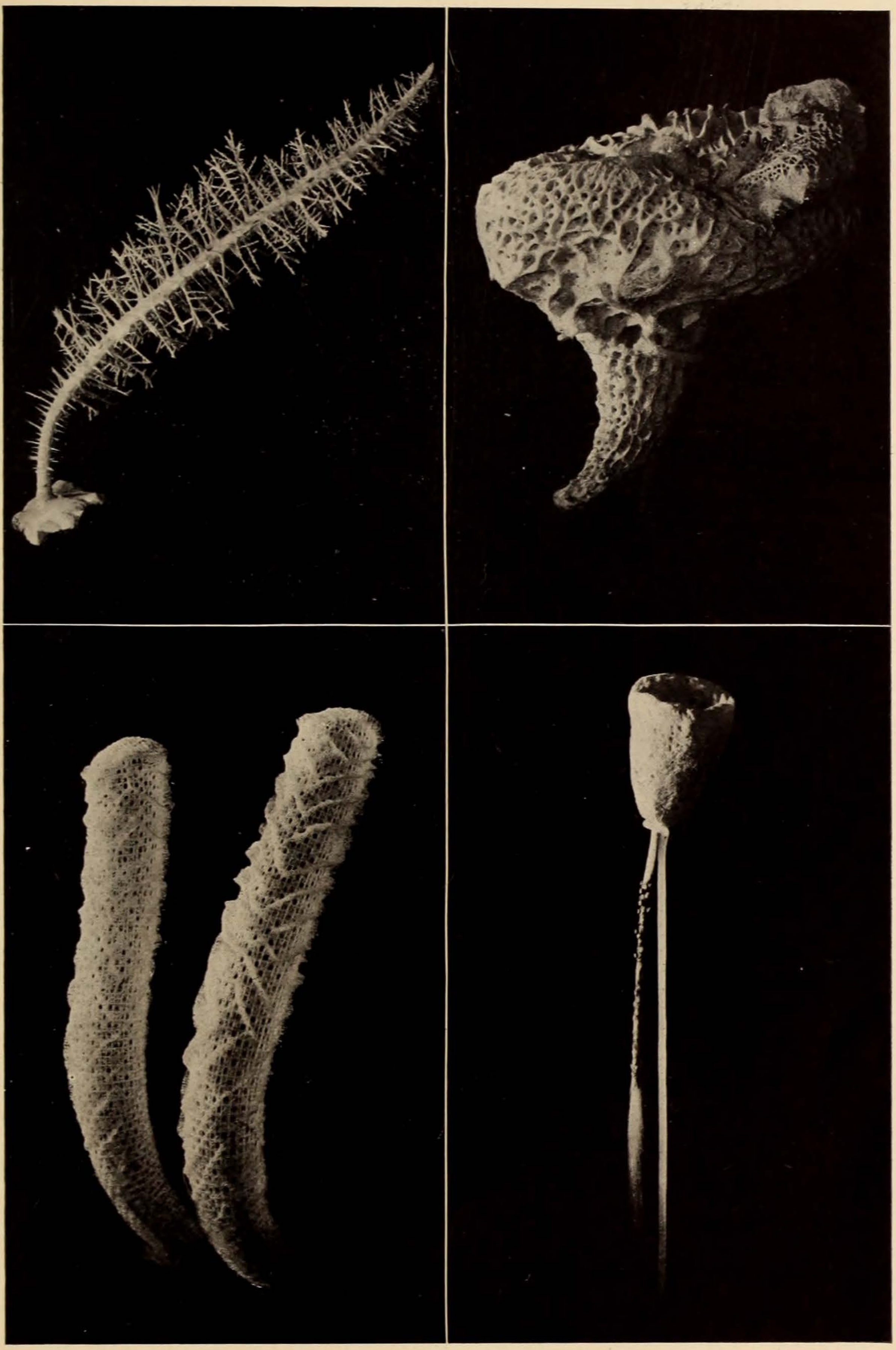
Those sponges which have six-rayed spicules belong to the order **Hexactinellida**, a group marked by forms of unusual beauty and grace, of which a fine collection is shown in this alcove. In some of these (suborder Lissacina), the spicules are independent during growth and are felted together by means of their hooks and spines; in others (suborder Dictyonina), the overlapping ends of the spicules have grown together to form a rigid lattice-like framework.

Suborder Lissacina.—The several species of *Euplectella* (Venus's Flower-basket) are especially noticeable for delicate beauty, while *Walteria* is remarkable for its odd tree-like form. *Acanthascus*, *Rhabdocalyptus* and *Crateromorpha* are also represented by fine specimens, (see opposite page) and give a good idea of the variety of forms which these sponges may assume, while the remarkable vase-like *Hyalascus similis* Ijima (Fig. 18, p. 239) is not only the type of its species, but is the only specimen known to have been found.

The so-called "glass-rope" sponges (*Hyalonema*) are remarkable for the twisted, cylindrical bundle of elongated spicules projecting from the lower end. In life this stalk-like support is anchored in the mud at the sea-bottom by means of barbs and hooks at the lower end of the spicules. An interesting peculiarity of this sponge is its association with tiny Zoöphytes (*Palythoa*) which are always found growing upon its stem (see Fig. 22). This is an illustration of the phenomenon of *symbiosis*, indicating an association of two animal forms for their mutual advantage.

Suborder Dictyonina.—The two specimens of *Farrea occa* Carter (see Fig. 14, p. 230) and *Aphrocallistes* show particularly well the lattice-like framework peculiar to this group, and also the characteristic manner of growth of these sponges.

The glass sponges are all universally distributed in the deep waters of tropical seas. Most of the specimens exhibited in this Museum were collected in the Sagami Sea, an arm of the Sea of Japan. This is a particularly favorable locality, as the sea-bottom falls away rapidly to a great depth close to the shore,



FIGS. 19-22.—SOME TYPICAL "GLASS" SPONGES

FIG. 19.—A tree-like species (*Walteria leuckhardti* Ijima).

FIG. 20.—The Cactus Sponge (*Acanthascus cactus* Schulze).

FIG. 21.—Venus's Flower-basket (*Euplectella speciosissima* Owen).

FIG. 22.—A "Glass-rope" Sponge (*Hyalonema owstoni* Ijima) with *Palythoa* growing on stem.

thus giving an opportunity for deep sea forms to stray up into comparatively shallow water.

The native method of collecting these sponges is interesting. An apparatus called a "dabo line" is used. This is a long line about an eighth of an inch in thickness, to which smaller branch lines or "snoods" are attached at short intervals. Each "snood" ends in a brass or iron wire hook with a barbed point. The "dabo lines" are coiled in baskets placed in the bottom of a boat manned by five or six men. The hooks are stuck in a row around the edge of the basket, and as the line is uncoiled, are successively unfastened by one of the men. The line is set by tying one end to the end of a long rope weighted with a stone sinker. The latter is then lowered perpendicularly, carrying the "dabo-line" with it, until the required depth is reached, when the upper end is moored to a buoy. The boat is then rowed away until the entire "dabo line" is paid out, when it is attached to another strong rope also weighted, which is lowered in the same manner as the first, and moored to a buoy. After a time the line is taken up, beginning at the first buoy, when sea-animals of all kinds including many "glass" sponges are found either hooked or entangled in the "snoods."

The order **Tetractinellida** comprises living and fossil forms, the skeletons of which are composed of four-rayed spicules.

The fossil Tetractinellids and other sponges are well shown in the Geological Hall, fourth floor, north wing of this building. *Hyalotrogos*, *Cnemidiastrum*, *Leidorella* and *Callopegma* are a few of the genera illustrated by the specimens.

The next great division of sponges, the order **Monaxonida,** comprises sponges having large spicules of but one axis. Sometimes these are arranged in radiating bundles and sometimes form a network. The species are quite numerous and universally distributed. The most remarkable of these sponges are the giant Neptune's Goblets (*Poterion neptunei* Harting), three fine specimens of which may be seen in a special case at the farther end of the alcove. At the left of these, another large cup-like Monaxonid sponge fished up near Santa Lucia, West Indies, may also be seen. This specimen (see opposite page) is remarkable for its size and beauty, for the peculiar irregular knob-like

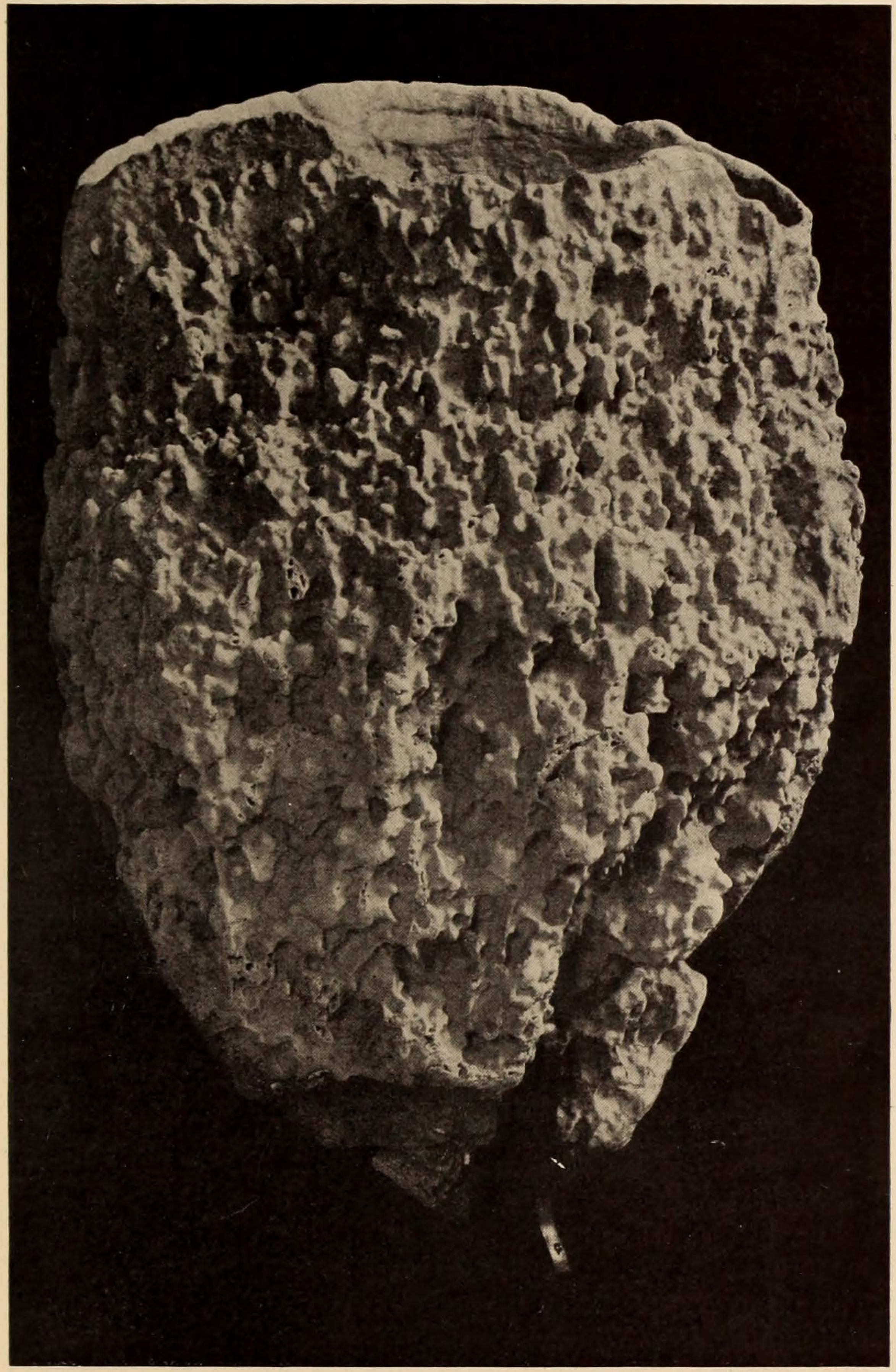


FIG. 23.—A REMARKABLE VASE-LIKE MONAXONID SPONGE
From Santa Lucia, W. I. (Height 31½ inches).

projections on its surface, and for its very fragile texture. Other noteworthy specimens belonging to this order are as follows:

Spongilla sp. (illustrated on page 231.)—This is an example of the fresh-water sponges which form the only exception to the rule that sponges are marine animals. In color it is usually yellowish, often tinged with green or brown. It is universally distributed in streams and ponds.

Pachychalina.—This genus consists of usually elongate, finger-like and branching sponges in which the spicules are buried in a horny coating of spongin. The numerous excretory openings, or oscula, are conspicuously scattered over the external surface.

FIG. 24—THE STOLON-BEARING SPONGE (*Siphonochalina stolonifera* Whitfield)
A peculiar adaptation of the branching habit.

Siphonochalina.—This is closely related to the preceding genus, but consists of a group of tube-like individuals varying in form, and with spongin of somewhat paper-like texture. This genus is represented by several species, of which *Siphonochalina stolonifera* Whitfield is the most remarkable. This beautiful sponge is illustrated in the above cut of the type specimen. It consists of a number of tubes with crown-like summits, growing

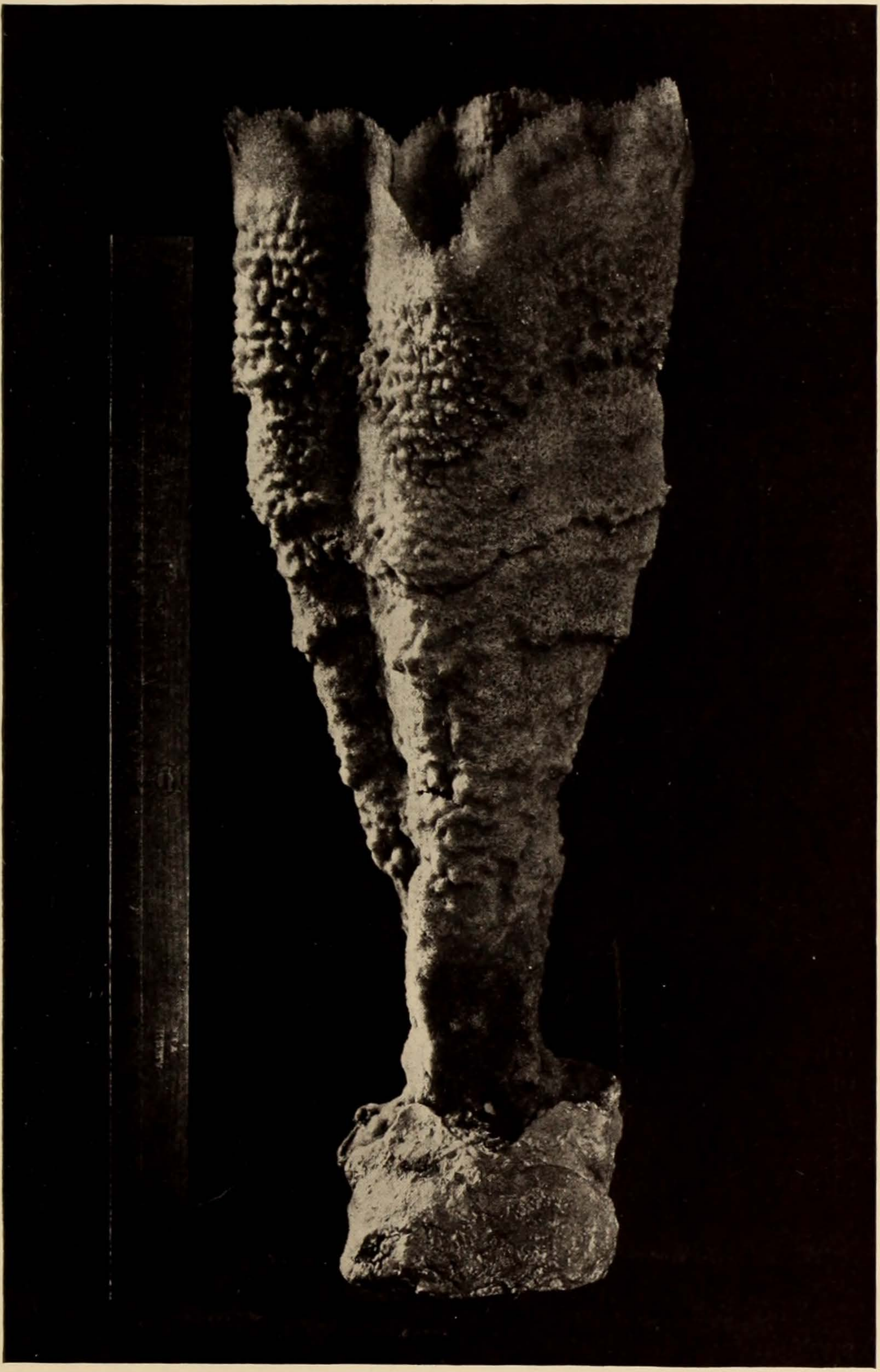
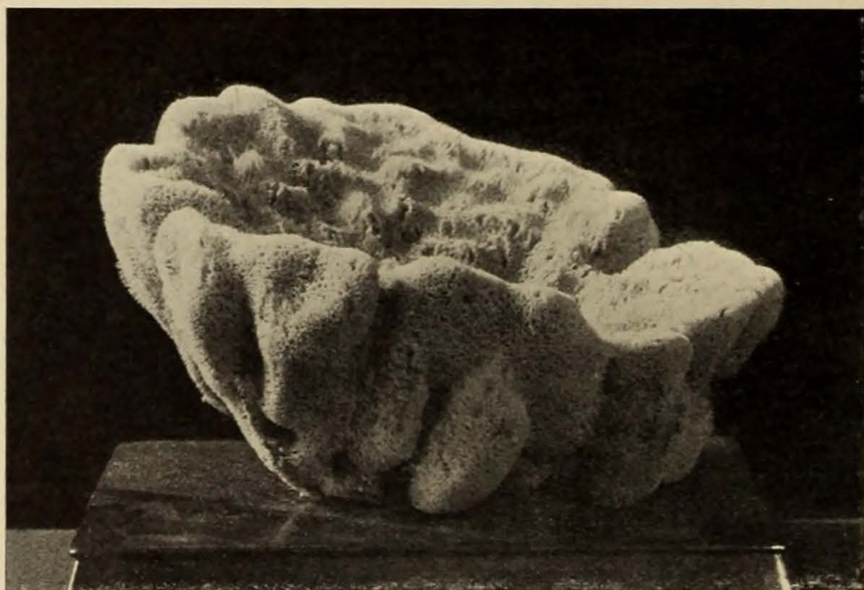


FIG. 25.—THE TRUMPET SPONGE (*Tuba plicifera* Hyatt.)

from a common base, and connected with each other by root-like stolons, which form the attachments to the rocks on which they grow. The texture of the skeleton is very fine and smooth.

Tuba.—The genus *Tuba* is represented by two species *T. bullata* and *T. plicifera.* These are more or less trumpet-shaped as the name implies. The specimen illustrated on page 245 is especially fine.

The Horny Sponges (order **Monoceratida**) includes the sponges whose skeletons are entirely made of the spongin substance. The most typical and most important of these are the commercial

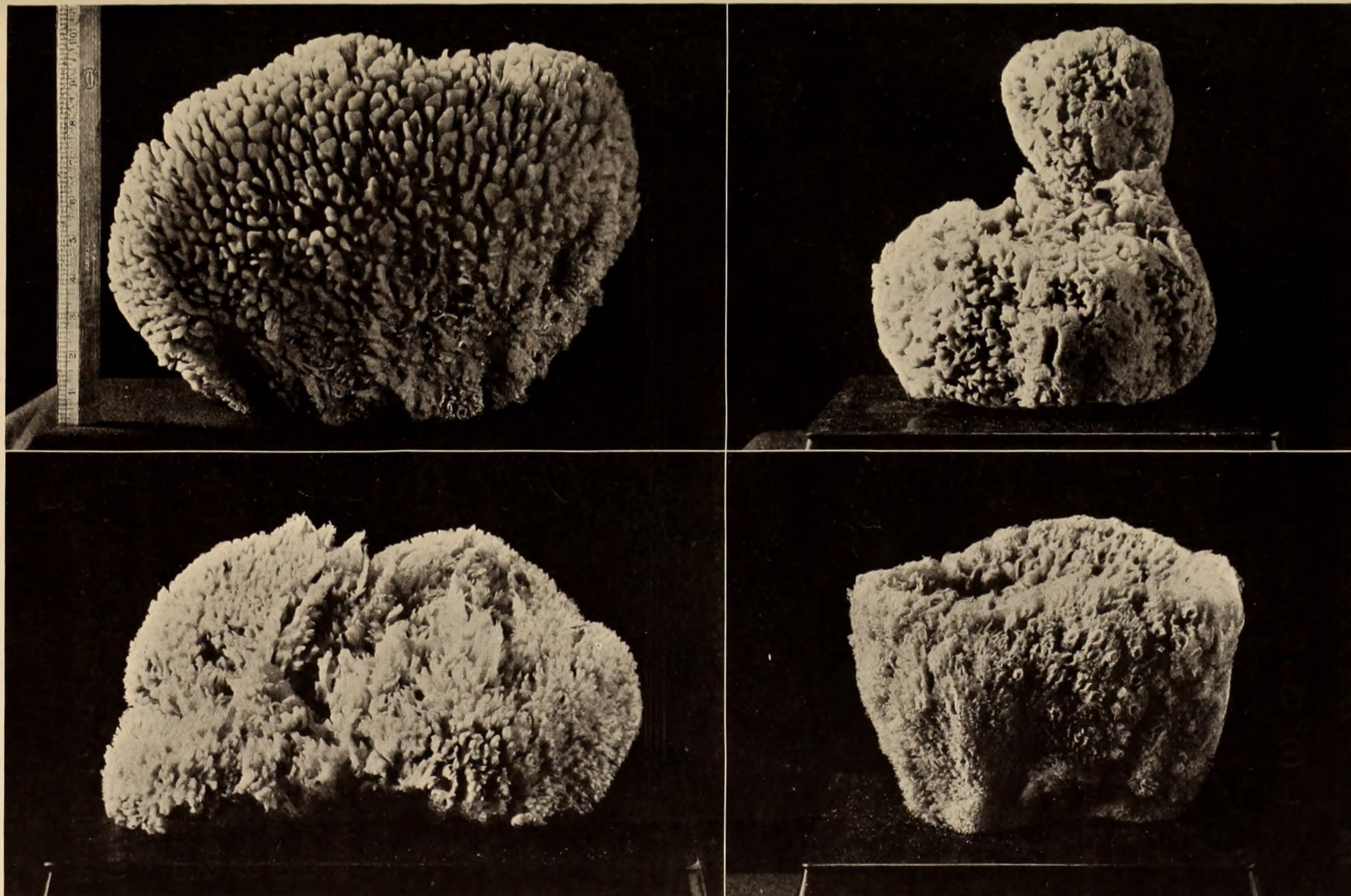


F G. 26.—THE ZIMOCCA SPONGE (*Euspongia zimocca* Schulze)

sponges. They are divided into the genera *Euspongia* and *Hippospongia.* In addition to these the fine finger-like sponges of the genus *Chalinopsilla*, the black branching skeleton of *Hircinia atra* Whitfield (type) and the graceful cup-like specimens of *Stelospongia* (see illustration on page 227) are worthy of note, although they possess no commercial value.

THE COMMERCIAL SPONGES.

The sponge of commerce is the elastic horny skeleton of spongin from which all the living tissues of the animal have been removed. The principal sources of supply are:



FIGS. 27-30—FOUR GRADES OF AMERICAN COMMERCIAL SPONGES.

FIG. 27.—The "Velvet" Sponge (*Hippospongia meandriformis* D. & M.).

FIG. 28.—The Florida Yellow Sponge (*Euspongia corlosia* D. & M.).

FIG. 29.—The "Sheep's Wool" Sponge (*Hippospongia gossypina* var. *hirsuta* Hyatt).

FIG. 30.—The Yellow Sponge (*Euspongia graminea* Hyatt).

(1) The Mediterranean coast, including the gulfs, bays and islands from Italy to the Levant, and the whole African shore.
(2) The Bahamas, Florida, and the north coast of Cuba.
(3) Australia and a few of the Pacific Islands.

There are three grades of European sponges, *i. e.*, the Turkey or Levant Sponge, the Horse Sponge, and the Zimocca Sponge.

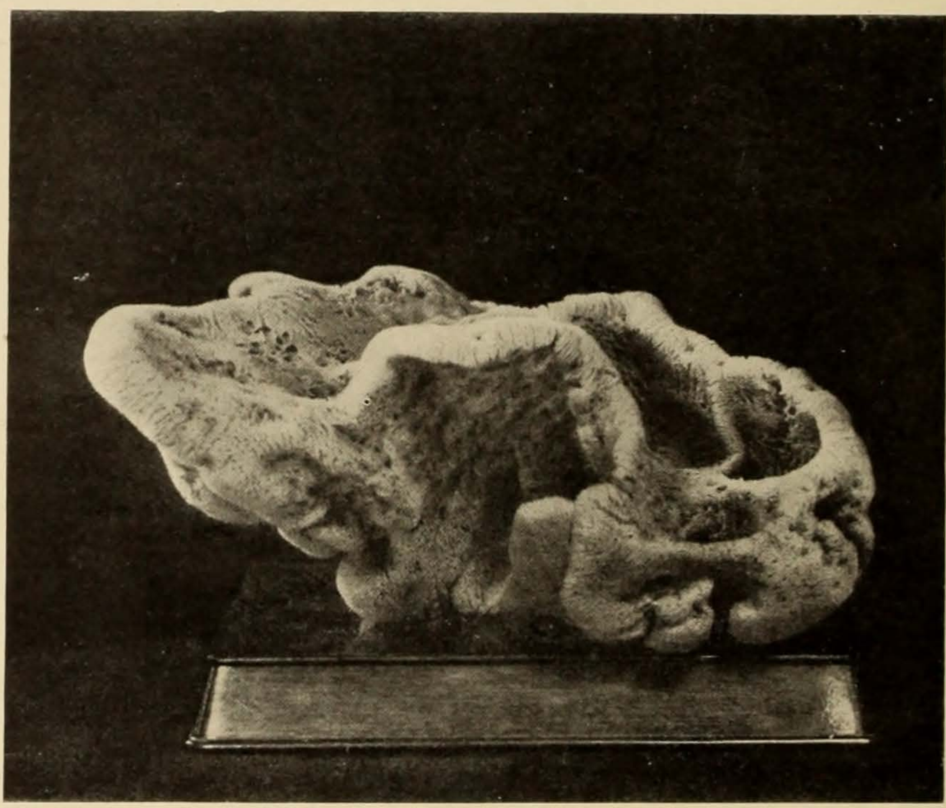


FIG. 31.—THE SYRIAN SILK SPONGE (*Euspongia officinalis* var. *mediterranea* Schum.)
The finest quality of Mediterranean sponge.

The Turkey or Levant Sponge (*Euspongia officinalis* var. *mediterranea* Schum.) is shown in the illustration. It is the finest grade of sponge known. Its texture is very soft, fine and silky. On account of the latter quality it is often called the Syrian Silk Sponge. This same species grows in Florida but is of very poor quality, probably on account of the climate and other differences in its surroundings.

The next grade of Mediterranean Sponge is the Horse Sponge (*Hippospongia equina* O. S.). Its quality is very fine and is paralleled on the Florida coast and in the Bahamas by the Velvet and Sheep's-wool Sponges (*Hippospongia meandriformis* D. & M. and *H. gossypina* Hyatt). These are the best of American bath-sponges. (Figs. 27 and 29).

The third grade, the Zimocca Sponge (*Euspongia zimocca* F. E. Schulze), is not as soft as the others, and corresponds to the Florida Yellow Sponge or "Hardhead." (Figs. 26 and 28).

The Grass Sponge (*Euspongia graminea* Hyatt. Fig. 30) is the poorest grade of American sponge and is of little commercial value.

Sponges grow attached to rocks and other objects at the sea-bottom. They are obtained in shallow water by means of long iron hooks, which, however, often damage the sponges by tearing them. The most perfect specimens as well as the largest are obtained at greater depths by divers. The Dalmatian fishermen are very skilful at this. The diver is stripped and has a small rope attached to his waist weighted with a slab of stone. He seizes the stone in his hands and dives to the bottom. A skilful diver can remain under water for two to three minutes, during which time he quickly gathers whatever sponges he can find and places them in a net attached to his neck. He is then quickly drawn to the surface. Diving by this method is confined to the summer season, as the winters are too cold for such work. The Greek divers use a water-glass to locate their sponges. This is a metal cylinder somewhat longer than a band-box, open at the top and closed at the bottom by a plate of glass. By holding the glass-covered end below water, a person looking through it can easily see the bottom at a depth of 180 feet. The divers work in regulation diving-suits supplied with air from above. Under these circumstances they can remain below for a length of time varying from an hour to a few minutes, depending on the depth at which they are working. The best sponges are obtained in this way, as they are more perfect and of larger size in deep water, and can be removed from the rocks with greater care.

Dredging is also practised off the coast of Asia Minor.

Sponges are prepared for the market by first exposing them to the air until the animal matter begins to decay. They are then washed, either by beating, by treading them with the feet or by exposing them to the action of the waves in so-called "crawls" or pens, until the skeletons are entirely freed of animal matter. They are then hung up to dry, baled, and sent to the market. Sometimes sponges are more quickly prepared by being bleached with chemicals. This gives them a very light color but impairs their quality. Sometimes when sold by weight they are adulterated with sand.

Sponge-fishing has been carried on so unwisely and with so little thought for the future, that the supply has been steadily declining in recent years, and lately the governments of the various countries concerned, foreseeing the almost certain destruction of the sponge industry, have attempted to regulate it in various ways and also to increase the supply by artificial propagation.

In Florida and Italy, more or less successful progress has been made, especially in the matter of sponge propagation. This is done in the winter season by choosing uninjured specimens and cutting them up into fine pieces about an inch square, on a board kept moist with sea-water. These "cuttings" are then placed on the ends of sharpened stakes held upright in a weighted wooden framework. This is sunk in a sheltered bay with a rocky bottom, free from mud, and protected from cold currents. If properly treated in this manner sponges will treble their size in a year and will be ready for the market in from five to six years.

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