

# THE FLORIDA COMMERCIAL SPONGES.

By HUGH M. SMITH, M. D.,

*Assistant in Charge of Inquiry respecting Food-Fishes, United States Fish Commission.*

The sponge fishery of the United States presents the interesting antithesis of an industry restricted to a single State and a product perhaps more generally employed and having a wider range of usefulness than any other article yielded by the American fisheries. There is scarcely a civilized habitation in the country in which the sponge is not in almost daily use. Besides its very general employment for toilet purposes, it is utilized in many other ways—in the arts, trades, and professions, and in domestic life—the mention of which would prove tedious.

In this paper it is not expected that much new or original information concerning sponges will be presented. All that is contemplated is to direct attention to certain aspects of the sponge industry, with a view to place it on a sounder basis. The special topics considered are the distribution, form, and peculiarities of the different species; their present and past abundance; the extent and causes of the decrease in the supply, as evidenced by a diminished annual catch; the protection of sponge-grounds; the cultivation of sponges on grounds now barren; and the increase of the productiveness of the industry by the introduction of some of the best grades of European sponges. In order to make the discussion of these subjects clearer to the sponge interests, it is desirable to briefly notice the zoological status of sponges and their methods of reproduction and growth. Reference is also made to the sponge legislation of Florida. Illustrations of the leading grades of marketable sponges are presented; these are based on specimens collected in Florida by the writer.

## THE NATURE AND STRUCTURE OF SPONGES.

Although for many years the status of sponges—whether animal or vegetable—was in dispute, the time has long since passed when the right of the sponges to be placed in the animal kingdom was established. Even the propriety of assigning the sponges to a position higher than the lowest animals—the protozoa—is now conceded, and they are put either in a subkingdom of their own (Porifera) or in a subkingdom (Coelenterata) with the corals, gorgonians, sea-feathers, jelly-fishes, etc.

The sponge in a natural state is a very different-looking object from what we see in commerce. The entire surface is covered with a thin, slimy skin, usually of a dark color, perforated to correspond with the apertures of the canals. The sponge of commerce is in reality only the home or the skeleton of a sponge. The composition of this skeleton varies in the different kinds of sponges, but in the commercial grades it consists of interwoven horny fibers, among and supporting which are spiculæ of

siliceous matter in greater or less numbers and having a variety of forms. The fibers consist of a network of fibrils whose softness and elasticity determine the commercial quality of a given sponge. The horny framework is perforated externally by very many minute pores and by a less number of larger openings. These are parts of an interesting double-canal system, an external and an internal, or a centripetal and a centrifugal.

At the smaller openings on the sponge surface, channels begin which lead into dilated spaces (sacs or ampullæ); in these, in turn, channels arise which eventually terminate in the large openings (craters or oscula). Through these channels or canals definite currents are constantly maintained which are essential to the existence of the sponge. The currents enter through the small apertures and emerge through the large ones.

The active part of the sponge—that is, the part concerned in nutrition and growth—is a soft, fleshy mass partly filling the meshes and lining the canals. It consists largely of cells having different functions—some concerned in the formation of the framework, some in digestion, some in reproduction. Lining the dilated spaces into which the afferent canals lead are cells surmounted by whip-like processes (cilia); the motion of these processes produces and maintains the water currents, which carry the minute food products to the digestive cells in the same cavities.

Sponges multiply by the union of sexual products, certain cells of the fleshy pulp assuming the character of ova and others that of spermatozoa. Fertilization takes place within the sponge. The fertilized eggs, which should now be called larvæ, pass out with the currents of water; and, being provided with cilia, swim actively for a while, like larval oysters. In a comparatively short time, probably in 24 to 48 hours, they settle and become attached to some suitable surface, where they in time develop into mature sponges.

#### THE FLORIDA COMMERCIAL SPONGES.

The merchantable sponges of the waters of Florida fall under five heads—the sheepswool or “wool” sponge, the velvet sponge, the grass sponges (two species), the yellow sponge, and the glove sponge. Numerous varieties have been described by naturalists and many grades are recognized by dealers, but all are included in the foregoing designations.

The principal center of the industry is Key West, where more than seven-eighths of the business is carried on. Other places at which sponges are landed are Apalachicola, St. Marks, and Tarpon Springs. About 100 registered vessels and 200 unregistered vessels and boats are employed in the fishery, which, with their outfit, are worth about \$260,000, and are manned by upward of 1,400 fishermen.

Sponges are by far the most important of the fishery products of Florida, representing about one-third of the annual value of the fishing industry.

In the calendar year 1895 the Florida sponge fishery yielded 306,070 pounds of sponges, of which the first value was \$386,871. In 1896 the catch, as represented by the purchases of the wholesale buyers, who handled practically the entire output, was 234,111 pounds, having a value of \$273,012. In 1897 the product was 331,546 pounds, valued at \$281,640.

The quantity and value of the yield of the different grades in each of the three years named are shown in the following table. This information is compiled from the

records of the sponge-buyers. The figures represent the actual purchases of the local dealers, with the exception of the business of one buyer, the details of which have been estimated.

Kinds.	1895.		1896.		1897.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Sheepswool.....	231, 272	\$363, 107	149, 724	\$248, 196	157, 476	\$240, 599
Yellow.....	29, 509	11, 798	23, 655	9, 318	32, 362	13, 082
Grass.....	21, 387	5, 494	44, 617	11, 508	128, 622	29, 188
Glove.....	14, 857	2, 882	15, 365	2, 263	9, 292	1, 301
Others*.....	9, 095	3, 620	2, 950	1, 727	3, 794	1, 870
Total.....	309, 120	386, 871	234, 111	278, 012	381, 546	284, 640

\* Includes, besides velvet sponges, "wire" sponges, "hardhead" sponges, and other miscellaneous grades having little value.

THE SHEEPSWOOL SPONGE.

The sheepswool is the best sponge found on the shores of the western Atlantic, and for most purposes has no superior anywhere. While the texture is coarser than that of the best Mediterranean sponges, this sponge is more durable—a quality of leading importance for most purposes. Belonging to the same species as the native sheepswool are the well-known eastern horse sponge, Venetian bath sponge, and Gherbis sponge.

The sheepswool sponge is taken on all the important sponging-grounds on the Florida coast. Its distribution may be said to be from Apalachicola on the west coast to Cape Florida on the east coast, although between Charlotte Harbor and Key West but few known grounds exist. The most productive are in the vicinity of Anclote Keys and Rock Island, and from these regions the best quality of sheepswool sponges comes. Between Key West and Cape Florida valuable grounds also exist, those in the vicinity of Matecumbe Key, Knight Key, Bahia Honda, and Biscayne Bay being especially important. This species usually grows on the bare coralline rock which underlies a large part of Florida and is exposed over large areas of the contiguous bottom. On sandy or muddy bottom it is rarely found. It is at present taken in water from 10 to 50 feet deep, but the largest quantities are obtained in depths of 20 to 35 feet. In the early days of the fishery, before the depletion of the grounds had begun, the principal part of the catch was from a depth of less than 12 feet.

With the methods in use in Florida sponges can not be profitably gathered in water more than 50 feet deep, and a question of considerable interest and importance is whether sponges grow in noteworthy quantities at a greater depth. Most spongers think that there are important grounds now beyond their reach, but others think that 50 or 60 feet is the maximum depth at which sponges grow. It is claimed by a few persons that beyond this depth the bottom is not adapted to the growth of sponges, the coralline rock being absent and sand predominating. Definite information on this point is, however, lacking, and a careful survey would be required to settle the matter. The probabilities are that in certain localities there are productive grounds beyond the present limits of operation, as there is nothing in the nature of sponges to prevent their inhabiting deeper water, and it seems improbable that the rocky bottoms should cease to exist beyond 50 feet.

Should future inquiry show the presence of sponge-grounds in water from 50 to 80 feet deep, the discovery of a method of utilizing them would be the first considera-

tion and would prove a great boon to the sponge fishery. Not the least important outcome of such a discovery would be the opportunity afforded the shallower grounds to recuperate by the diversion of the spongers' operations. Attention may be drawn to the advisability of experimenting with an apparatus constructed on the principle of the so-called "deep-water oyster-tongs," by means of which oyster-beds beyond the reach of ordinary tongs become readily accessible.

The tongs in question, of which there are several types, consist essentially of two curved iron bars, riveted together near the middle to permit free motion. These are attached on one extremity to the teeth and cradles, and on the other to the ropes by means of which the apparatus is lowered and raised. Beneath the crossing-point of the two arms a weight is suspended. To the upper bar of one side an iron link or loop is attached by means of a staple, and on the lower bar, just below the link, is a small iron peg or stud over which the link fits when the teeth are separated to their widest extent. When oystering begins, the arms are locked by means of the loop and peg and the tongs lowered to the bottom. By suddenly dropping the tongs from the height of a few feet from the bottom the loop slips off the pin, by virtue of the weight referred to, and the teeth will then approach each other when the ropes are hauled taut. The weight and the loop and peg may, however, if desired, be dispensed with by attaching a line to the crossing-point of the two arms and placing weights at the upper ends of the latter, the tongs being lowered by means of the middle line and kept open by the weights mentioned.

The extreme simplicity of this apparatus is a great recommendation for its use in the oyster fishery, and suggests its employment in the sponge fishery. It is open to the objection of being somewhat heavier than the ordinary oyster-tongs, and in deep water a small windlass must be attached to the mast or elsewhere on the boat, by which it can be raised and lowered. The cost, complete, is about \$15. If the principle embodied in this apparatus is found to be adapted to the sponge fishery a modification in the line of lightness and cheapness could doubtless be made. The number of teeth and the carrying capacity of the tongs required in the oyster fishery might be reduced and the apparatus made to consist practically of two opposing hooks, such as are now used in the sponge fishery.

The sheepswool is probably the most abundant of the Florida sponges, although it is not relatively so abundant as the catch of it and other species would indicate, owing to the fact that its greater value makes it more eagerly sought.

The decrease in the abundance of this species has been marked in many places. In the vicinity of Anclote Keys the grounds in 10 to 12 feet of water were exhausted before the civil war; but during the war the sponge-beds had a chance to recuperate, and later afforded some good fishing. They were very soon depleted, however, and have not since borne sponges in any noteworthy quantities. This is the general history of the "bay grounds." Deeper and deeper bottom has had to be resorted to in order to make the fishery profitable, until now some fishing is done in water as deep as 50 feet. Occasionally good fares are taken on the inshore and key grounds. The latter, in depths of 10 to 20 feet, seem to recuperate more rapidly than the bay grounds, and produce excellent crops some seasons; but they have in general shown the same depletion as other grounds, and the spongers have to work over a larger area and more assiduously than was necessary a few years ago. Even the deepest grounds now frequented are showing the effects of overfishing, and would doubtless soon prove

nonproductive of marketable sponges if the weather and water were always favorable to the spongers, the preservation of the beds largely depending on the prevalence of storms or turbid water during some seasons or parts of seasons.

The sheepswool is believed by many observers to grow the most rapidly of any of the sponges, but information on this point is not as complete or accurate as might be desired. Some experiments performed and observations made by gentlemen of Key West lead them to believe that this species may, under favorable conditions, grow from the beginning to one-tenth of a pound weight in six months. The opinion that this sponge will grow from the spat to good commercial size in one year is practically unanimous and seems to be verified by the sponging operations. The spongers all testify that grounds which were thoroughly fished out one year are found to yield large numbers of commercial sponges twelve months thereafter.

The catch of the sheepswool in 1895 was fifteen times and in 1897 six times as valuable as that of all other species combined, and is thus sufficiently important to give prominence to the sponge industry, even if no other kinds were taken. The average prices per pound brought by sheepswool sponges were \$1.57 in 1895, \$1.66 in 1896, and \$1.53 in 1897.

Of late, owing to a diminished supply, the relative catch of sheepswool sponges has been decreasing, cheaper varieties entering more largely into the receipts. In 1895 the percentage of sheepswool sponges in the total catch was 76; in 1896 it fell to 64, and in 1897 was only 47.

#### THE VELVET SPONGE.

This is an uncommon form, with a very limited distribution. Along the west coast of Florida it is rarely found, the yield coming almost entirely from certain grounds among the keys. It resembles the sheepswool in general structure, but has a smoother surface and finer fibers. The characteristic feature is the presence of soft protruding cushions, whence the name. It is also known as the boat sponge. Its shape is very irregular. Its average size is 7 or 8 inches in diameter, but the diameter of some is a foot or a little over. Its principal source of supply is the region adjacent to the Matecumbe Keys, where it is taken on coral bottom in water from 15 to 20 feet deep. The grounds have undergone serious depletion, and smaller cargoes are landed each year. Velvet sponges are taken in smaller quantities than any other Florida sponges. In 1897 many dealers did not handle any, and the receipts in recent years have never exceeded a few thousand pounds per annum. The usual price paid by dealers is 50 cents a pound.

#### THE GRASS SPONGES.

There are at least two species comprehended under the trade name of grass sponge, and the individual variations are numerous. One species (called *Spongia graminea* by Hyatt) has a coarse, open structure, with deep furrows on the sides, in which the afferent channels always begin. The general shape is that of a truncated cone, with the larger openings always on top. The other grass sponge (*Euspongia equina cerebriformis*) resembles one form of the yellow sponge, but differs in having its surface marked by parallel longitudinal ridges surmounted by two or three lines of tufts. In the depressions between the ridges the large efferent canals open, their orifices being in rows. Many forms of this species exist. The cup shape predominates.

Grass sponges are of relatively inferior quality, although largely consumed for special purposes. They are found in all parts of the sponge region, and are probably the most abundant of the Florida sponges, the annual yield not being proportional to the abundance. Large cargoes are obtained on the Rock Island, Anclote, and Key grounds. The Anclote region of late has produced the largest part of the catch, and the sponges there are of relatively good quality.

The recent increase in the production of grass sponges, especially from grounds in the Gulf of Mexico, has been noteworthy, as shown by the preceding table. In 1895 grass sponges constituted less than 7 per cent of the total yield; in 1896 the output rose to 19 per cent, and in 1897 was nearly 39 per cent. This utilization of larger quantities of a relatively cheap sponge is a strong indication of the decrease in the supply of the best quality of sponges.

#### THE YELLOW SPONGE.

This ranks next to the sheepswool in quality. It corresponds with the Zimocca sponge of the Mediterranean. The dealers classify the "hard-head" sponge in this grade—a form having a darker color, harder texture, and less value than the yellow proper. The distribution of the yellow sponge is coextensive with that of the sheepswool, both growing together among the keys and on the west coast of Florida. The yellow sponge is most commonly found on rocky bottom, at depths of a few feet to over 30 feet. Those taken for market are from 4 to 10 inches in diameter, 6 to 8 inches being the average.

The yellow sponge is very abundant, but less so than formerly, especially among the keys, whence most of the supply comes, and where the grounds, being more accessible, are more assiduously fished. The key sponges are of much finer quality than those from the "bay grounds," being softer in texture and more durable. The grounds about Matecumbe Key yield an especially good grade of yellow sponge, characterized by a rich yellow color, regular shape, and superior quality. Biscayne Bay and other grounds on the east coast also produce a fine class of yellow sponges.

This species ranks next to sheepswool in the commercial scale, although it commands a less price per pound than the velvet sponge. In the aggregate the value of the catch of yellow sponges was formerly more than that of all the remaining grades except the sheepswool, but of late the grass sponge has surpassed the yellow in this respect. The average price received by sponge fishermen is about 40 cents a pound.

#### THE GLOVE SPONGE.

This is the least valuable of our commercial sponges. Its fibers have a tendency to become brittle with age, it lacks elasticity, and it has very little market value. The skeleton is dense and the surface is much smoother than in the other sponges. It does not attain a large size, not often exceeding 8 inches in diameter and averaging less than 5 or 6 inches.

It is a singular and suggestive fact that this, the very poorest of our sponges, is of the same species as the very finest and best of the Mediterranean sponges, namely, the Levant toilet sponges and the Turkish cup sponges; even some of these, however, are of inferior quality. The fact is thus strikingly emphasized that the quality of sponges is to a considerable extent independent of their specific characters and depends on physical conditions.

The glove sponge has a more limited distribution than any other Florida species. It is found from Biscayne Bay to Key West, but appears to be either very rare or entirely absent on the grounds along the west coast. It grows on rocky bottom in comparatively shallow water, in company with other commercial sponges. Most of the catch is from a depth of less than 10 feet, although the species inhabits somewhat deeper water. It is taken in smaller quantities than any other standard species except the velvet sponge. This, however, is not an accurate criterion of its abundance, as it is less sought for, owing to its poor quality and small market value. It brings the spongers only about 10 to 15 cents a pound, a price so low as to discourage its gathering.

#### SPONGE LEGISLATION IN FLORIDA.

The sponge laws of Florida now in force relate to the gathering of small sponges, the use of dredges, the taking of sponges by diving, and the artificial propagation of sponges, the legislation covering the last-named item having been enacted in 1897. The full texts of the laws are as follows:

Whoever dredges or uses a dredge for the catching or gathering of sponge in or upon the waters of the Gulf of Mexico within three marine leagues of the shore, or upon any of the grounds known as sponging-ground along the coast line of Florida from Pensacola to Cape Florida, or whoever gathers sponge less than 4 inches in diameter, shall be punished for each offense by fine not exceeding \$500, and by confiscation of the boat, tackle, and machinery, and in default of the payment of the said fine the offender shall be imprisoned not exceeding one year. (Revised Statutes of Florida, section 2772, chapter 3615, act of 1883.)

Whoever gathers or catches sponge in or upon any of the grounds known as sponging-grounds, along the coast of Florida, from Pensacola to Cape Florida, by diving either with or without a diving suit or armor, shall be punished by fine not exceeding \$2,000, and by confiscation of all diving suits or armor, boats, and vessels used in such unlawful gathering of sponge, and in default of the payment of said fine the offender shall be imprisoned not exceeding one year.

The fact of having one or more diving suits or armors on board of any vessel or boat in and upon any of the grounds known as sponging-grounds along the coast of Florida, shall be prima facie evidence of the violation of the preceding section.

Whenever an officer arrests any person charged with an offense which, by the provisions of this article, may be punished by the confiscation of the vessel, boats, crafts, nets, seines, tackle, or other appliances used in such unlawful act, it shall be his duty to seize the same and take them into his custody to await the sentence of the court upon the trial of the offender.

If the offender be convicted, the court in awarding sentence shall make an order confiscating the said vessels and implements, and authorizing the executive officer of the court to sell them, after due notice, at public auction to the highest bidder. If the accused be acquitted, the said vessels and implements shall be returned to him. (Revised Statutes of Florida, sections 2773, 2774, 2775, 2776; chapter 3913, act of 1889.)

An act to protect and encourage the artificial growth of sponges within the waters of the State of Florida, and conceding certain riparian rights to those engaged therein, and to prescribe a license in certain cases.

*Be it enacted by the legislature and State of Florida:* It shall be lawful for any person or persons owning lands bordering upon the waters of the State to propagate and grow sponges in the waters in front of such lands, to depth not exceeding 1 fathom at low tide, and they shall have the exclusive right to sponge or propagate and grow sponges within such limits: *Provided*, That in no case shall this right extend beyond 300 yards from the shore line.

SEC. 2. Any person or persons owning lands bordering upon the waters of any bay, lagoon, sound, or strait, shall, within their headline, have the exclusive right to sponge, propagate, or grow sponges



within such waters to a depth not exceeding 1 fathom at low tide: *Provided*, That this exclusive right to grow and propagate sponges shall not extend beyond the distance of 300 yards from the shore line. And when different persons own lands upon the opposite sides of such waters, and the depth thereof does not exceed 1 fathom; then the lines shall extend from lines drawn across their respective headlines to another line equidistant from the lines drawn across such headlines.

SEC. 3. It shall be lawful for any person or persons owning lands as described in the preceding sections, or surrounding any basin, bay, or lagoon not exceeding 1 fathom in depth at low tide, to inclose or stake off the waters in front of such land, not exceeding the distance of 300 yards from the shore line, for the purpose of protecting and marking the waters to which they are entitled, and they shall have the sole and exclusive right to sponge, propagate, and grow sponges within such limits out to a depth in front of such lines drawn through the headlines of their respective lines, and they shall have the right to post such inclosures and warn off trespassers: *Provided*, That no one shall obstruct the waterways necessary for the purposes of navigation, and that no right or privilege shall extend across or beyond any waters used for navigable purposes: *Provided further*, That the rights and privileges mentioned in this act shall only extend to those persons who are actually engaged in the business of raising and propagating sponges.

SEC. 4. That nothing in this act shall be construed as interfering with the rights of any person or persons to fish for fish or oysters in or upon said lands.

SEC. 5. Any person or persons who shall willfully and maliciously destroy, deface, or break down any sign, fence, gate, inclosure, or staked place for the purpose of defining and protection of waters used for sponge-culture shall, upon conviction, be punished by imprisonment in the county jail for a period not to exceed six months, or by fine not to exceed \$500.

SEC. 6. It shall be lawful for any person or persons engaged in the business of artificial growth of sponge to gather sponges of any size to be used solely and exclusively for the purpose of transplanting.

SEC. 7. That any person not a citizen of the United States who shall engage in the business of sponge fishing, either for himself or any other person, shall, before entering into said business, pay an annual State license of \$25. Any person violating the provisions of this section shall, upon conviction, be fined in a sum not to exceed \$50, or be imprisoned in the county jail for a period not to exceed sixty days. (Act of May 12, 1897, chapter 4564.)

#### EVIDENCES AND CAUSES OF A DECREASE IN THE SPONGE SUPPLY.

Although the sponge fishery of Florida is only forty-five years old, the sponge-grounds are on the whole much less productive than formerly, as is acknowledged by practically everyone who is in a position to express an intelligent opinion. Of course there are still very important grounds among the keys and on the west coast of the State, and sponges still exist and are taken in very large quantities; but the efforts now made would result in a vastly increased catch if the sponges were found in anything like their original abundance. There are many points of similarity between the history of the Florida sponge-grounds and that of the oyster-grounds of some States in which dependence has been chiefly placed in the natural beds for supplying the demand. In confirmation of the diminution of the sponge supply, the following facts may be cited:

1. There has been a complete abandonment of some grounds formerly productive, especially the inshore grounds, which were the only ones resorted to in the early days of the fishery. The depletion naturally began in the shoaler waters, where sponges could be more easily gathered, and has gradually extended so as to embrace, to some degree, all available grounds.

2. The fishery has had to be prosecuted in deeper and deeper water in order to maintain the catch, until the maximum depth in which sponging is possible with present methods has been reached. Beyond 50 or 52 feet it is practically impossible to pull sponges with appliances now in use, although in the Mediterranean sponging is done in water as deep as 70 feet by using improved poles.

3. In general there has been a smaller catch per man and per vessel. Very many trips result in a loss to the owners or outfitters of the vessels, and it is now the exception for a vessel to bring in the average catch of earlier years.

4. The catch is very noticeably made up of small sponges, those under the legal size constituting a too prominent proportion.

The causes for the decrease are readily determined and are almost unanimously recognized by spongers and buyers. They are directly traceable to indiscriminate fishing, although stress is laid on natural agencies by some of those interested.

#### TAKING OF SMALL SPONGES.

This is undoubtedly the principal cause of the decrease in the supply of Florida sponges. While the State law, which has now been in force fifteen years, expressly forbids the sale of sponges less than 4 inches in diameter across the top, the law has never been seriously regarded by fishermen, dealers, or sheriffs, and the occasional spasmodic efforts made to enforce it have only added to the disrepute in which the statute is held. It is extremely doubtful if the law has resulted in the saving of a single undersized sponge or the slightest protection of the grounds. The attempt to remind the spongers of the existence of the law has usually been on the arrival of the fleet, when the damage has been done, and by the time vessels have returned to the grounds the law has been conveniently forgotten by law officers and law breakers alike.

Some figures are available which illustrate the great damage done to the industry by the gathering of small sponges, and show how short-sighted the fishermen are in this respect, and emphasize the necessity for a change in the present status.

The very small sheepswool sponges which the fisherman bring in, many of them only half the legal size, have little market value. When a sponge-buyer purchases a cargo these small sponges receive scant consideration and are often entirely discarded in determining the value of the lot. When undersized sponges are sold independently it has not infrequently happened that 20 bunches or strings, each holding 25 sponges, have brought the fishermen only \$1 or \$2. The same sponges if left on the grounds six months longer would have been worth \$150 to \$175. A case is cited in which 1,250 sheepswool sponges were sold in Key West for \$5. Conservative estimates indicated that if left down six months longer these would have brought at least \$390.

It is a very small sponge which the average sponge fishermen will now discard, and yet, on the authority of reputable dealers, it may be stated every season there are many thousands of sponges gathered which never reach the markets, but are thrown away. It may be safely asserted that each year the small sponges taken from the Florida grounds would add \$100,000, or 30 per cent, to the value of the product if they could be left growing for six months.

#### EXCESSIVE FISHING.

Coincident with the gathering of small sponges has been the excessive sponging on grounds, season after season, without any regard whatever for the preservation of enough stock to secure the repopulation of the beds. A sponge fisherman will rarely willingly or knowingly leave any sponges of value on a ground; and the entire history of the sponge industry shows a flagrant disregard for the preservation of the supply.

It can scarcely be wondered at, therefore, that there is more difficulty each year in obtaining good cargoes, and that the output is decreasing. An average cargo now is only a half or a third what it was ten or fifteen years ago.

#### POISONOUS WATER.

A factor in the decrease in the sponge supply to which many of the spongers attach much importance is the so-called "black" or "poisonous" water. Its nature is not definitely established. Some think it is water from the Everglades, discharged into the Gulf in unusual quantities; others that it is due to submarine volcanic disturbances, resulting in the liberation of noxious gases. Whatever the cause, it is certainly destructive to all forms of life, and it is known to have depleted some very productive grounds. Fortunately this kind of injury is of infrequent occurrence, seldom coming in serious form oftener than once in a decade. Of the very disastrous poisonous water plague in 1878, the following account has been given:

The earliest indication of it was the floating up of vast quantities of dead sponges, chiefly loggerheads. The dead sponges were first noticed less than 40 miles north of Key West, but it was soon discovered that all the hitherto profitable sponging-grounds lying off the coast, as far north nearly as Cedar Keys, and particularly off the Anclotes, had been ruined. These grounds had only begun to show signs of recuperation as late as 1882; their abandonment from the reefs to Cedar Keys, during the three or four years which followed the occurrence, entailed a loss estimated at \$100,000. Had it not been for the fortunate discovery, just at that time, of sponge tracts off Rock Island, northward of the Suwanee River, almost a famine in this article would have ensued.<sup>1</sup>

Too much stress, however, is now laid on this condition as a factor in the diminished supply during recent years.

#### REMEDIAL MEASURES.

With anything like fair treatment there is no reason why the Florida sponge-grounds should not only support the present drains, but permit much more extensive fishing than is now possible. The area of the grounds is so large, estimated to be over 3,000 square miles, and the growth of the sponges is so rapid that with proper precautions there is hardly a limit to the productive capacity of the beds.

Foremost among the remedial measures that are demanded I place the enforcement of the law relative to the gathering of small sponges. It is probable that the statute should be slightly modified, so as to make it more readily executed; it would doubtless be improved by having it prevent the landing or sale of undersized sponges. It is said that there is some question as to the State's jurisdiction over grounds lying beyond a marine league; if so, it is an additional reason for amending the law as indicated.

It is claimed by some that such a law is difficult to enforce, especially after years of flagrant violation. To this I take exception, and believe that the law will almost enforce itself if the State will show any disposition to encourage its observance. The sentiment in favor of the law and its impartial enforcement is remarkably strong. Dealers and vessel-owners, and others having pecuniary interests at stake, are unani-

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<sup>1</sup>The Fishery Industries of the United States, sec. v, p. 831.

mous in the belief that the law is wise and beneficial in principle and that it should be enforced; and very many of the sponge fishermen entertain the same opinion. With this feeling prevailing among the sponge interests, the question very naturally arises, Why do not the buyers and outfitters observe the law even if the State regards it as a dead letter? The answer is that as long as such small sponges have any market value the fishermen will take them to fill out their cargoes, especially when large sponges are scarce. When sponges are once landed there is no reason for buyers to refuse to take them, especially as they pay very little for them.

The statement is confidently made that if the State officers in each sponging center should announce that the law would be enforced against all vessels and boats which sailed after the date of the notice, within six months a new order of things would be firmly established, to the benefit of all concerned.

The opinions of the fishermen themselves as to remedial measures should not be given too much weight. Very many of them are aliens (Bahama negroes), and few of them have any pecuniary interests at stake. The men owning vessels and having capital invested in the sponge trade are those whose views are entitled to consideration.

The present legal minimum size of sponge is almost unanimously regarded as too low by those pecuniarily interested. A sponge 4 inches in diameter across the top is very small and has little market value. There is a general sentiment favorable to an increase of the legal size to 5 inches, and some persons favor even a larger standard.

In order to permit the recuperation of the exhausted grounds and prevent the absolute depletion of beds, the prohibition of sponging on certain grounds for definite periods has been suggested, and meets with general approbation. A sponge merchant of Key West, who has devoted much attention to the subject, writes as follows regarding this matter:

Let nature do its work by allowing it sufficient time. This can be done by dividing the area of the sponge-grounds at sea into squares each of 100 miles, more or less, and then allowing the fishermen to gather sponges only in certain squares each season of the year. According to all reports, on some grounds sponges grow much faster than on others. They have been noticed to grow to full size inside of four months in certain localities along this coast, while at other localities it takes young sponges at least six months to grow to full size. This fact can be put to advantage by restricting sponge gathering during several months on certain grounds, during which time the sponge fisherman can gather sponges on the other parts of this coast. However, as it is necessary to the sponge fishermen to have not only good weather, but also clear water, so as to enable them to see the bottom and to locate the sponges, it may happen that when they are out on their expeditions they may meet with muddy water on the unrestricted sponge-grounds of the season, while on the restricted grounds during that season the water may be clear and just in condition to allow them to locate and to gather the sponges. As the benefit that sponge fishermen could derive from the above restriction of certain grounds during certain seasons of the year would soon be important and lasting, it seems to me that no proper objections could be offered to the method.

In a report<sup>1</sup> on "The Fish and Fisheries of the Coastal Waters of Florida," the United States Fish Commissioner suggests that sponging on the grounds of Biscayne Bay and the Florida Keys be permitted only during a specified part of any period of twelve months, and that fishing on either the Anclote or Rock Island grounds be allowed only once in any period of twenty-four months, so arranged that the Anclote

<sup>1</sup> Senate Document No. 100, Fifty-fourth Congress, second session; also Report U. S. Fish Commission for 1896, pp. 263-342.

region may be open to unrestricted fishing one year and the Rock Island grounds the next.

Whatever action is finally taken by the State in this matter, there should be a careful preliminary investigation by a competent board, which should inquire into the special conditions in the different parts of the sponge region and determine the boundaries of the areas to be successively brought under restrictive provisions.

A final remedy for arresting the decrease in the sponge supply is the cultivation of sponges, the necessity for which depends to a large degree on the carrying out of the foregoing measures.

#### CULTIVATION OF SPONGES FROM CUTTINGS.

The growing of sponges from clippings may be said to have almost passed beyond the experimental stage, since the possibility of the procedure has been amply demonstrated. At the same time, the business of producing marketable sponges from clippings has not been engaged in, although there seem to be no insurmountable difficulties in this country at least; and the present indications are that before five years have elapsed private sponge-farms will have become established on parts of the Florida coast.

There are various reasons why the artificial growing of sponges should receive attention. In the first place, sponge-culture should partly arrest the further depletion of the natural grounds by diverting the energies of some of the spongers in the direction of the possibilities of the now barren grounds. If the cultivation of sponges becomes established along the many hundreds of miles of suitable coast, it will certainly prove a profitable employment to a large number of people, either independently or in connection with other branches of industry. Furthermore, the increase in the output which must follow the successful inauguration of sponge-culture will reduce the dependence of the United States on foreign sponges. Finally, the State may with great propriety obtain a revenue from this source.

The lines along which the planting of sponges must be conducted have been indicated in the different experiments already made, to the printed accounts of which those especially interested are referred.<sup>1</sup> No detailed statement of the methods employed by various experimenters is necessary for the purpose in view in the present paper.

It may be stated, however, that thirty-five years ago the question of artificial propagation of sponges received attention in Europe and was under consideration for ten years; that nearly twenty years ago limited experiments were conducted at Key West; that in 1889, 1890, and 1891 some very interesting trials were made in Biscayne Bay; and that at present the matter is receiving serious attention in the vicinity of Key West, where planting has begun on a commercial basis.

While the work of Mediterranean experimenters was of a more systematic and

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<sup>1</sup> Reference is especially made to the following articles: (1) Experiments in sponge-culture at Key West about 1880: The Fishery Industries of the United States, sec. v, vol. 2, p. 832. Reprinted in Senate Document No. 100, second session, Fifty-fourth Congress, being a report of the United States Fish Commission on the coast fisheries of Florida. (2) Sponge-cultural experiments in the Adriatic Sea, 1863-1872: Die Aufzucht des Badenschwammes aus Theilstücken, by Dr. Emil von Marenzeller, Vienna, 1878. An abridged translation appears in the Fishery Industries of the United States, sec. v, vol. 2, pp. 833-836; the latter is also reprinted in the Senate document named. (3) Account of Sponge-cultural experiments in Biscayne Bay, 1889-1891, by Ralph M. Munroe. Contained in Rep. U. S. Fish Com. 1895, pp. 187, 188.

prolonged nature than that of our own countrymen, it can not be said that their results were as striking or encouraging. Their studies, which were supported by the Austrian Government and merchants of Trieste, were finally abandoned, owing to the hostile attitude and depredations of the fishing population.

The following are some of the special facts that have been established by the experiments in this country and abroad:

(1) Sponges may be cut into small pieces, which will live and grow if properly attached in suitable water. They may be cut in water or on a moistened board with a knife or fine saw. Care must be exercised not to express the soft matter. The preferred size of the cuttings is about an inch broad and a little more in height. The outer skin is to be retained as far as practicable. In cutting, the lines of the circulating canals should probably be considered, although pieces cut without any reference to the direction of the canals have lived and grown.

(2) Exposure of the sponge to the air in making and fixing the cuttings is not injurious, unless prolonged or in very warm weather. This is contrary to a prevalent impression, but seems to be amply proved. Mr. Munroe, in his experiments in Biscayne Bay, found that clippings from sponges that had been exposed several hours lived and grew; and in the Adriatic Sea sponge cuttings kept out of water, in a shady place, for eight hours in February, the air temperature being 48° F., took root when planted. It is probable, however, that in the case of larger sponges, when removed from their element, the weight of the contained water may have a crushing effect on the soft parts concerned in nutrition and thus retard growth in the clippings subsequently made therefrom. In a high temperature the sponges have a tendency to rot, hence the winter is regarded as the best time for planting.

(3) Clippings may be made from distorted sponges having little market value, and will assume a symmetrical shape during growth. A healthy cutting will become firmly attached to a surface comparatively soon if it does not move. Even as short a time as 24 hours has been sufficient, in the European experiments, to secure attachment during the prevalence of warm weather.

(4) The possible methods of attachment are various. This is a very important step, and probably the ideal practice is still to be determined. The things to be accomplished are: (a) to make the clipping fast pending the time when it will naturally take root; (b) to employ for this purpose some material that is not injurious to the sponge and will not distort its growth; (c) to place the attached clippings on the bottom in such a way that they will maintain the upright position and not be smothered by mud, sand, or sediment. The sponge clippings have been attached to boards, frames, poles, and different kinds of wire. The wooden parts are liable to attacks of worms, and some kinds of wire are injurious because of the chemical decomposition that ensues in salt water. The use of bamboo pegs seems to have given much satisfaction.

In Europe, the cuttings appear to have been placed at depths of 16 or 23 feet, light being considered an objection, but in Florida the experiments have been conducted in water from 8 feet to less than 1 foot deep at low tide, and good results have been had at the shallowest depths.

(5) The rate of growth in Florida waters is comparatively rapid. It is a common experience of spongers to find marketable sponges on grounds that had been thoroughly depleted of all salable sponges in the previous year, and the results of

experiments bear out this point. In as short a time as one year, under favorable conditions, the cuttings will attain a marketable size, and certainly within sixteen or eighteen months the harvesting of relatively large sponges may be depended on. These results are in marked contrast to those in the Adriatic, where the rate of growth was so exceedingly slow as to seriously militate against the feasibility of sponge propagation in those waters. The person in charge of the experiments states that "the clippings grow two or three times their original size during the first year," and that, "although some pieces will grow to a considerable size in five years, it will require seven years to raise completely matured sponges which are fit to become an article of merchandise." A writer who reviewed the experiments very pertinently remarked:

The profitableness of sponge-culture would be far more evident if there was not such a long interval between planting and harvesting; in other words, if the sponges would grow more rapidly. This was certainly looked for when the enterprise was started; but it is dispiriting to have to wait for your crop for seven long years.

The attitude of the State toward the project to increase the supply of sponges by artificial means must necessarily exert considerable influence on its success. Adequate encouragement and authority should be given by the Commonwealth to those desiring to engage in this enterprise, to be supplemented by ample protection from poachers after grounds have been planted.

Artificial sponge-grounds are susceptible of the same methods of regulation that have proved of value in the case of the oyster. The State might levy a tax, which would defray the expenses incurred in protecting the growers, but if such action is calculated to discourage the business it should not be broached until the industry has been placed on a substantial footing.

The area of barren bottom which one person may be allowed to appropriate should be limited, so that no monopoly will be created and the undertaking of the enterprise by numerous small planters be encouraged. The project is popular with many of the persons already interested in the sponge industry. Some, however, have expressed the fear that the best planting-grounds will fall into the hands of a few persons, who may in time secure control of the industry. The fear also exists among some of the sponge fishermen that extensive planting may deprive them of a livelihood, but there is little or no basis for such apprehension. Sponge-planting will give employment to many additional persons, and probably will indirectly prove of benefit to those who sponge on the natural grounds, by diverting some attention therefrom and permitting a larger growth thereon.

#### PROPOSED INTRODUCTION OF MEDITERRANEAN SPONGES.

While for general purposes there is no better sponge than the Florida sheepswool, some of the foreign sponges, used in surgical practice and in other special branches, are more delicate, and yield a much higher price per pound than any native species. Some of the small Levant toilet sponges bring as much as \$50 a pound, and the consumption of these high-priced sponges in the United States is quite large.

The possibility of transplanting in our own waters some of the best of the foreign sponges, in order that our own fishermen may reap the benefits of the high prices, opens up a very interesting subject. It has been thought that a very small colony, properly nurtured, would, under favorable conditions, form a nucleus from which a

large area might eventually be stocked. This subject has been discussed to some extent by those interested in the sponge industry, and the United States Fish Commission has been urged to make the experiment. The transplanting of Mediterranean sponges to the Bahamas has also been under consideration in Great Britain.<sup>1</sup>

The transportation of Mediterranean sponges to this country would involve difficulties which readily suggest themselves. There seems little doubt, however, that the project would be practicable by the use on the transporting vessel of tanks in which water could be kept aerated and of a suitable temperature.

If the acclimatization of Mediterranean sponges in Florida waters were accomplished the ultimate results of the experiment would still be problematical. It is a question whether, under the changed and less favorable environment, the introduced sponges would retain their superiority, or at least exhibit it in their offspring. Mr. Bidder states that the calcareous sponges exhibit a remarkable susceptibility to changes in environment, and thinks it not impossible that the progeny of the imported sponges would be similar in quality to the native sponges. The experiment is, however, worthy of the attempt.

There is a remarkable similarity between the marketable sponges of Europe and those of America. Hyatt thinks it evident that the Mediterranean sponges originated in the Caribbean Sea. The three leading American species (sheepswool, yellow, and glove) correspond respectively with the leading sponges of Europe (horse, Zimocca, and bath).

As to the cause of the superiority of the best Mediterranean sponges over our native sponges, there is some diversity of opinion, and different factors probably have their influence. An eminent American authority in considering this question expresses the opinion that the superiority may be due in part to the greater depth at which the Mediterranean sponges are taken, the deeper water being of better quality than the shallower, because freer from sediment, which is detrimental to the growth of the finest grades of sponge. Milky water (i. e., water made opaque by sediment) is incompatible with the best quality of sponge. While the coral reefs of the Florida coast, as in the Mediterranean, furnish excellent material for the attachment of sponges, the reefs in our own country are more exposed than in the Mediterranean, and large quantities of limy sediment are washed from them by the waves, a condition which does not exist to a conspicuous degree in the Mediterranean, where the coarsest species of sponges are found at those depths and in those situations exposed to the injurious influence of suspended matter. In the case of different grades of the same sponge the coarsest are in the shallower water. Coarseness consists in the greater stiffness and harshness of the skeleton, and is usually associated with a looser or more open structure—that is, a greater number of canals. It is this latter feature that is perhaps the most constant difference between the best Mediterranean sponges and the best Florida sponges.

The finest Mediterranean sponges grow in water having a surface temperature in winter of 50° to 57°, the mean air temperature at that season being from 63° to 70°. The sponges which occur in deeper water off the coast probably are not exposed to a colder temperature than 60° or perhaps 50° in January.<sup>1</sup> This differs considerably from the conditions on the southern coast of Florida, as shown by the following table,

<sup>1</sup> Note on projects for the improvement of sponge fisheries, by George Bidder. *Journal Marine Biological Association of the United Kingdom*, IV, No. 2, Feb., 1896.



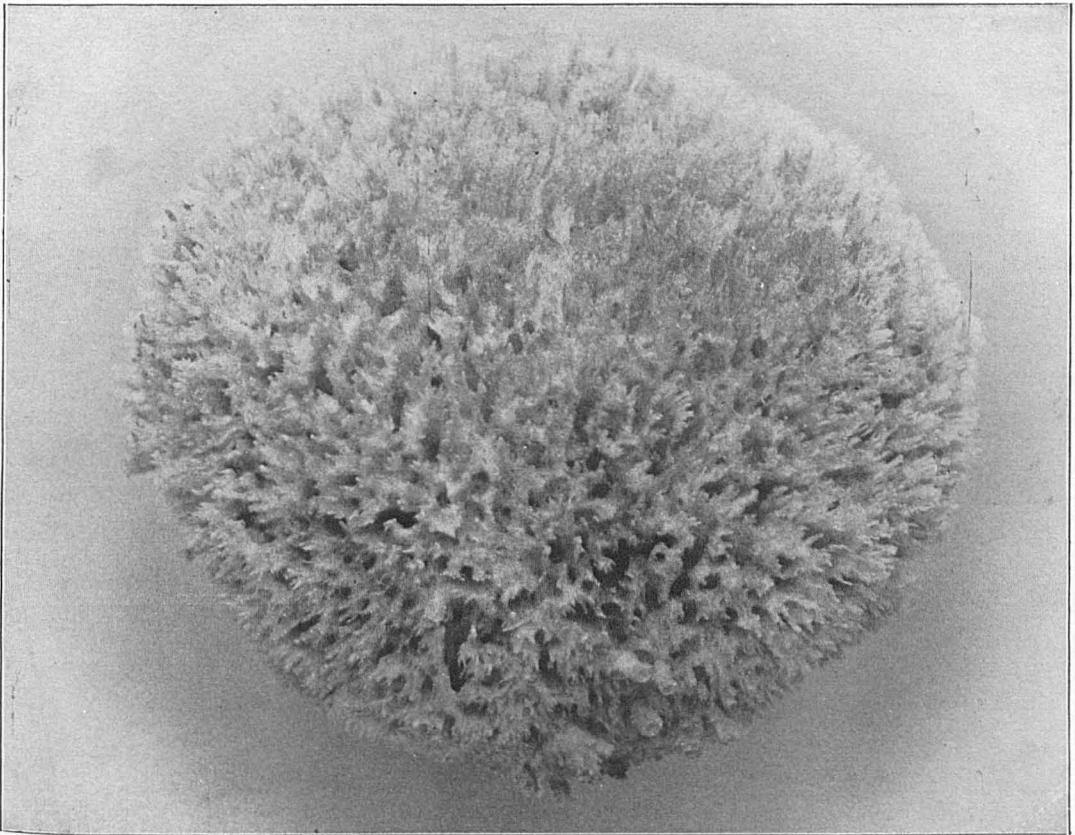
which gives the temperature of the air and surface water as observed at three light-houses in the sponging region. It is stated by Bidder (loc. cit.) that "the Levant variety lives where the atlas shows a mean annual [air?] temperature of about 7° F. below that of Florida, and the Adriatic variety at a mean temperature of about 7° F. lower still."

*Statement of the mean air and surface water temperatures at points on the coast of Florida in the vicinity of the sponge-grounds.*

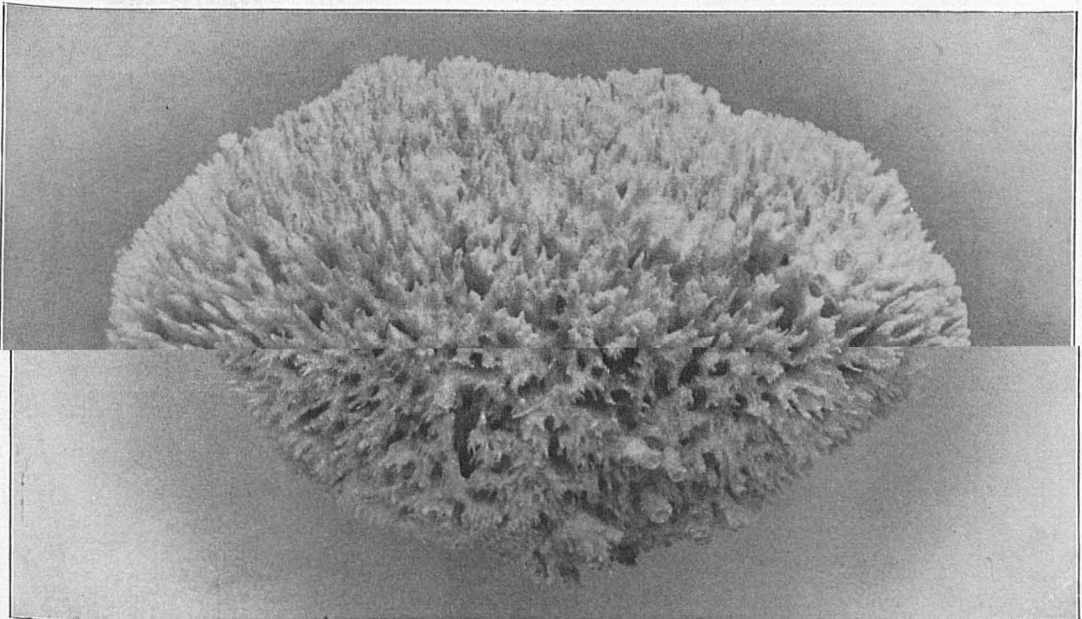
[Depths of water where observations are made: Fowey Rocks, 5 feet; Carysfort Reef, 3½ feet; Dry Tortugas, 4 feet.]

1895.	Fowey Rocks.		Carysfort Reef.		Dry Tortugas.		1896.	Fowey Rocks.		Carysfort Reef.		Dry Tortugas.	
	Air.	Water.	Air.	Water.	Air.	Water.		Air.	Water.	Air.	Water.	Air.	Water.
January ....	° F. 70.41	° F. 72.98	° F. 70.95	° F. 71.98	° F. 71.47	° F. 73.03	January ....	° F. 74.60	° F. 69.18	° F. 69.20	° F. 72.20	° F. 68.93	° F. 70.17
February ....	68.87	68.71	64.17	70.45	66.48	67.93	February ...	72.38	70.47	69.38	72.31	68.87	70.15
March .....	73.23	73.45	72.32	72.16	73.87	73.41	March .....	76.85	72.13	72.37	72.05	71.22	70.43
April .....	75.50	74.78	75.35	73.53	76.20	74.98	April .....	76.40	75.10	77.37	76.45	76.41	75.61
May .....	78.40	78.18	79.85	78.45	81.27	80.07	May .....	83.77	79.60	80.50	78.31	81.02	79.41
June .....	80.35	79.38	83.22	81.73	83.25	81.01	June .....	85.85	82.06	83.47	81.90	82.82	82.01
July .....	82.83	82.70	86.60	85.40	84.32	84.01	July .....	86.48	85.23	84.80	83.00	83.25	82.60
August .....	83.93	83.75	84.42	84.30	85.05	84.97	August .....	88.58	86.58	85.88	87.74	85.02	85.73
September ..	84.47	84.70	84.13	84.31	84.33	84.60	September ..	87.53	86.16	85.03	85.73	84.13	84.88
October .....	79.47	78.88	82.75	81.38	81.27	80.97	October .....	83.15	82.18	82.92	81.15	81.98	81.08
November ...	75.82	75.88	77.50	77.48	77.87	78.13	November ..	83.45	82.00	80.90	79.51	77.75	79.28
December ...	74.58	71.64	69.75	73.54	70.75	73.45	December ...	77.11	72.62	72.63	75.68	71.95	74.60
Annual mean .	77.31	77.08	77.58	77.89	78.01	78.04	Annual mean .	81.32	78.66	78.68	78.49	77.86	77.99

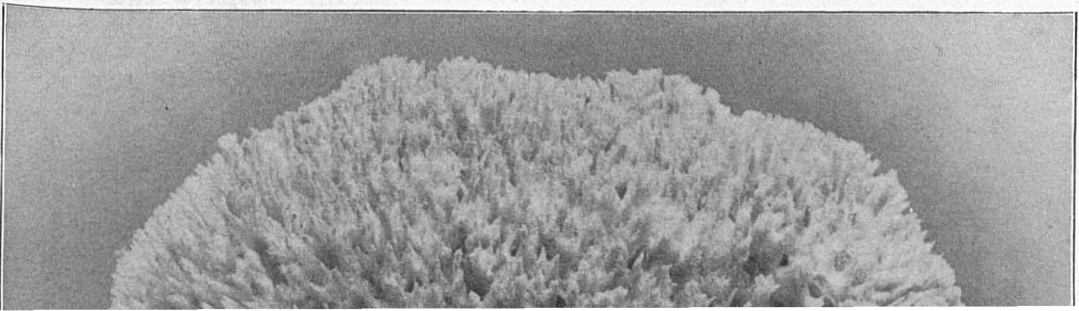
WASHINGTON, D. C.

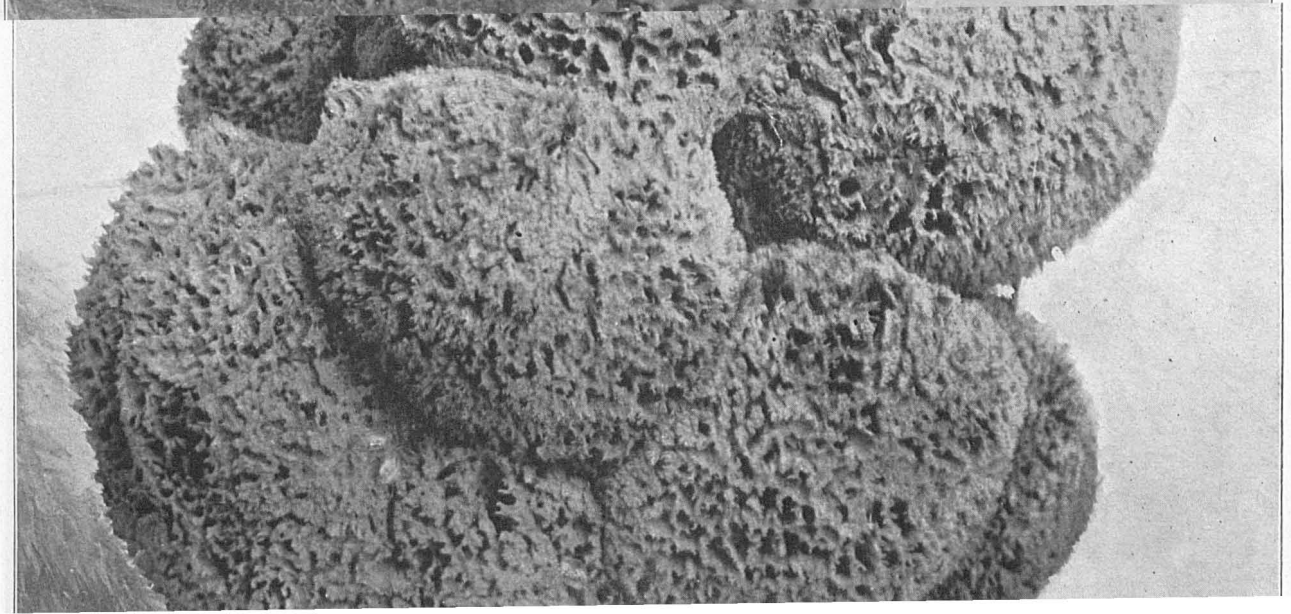
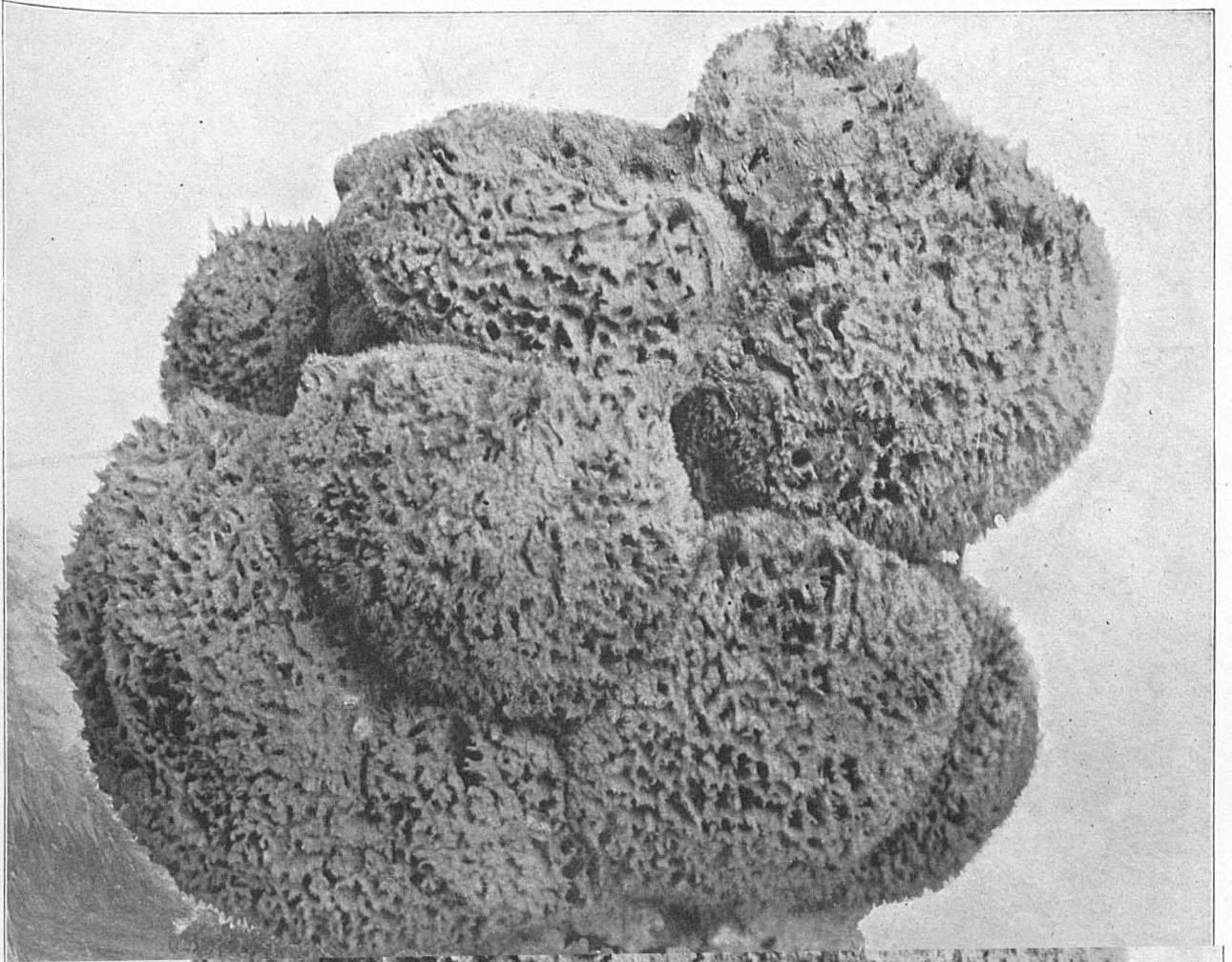


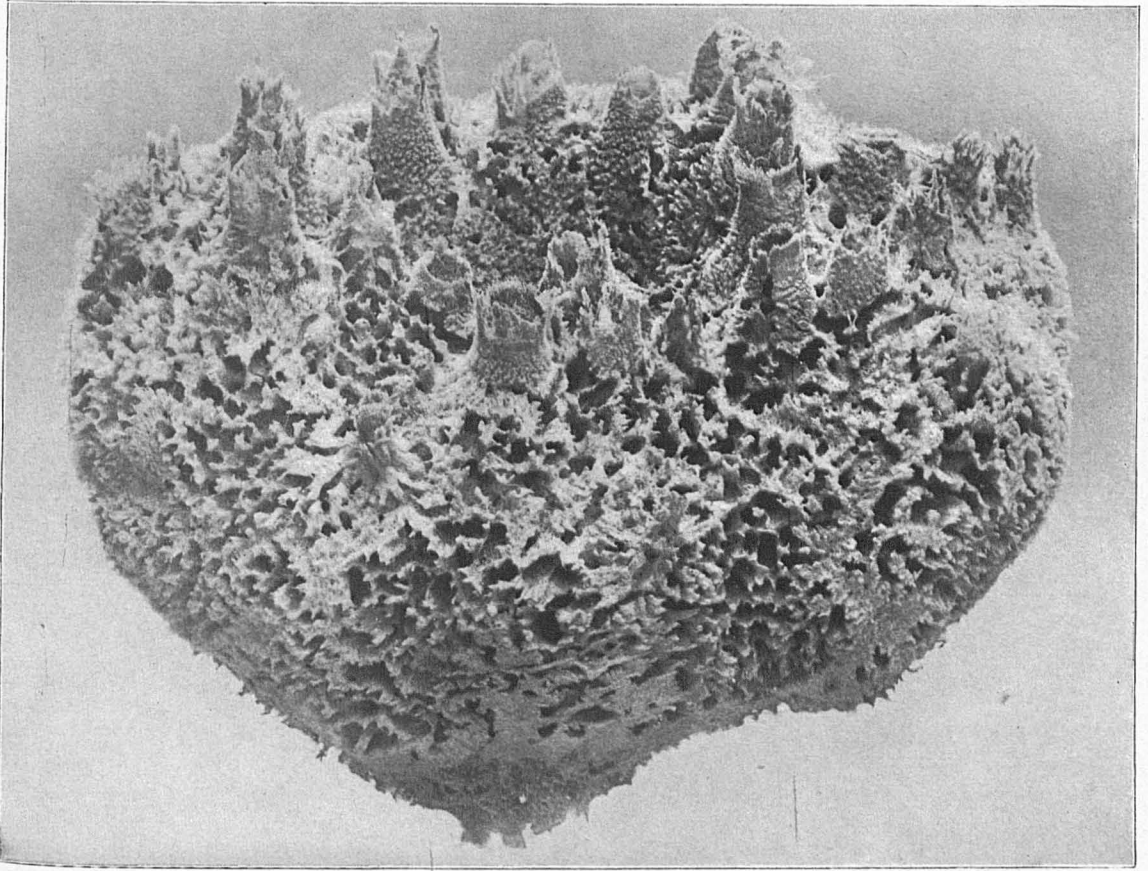
SHEEPSWOOL SPONGE. From Matecumbe Key. Diameter, 8½ inches; weight (dry), 2½ ounces.



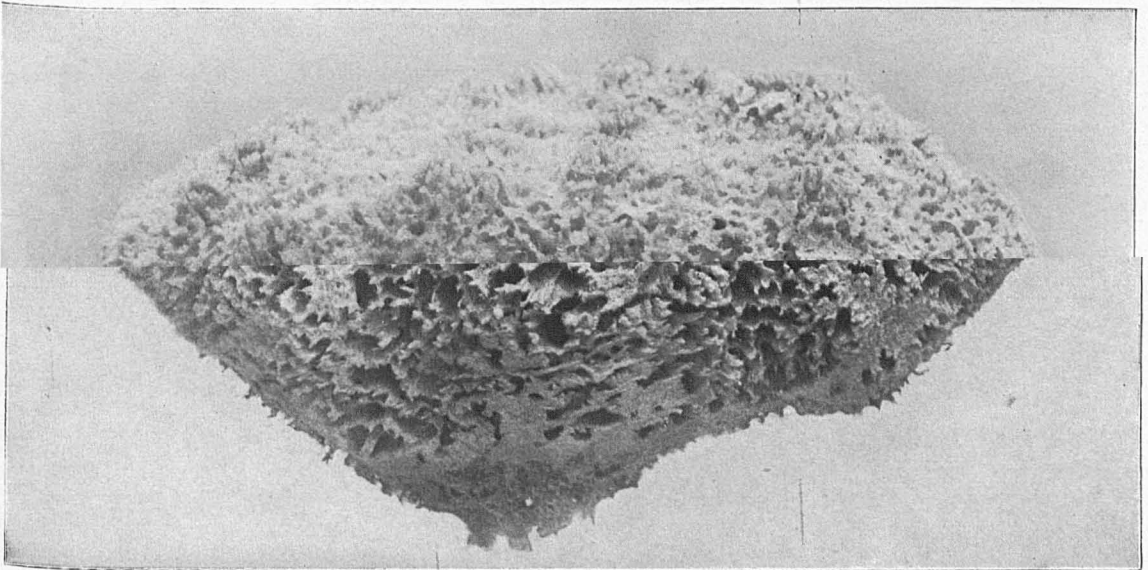
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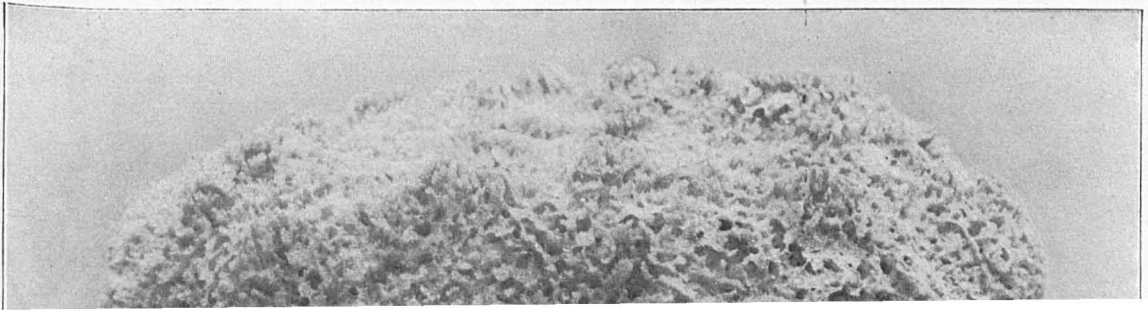


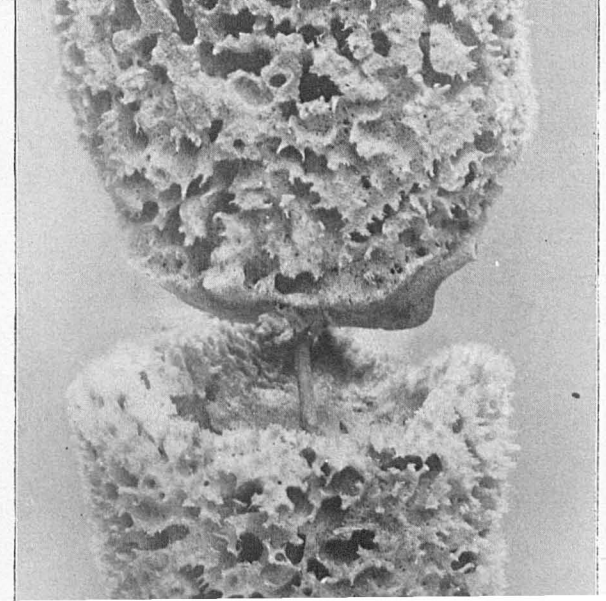
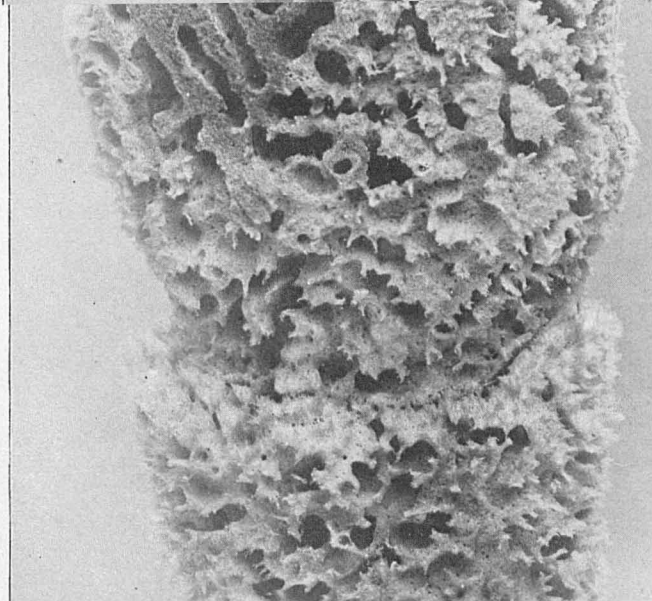
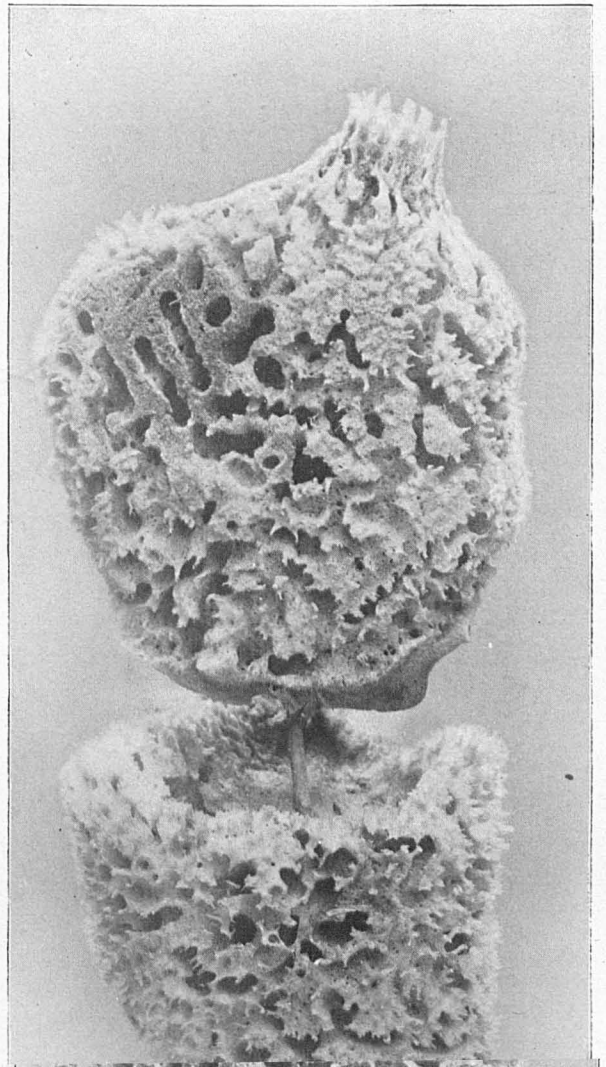
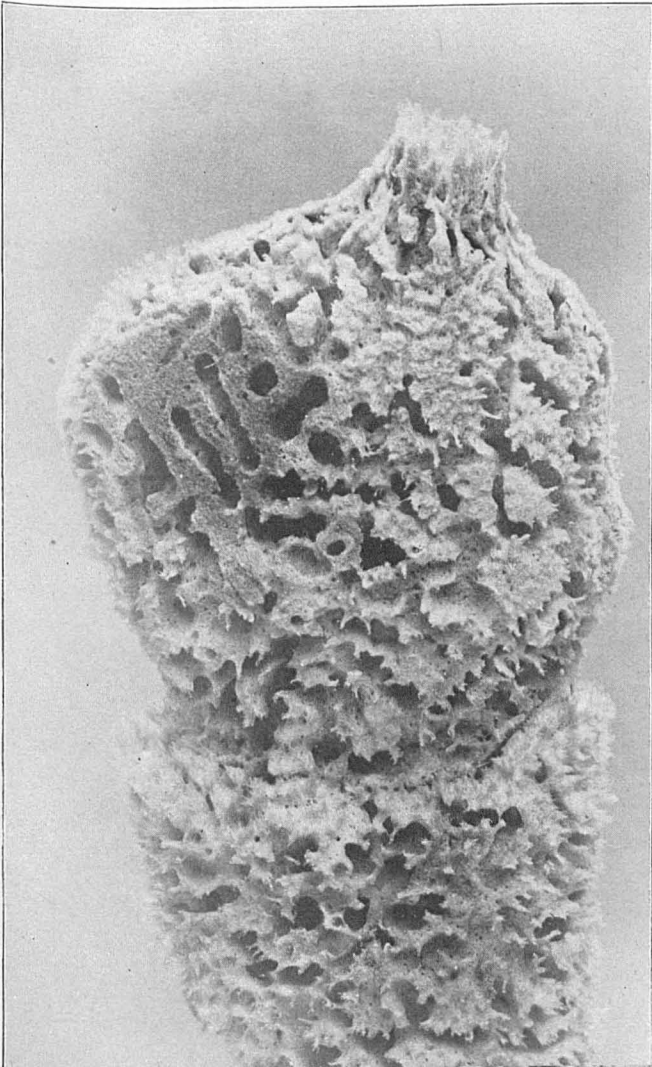


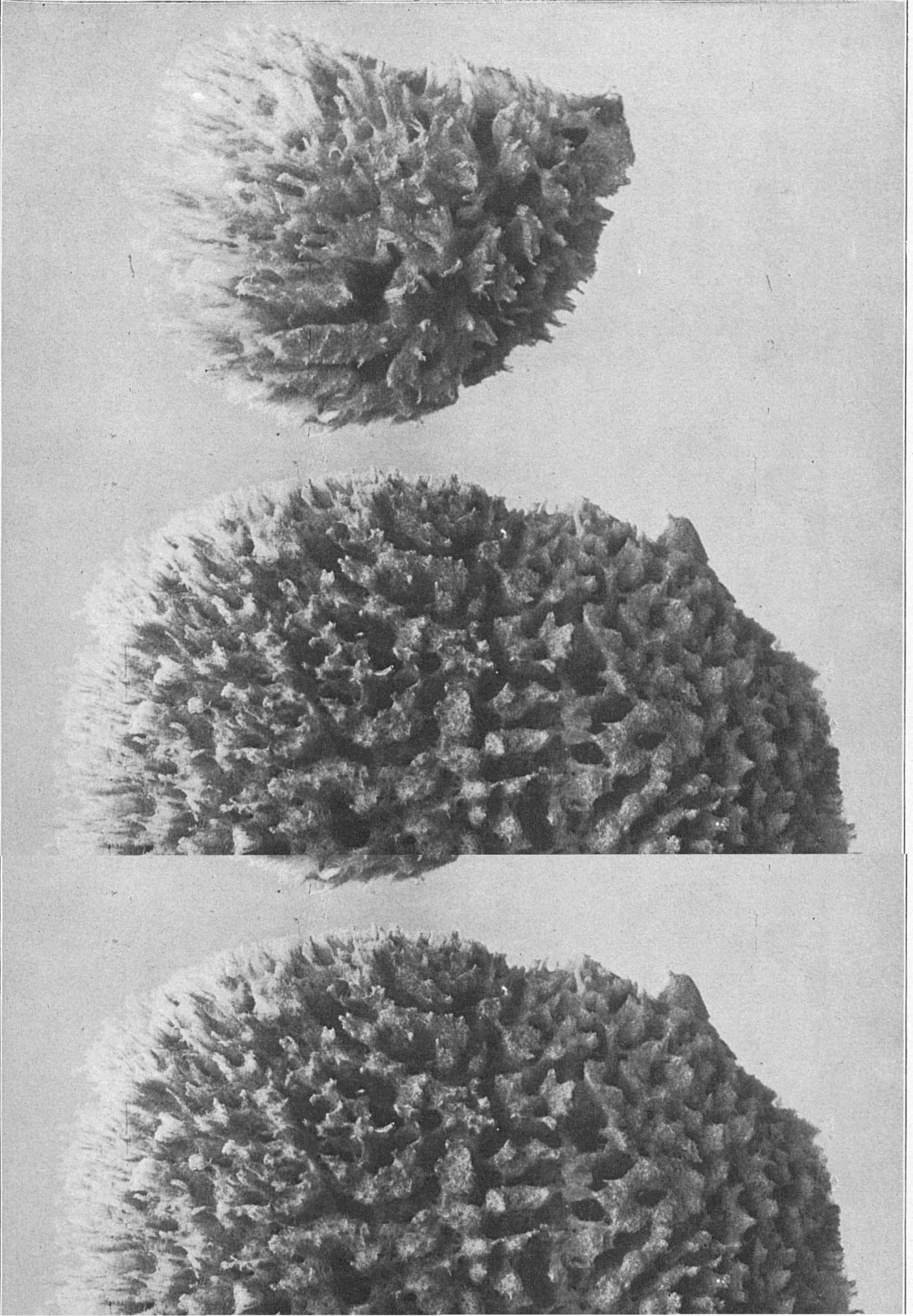
SHEEPSWOOL SPONGE. From Florida Keys. The craters or oscula very prominent. Diameter, 12 inches; weight (dry), 5½ ounces.

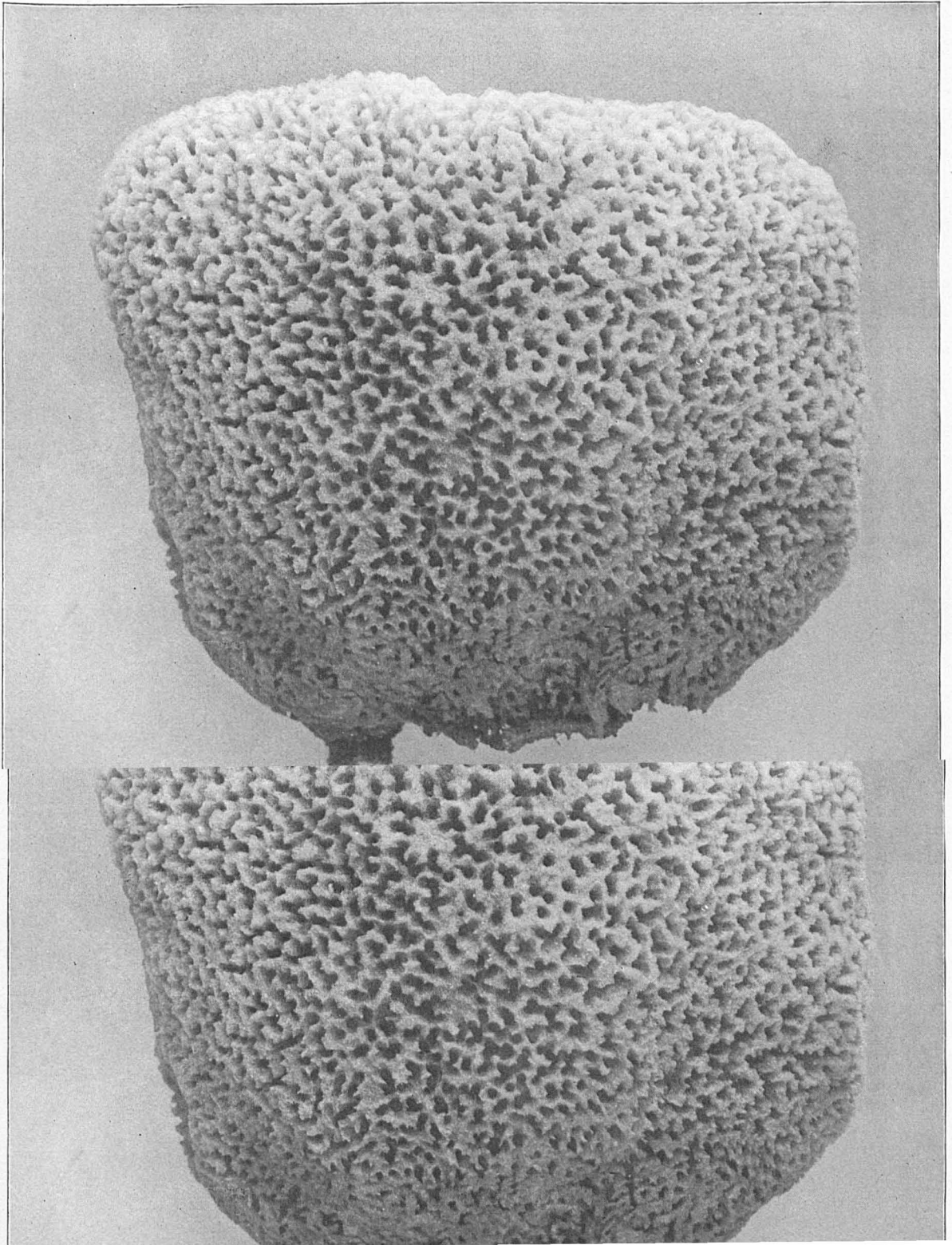


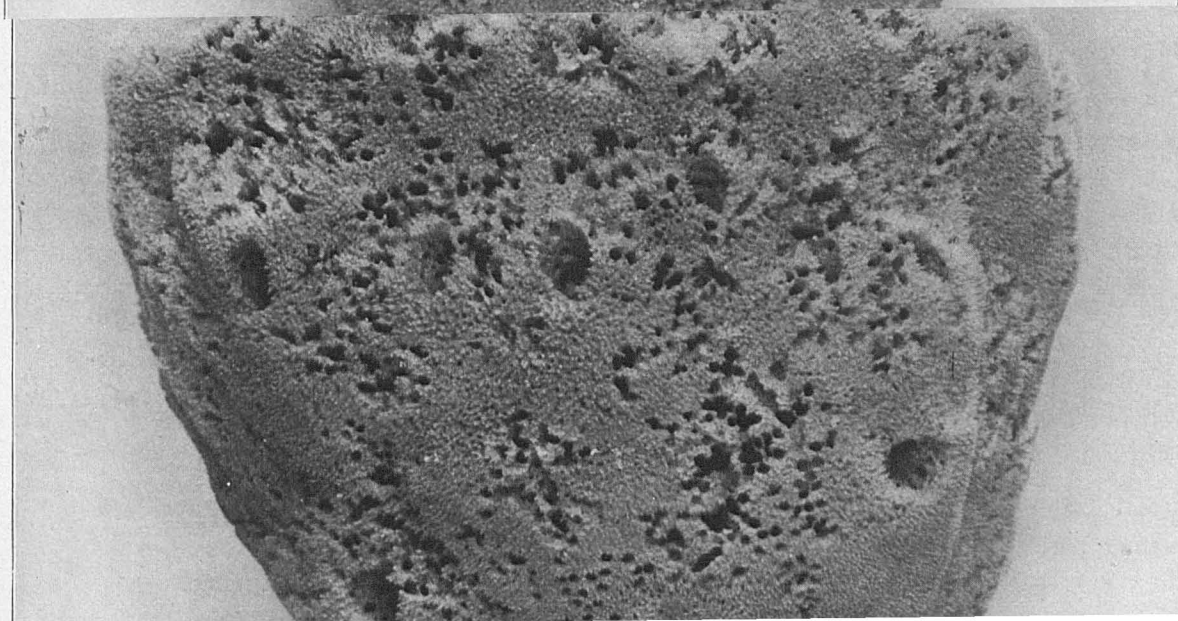
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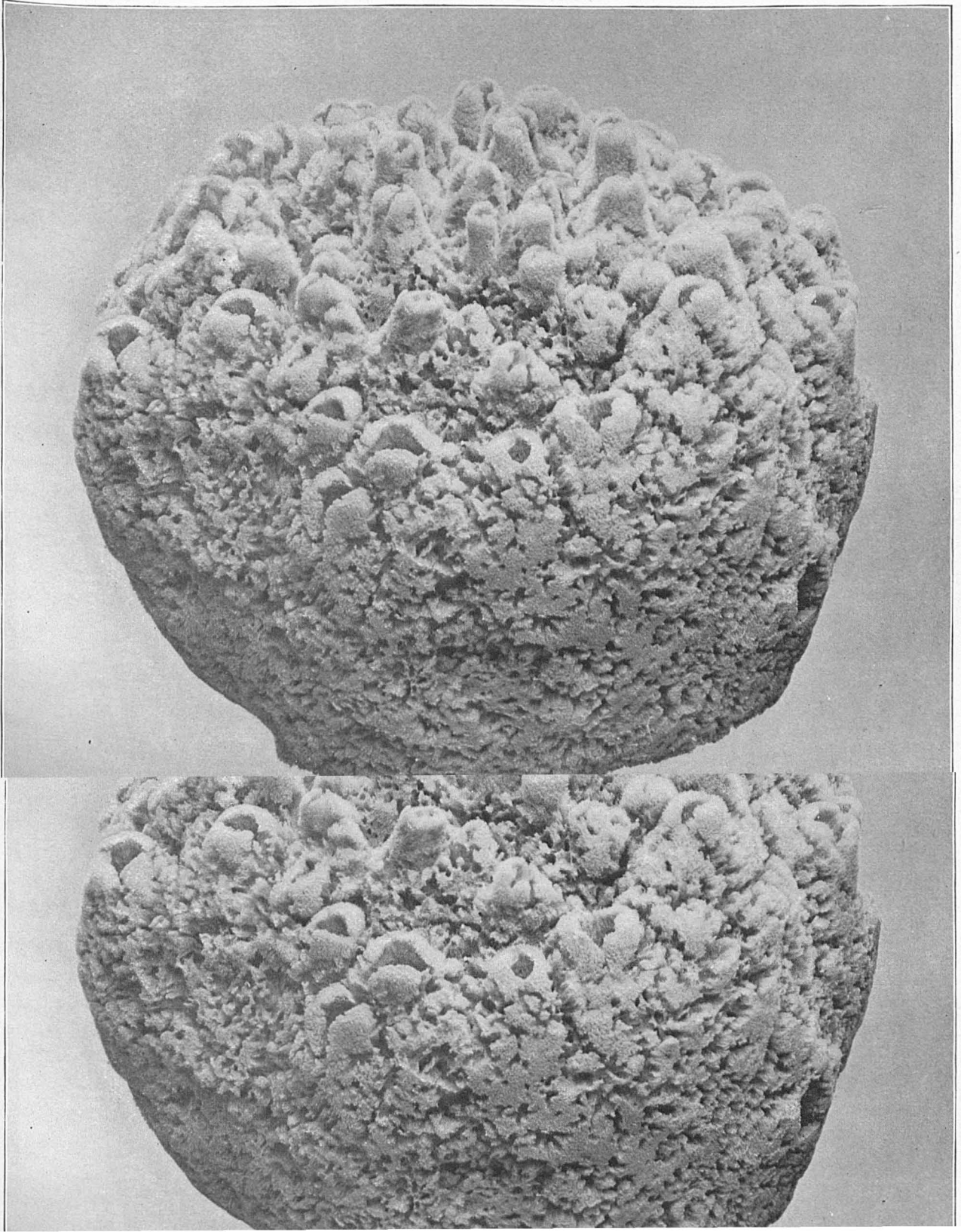


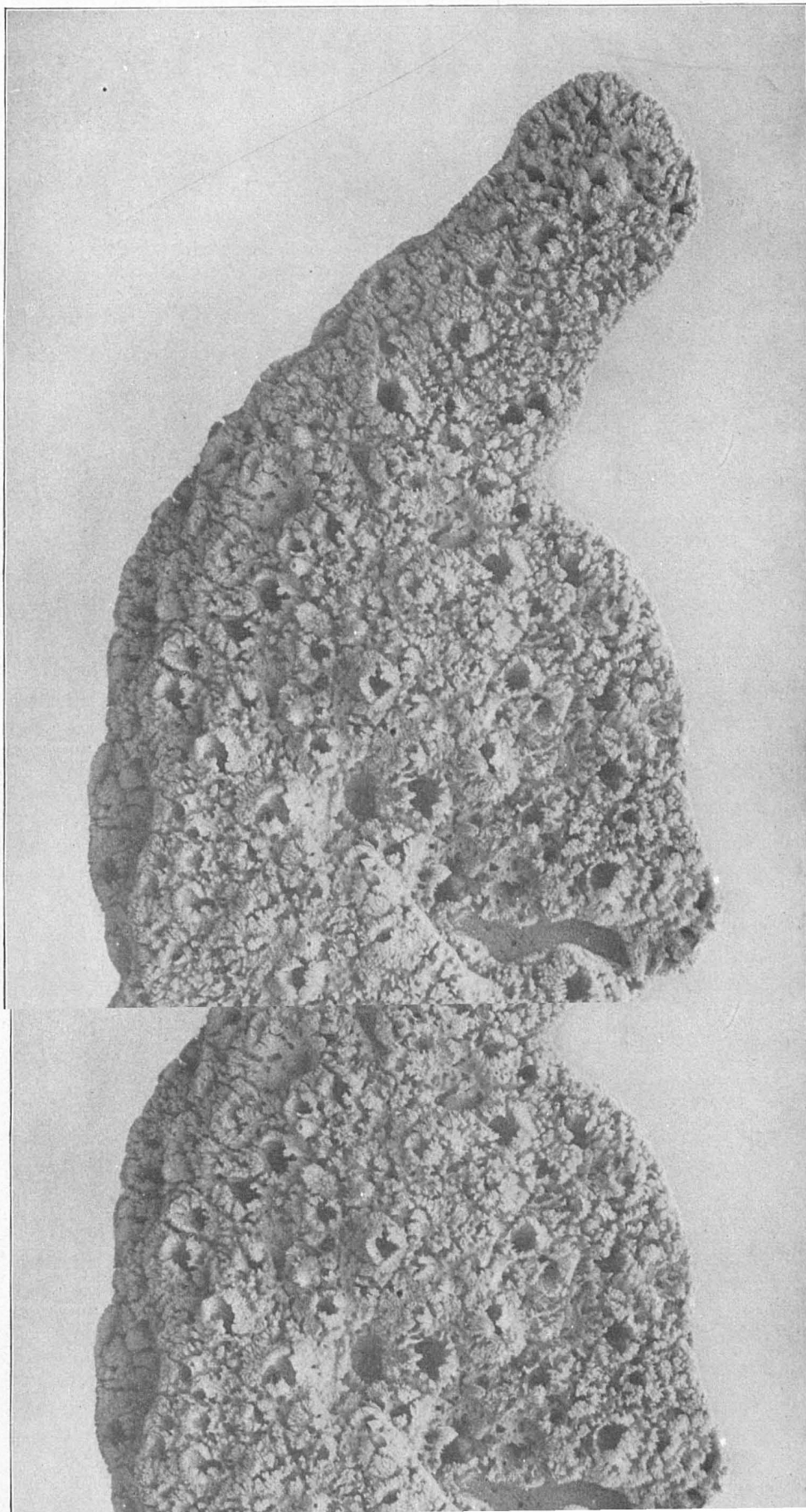


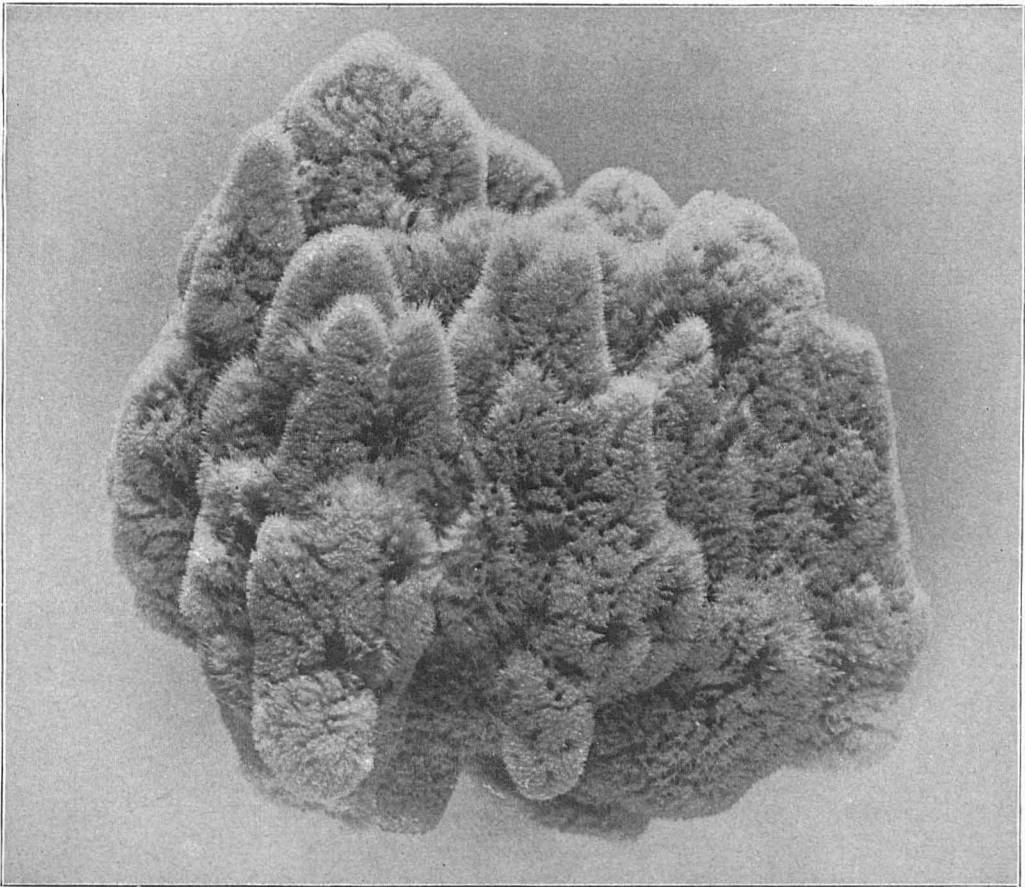




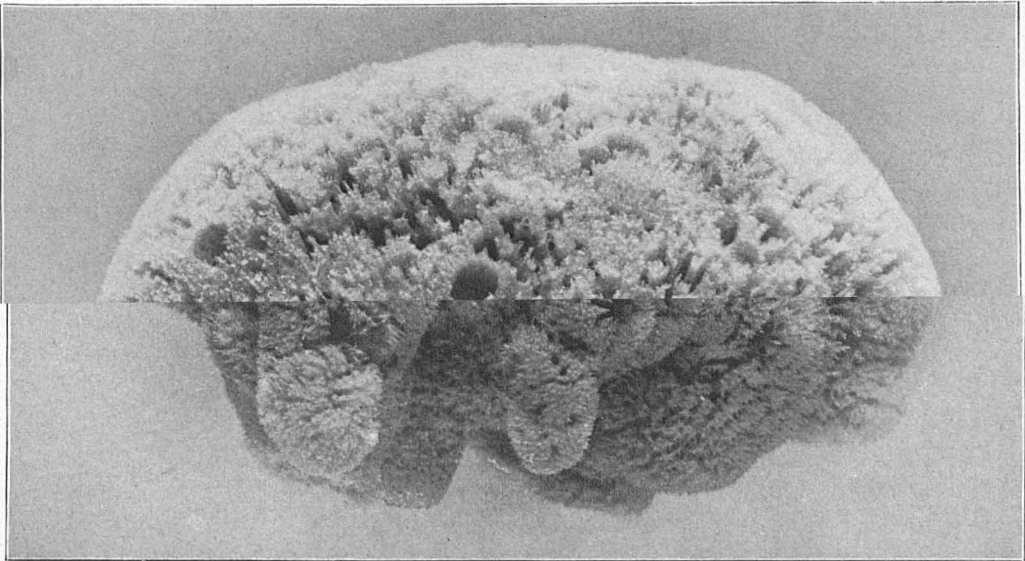




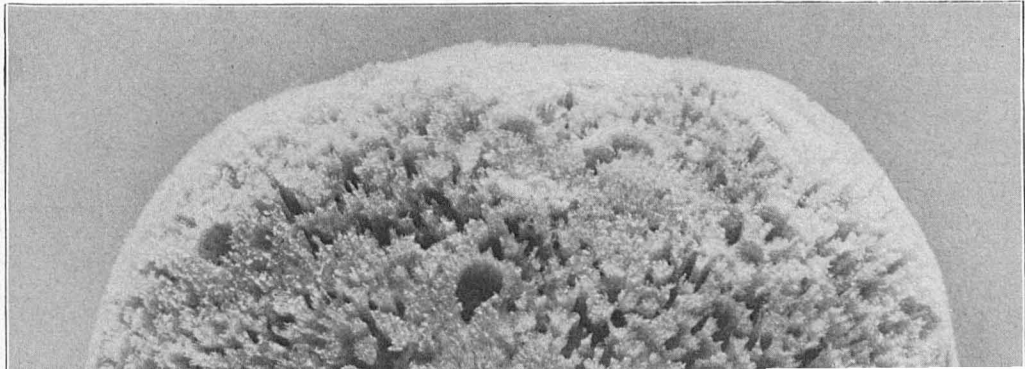


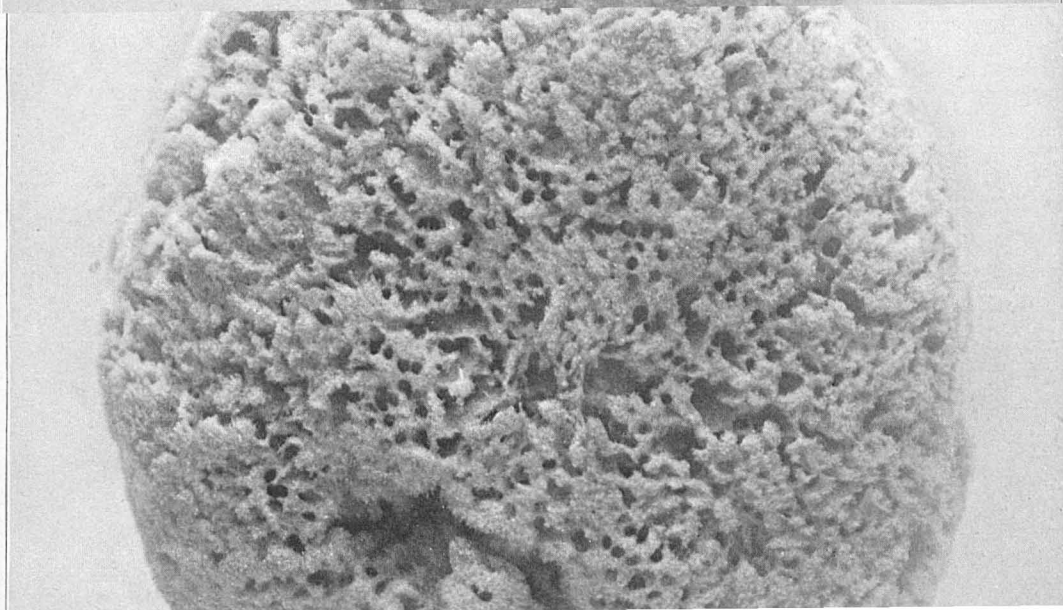
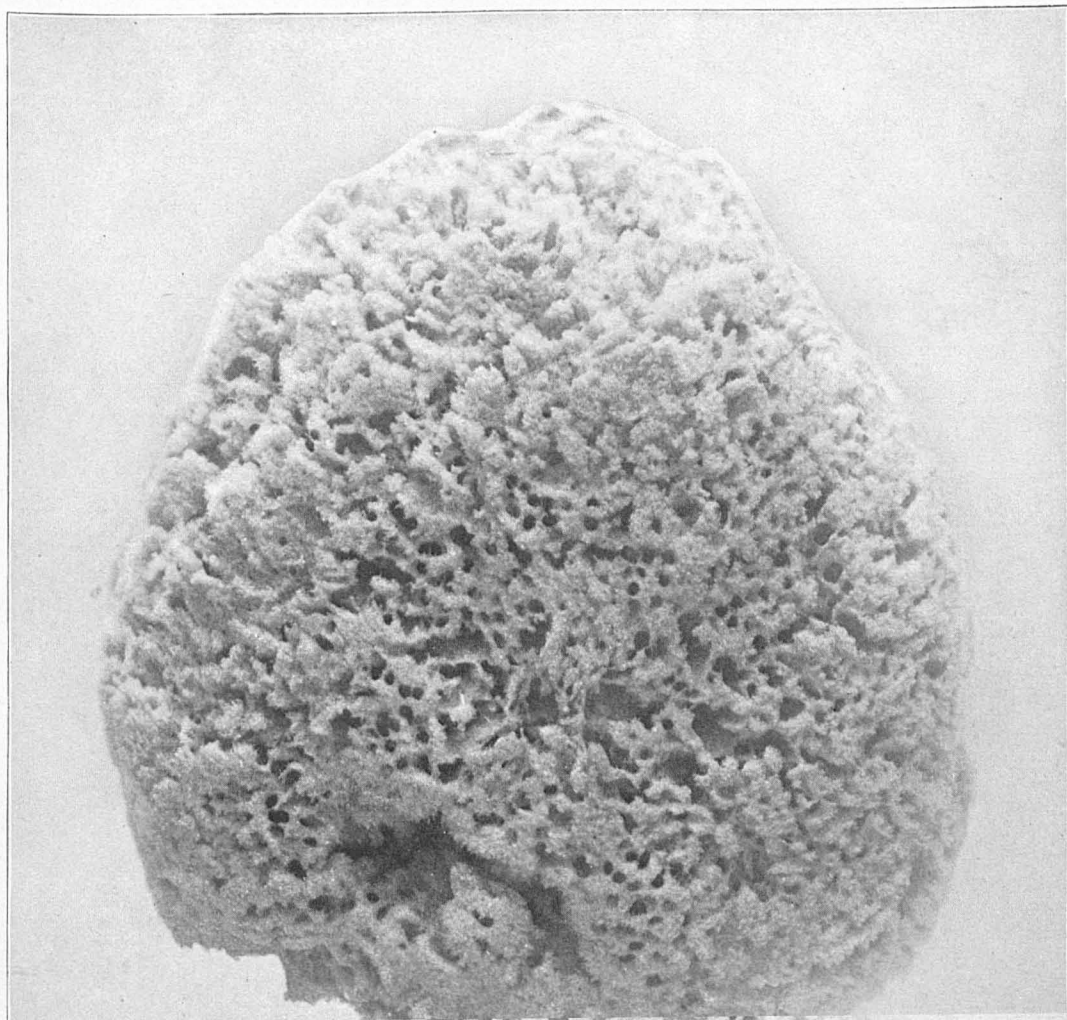


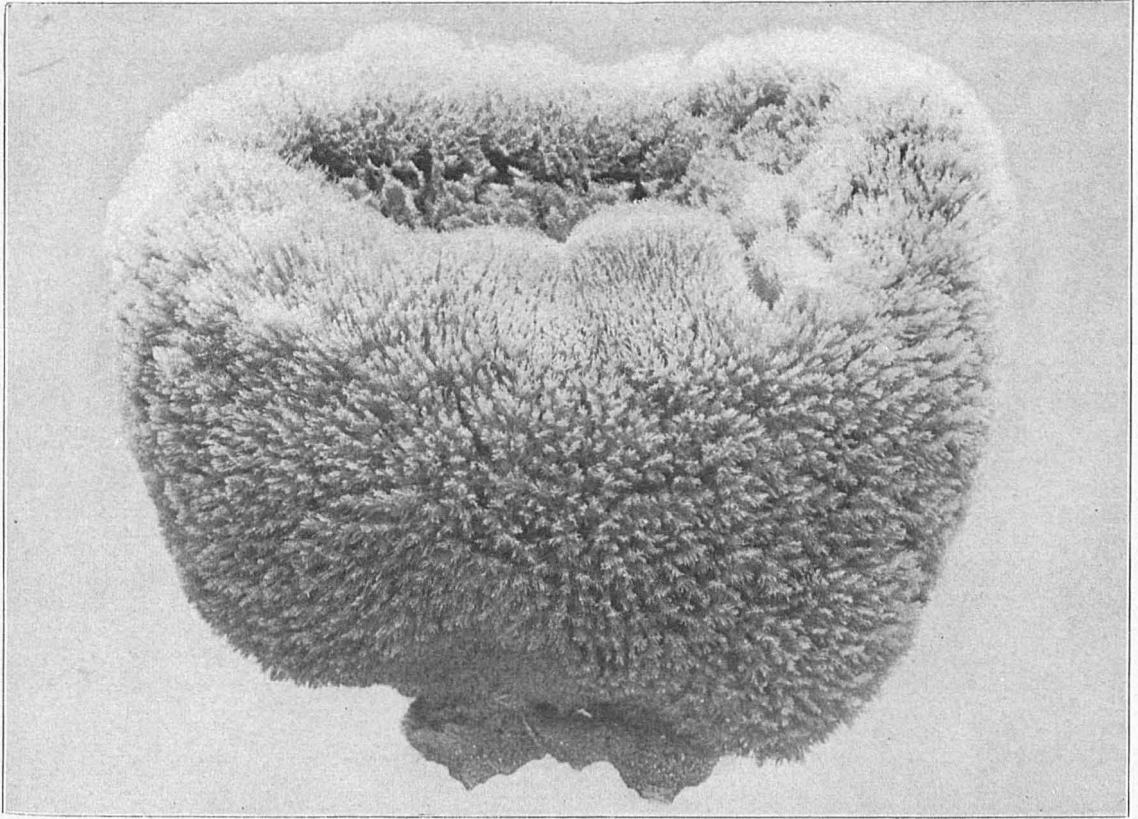
YELLOW SPONGE. (Locally called "Hardhead.") From Florida Keys. Diameter, 5½ inches.



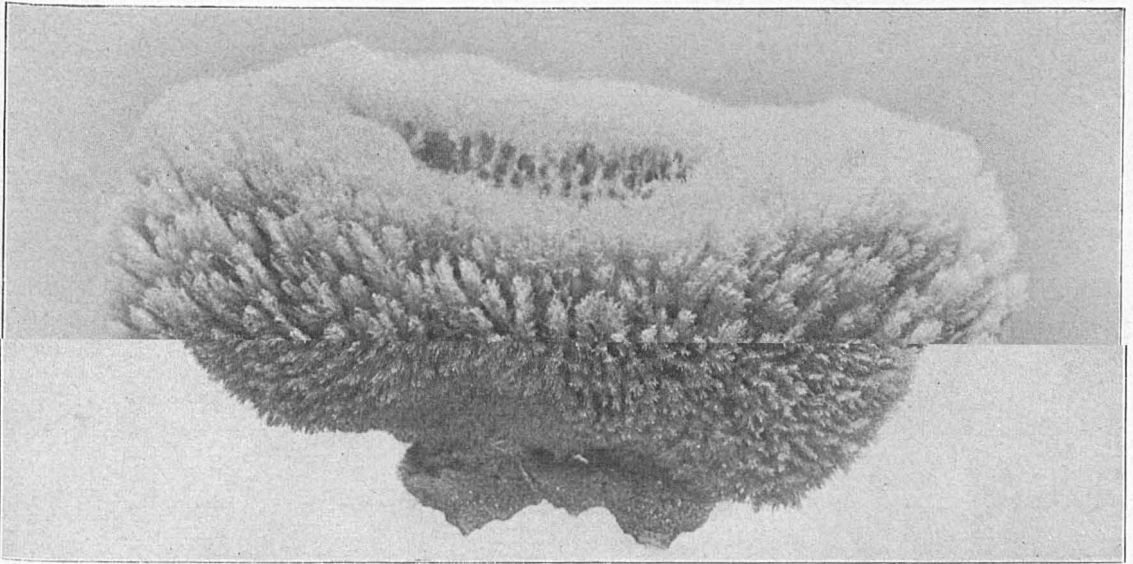
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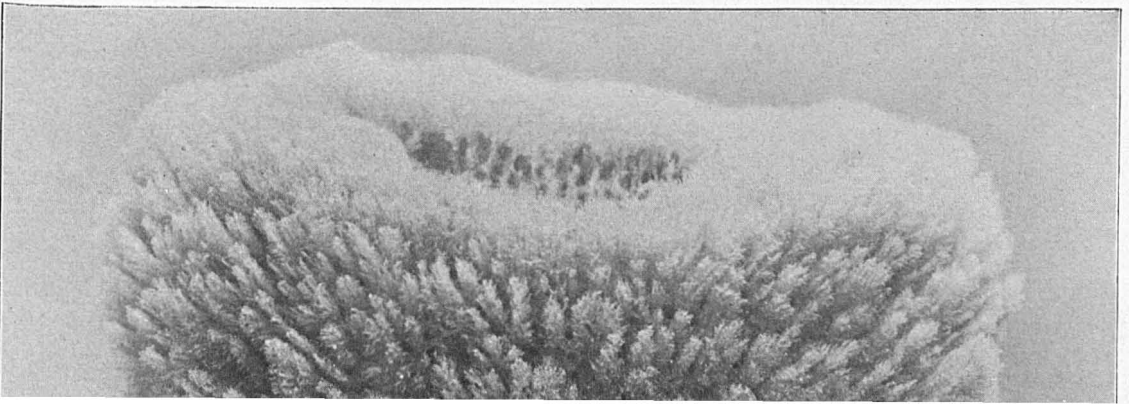


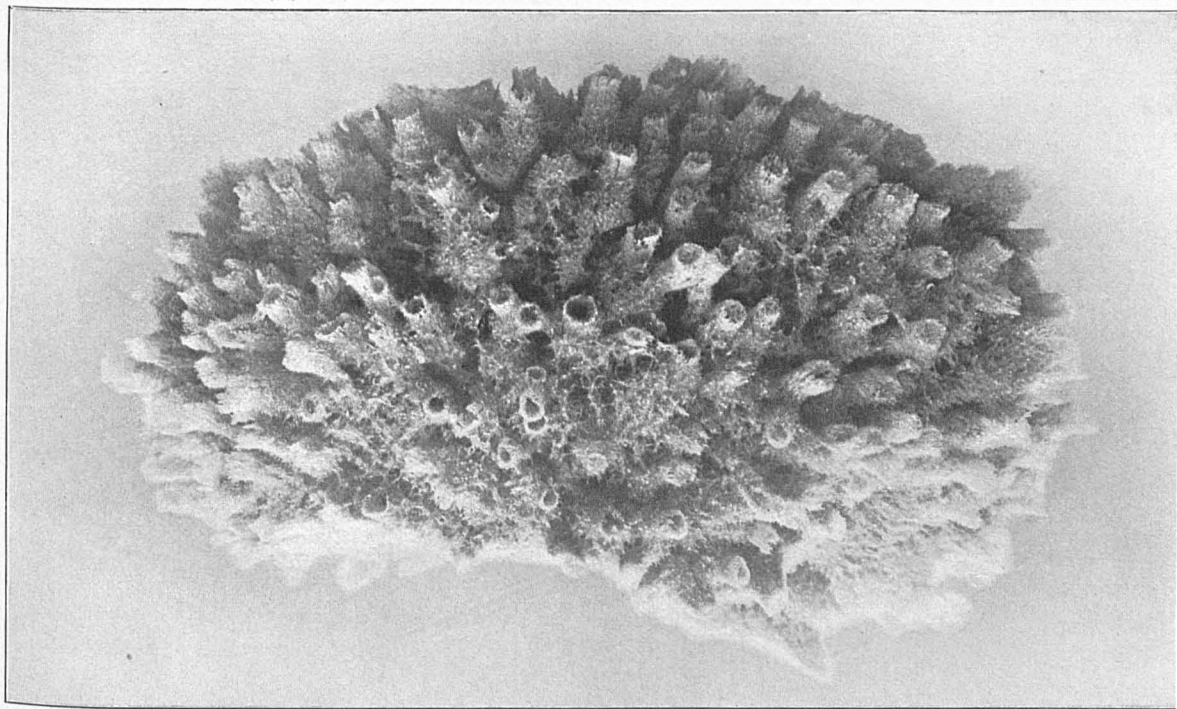


GRASS SPONGE. From Matecumbe Key. Diameter, 9 $\frac{1}{4}$  inches.

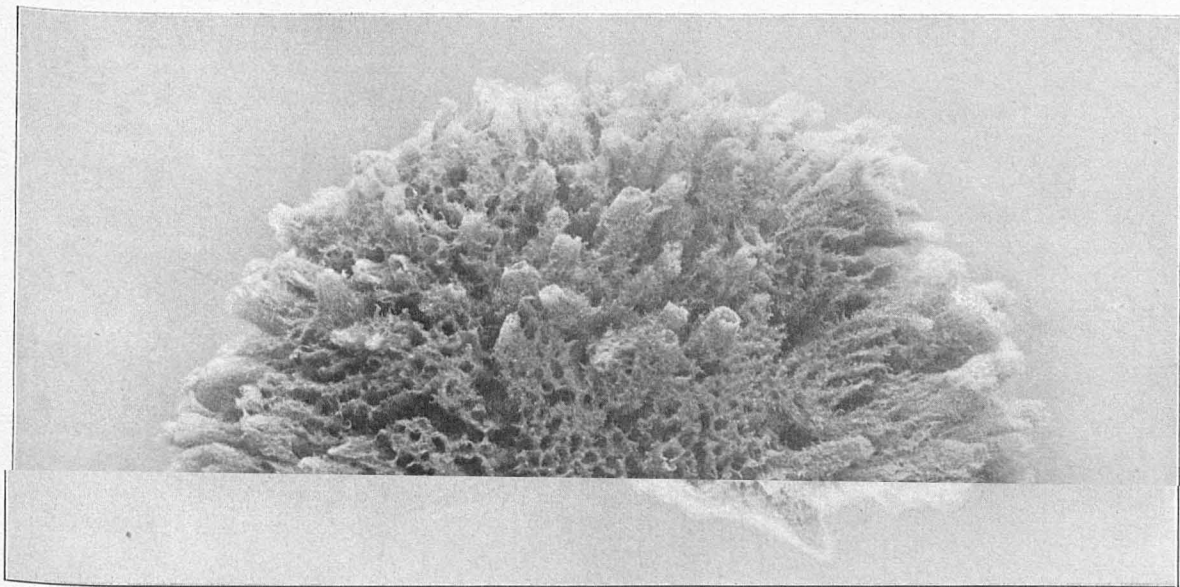


GRASS SPONGE. From Matecumbe Key. Diameter, 9 $\frac{1}{4}$  inches.

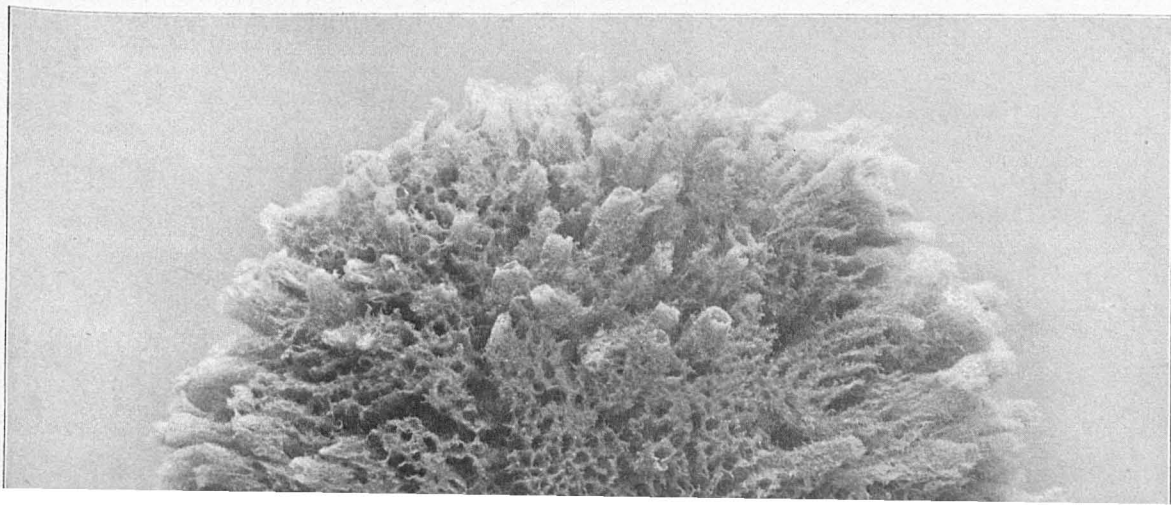


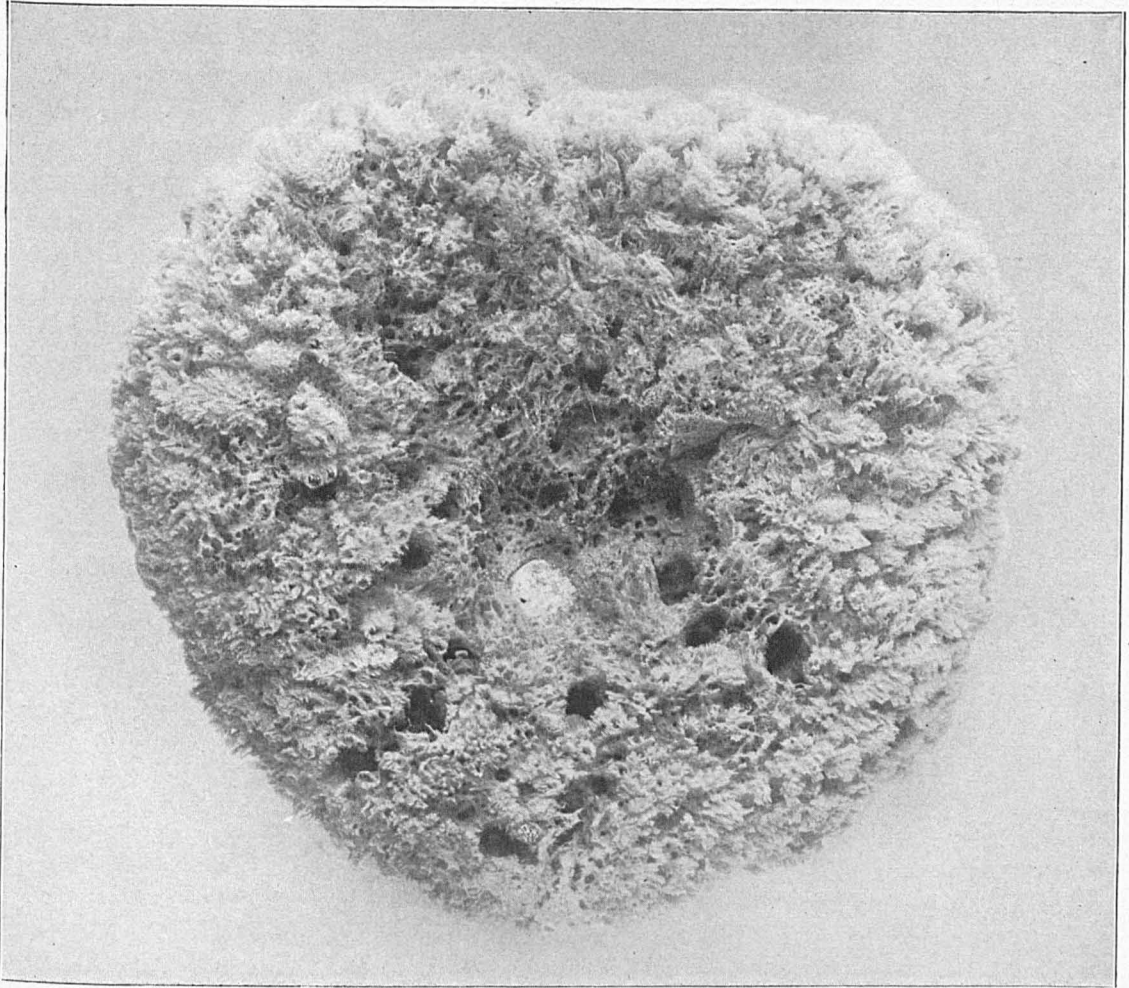


GRASS SPONGE. From Florida Keys. Side view. Diameter, 8½ inches.

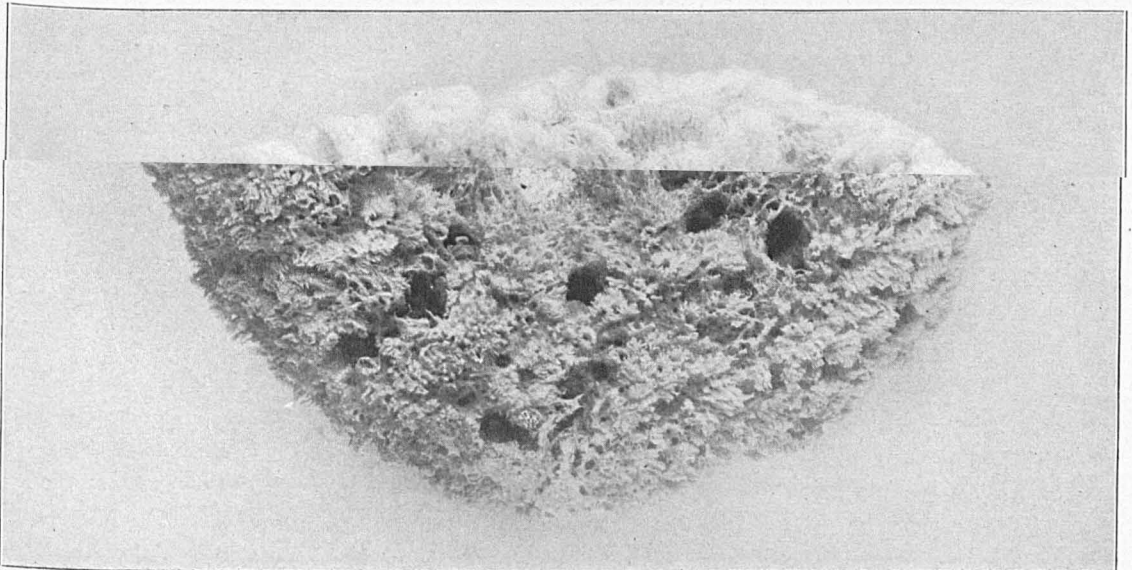


GRASS SPONGE. From Florida Keys. Side view. Diameter, 8½ inches.

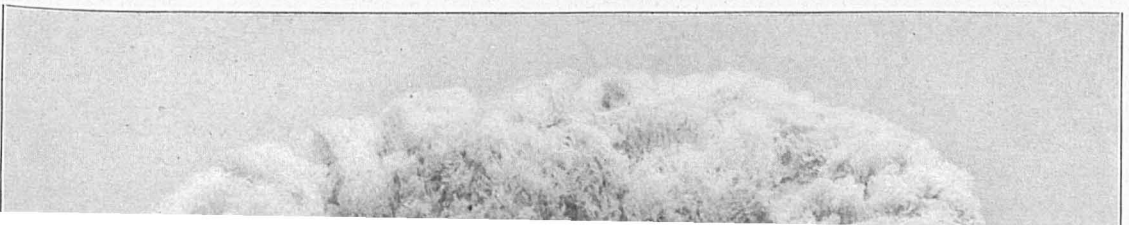


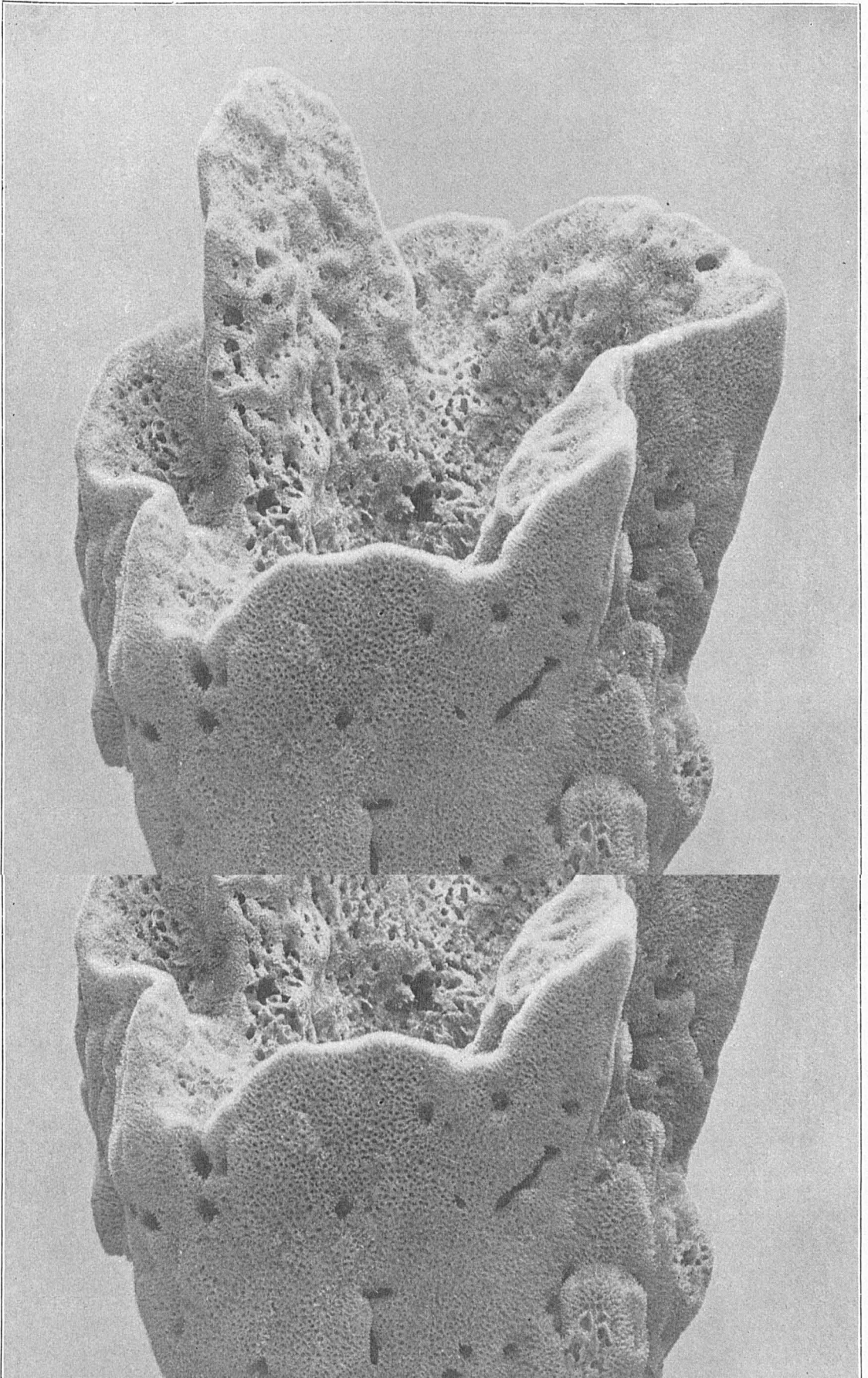


GRASS SPONGE. (Locally known as "Niggerhead.") From Matecumbe Key. Top view. Width, 14 inches.

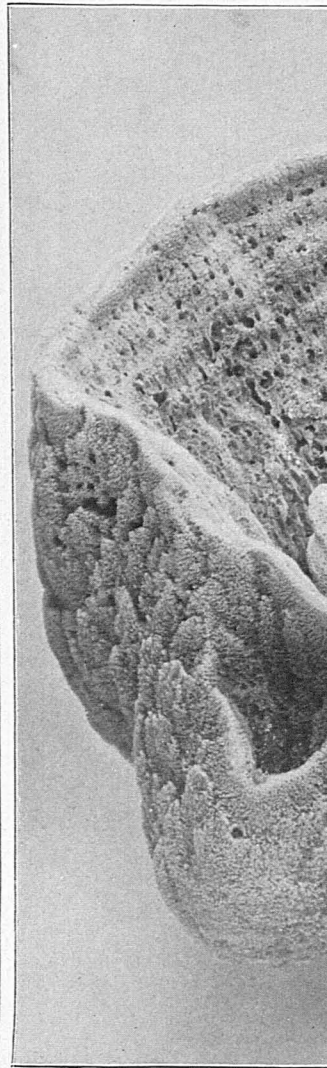
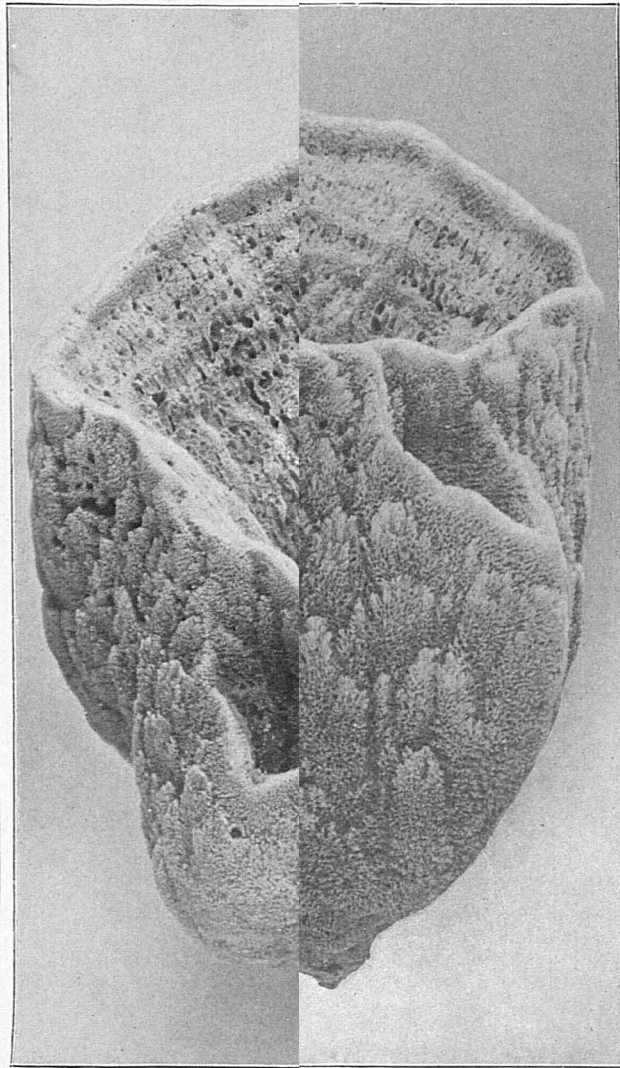
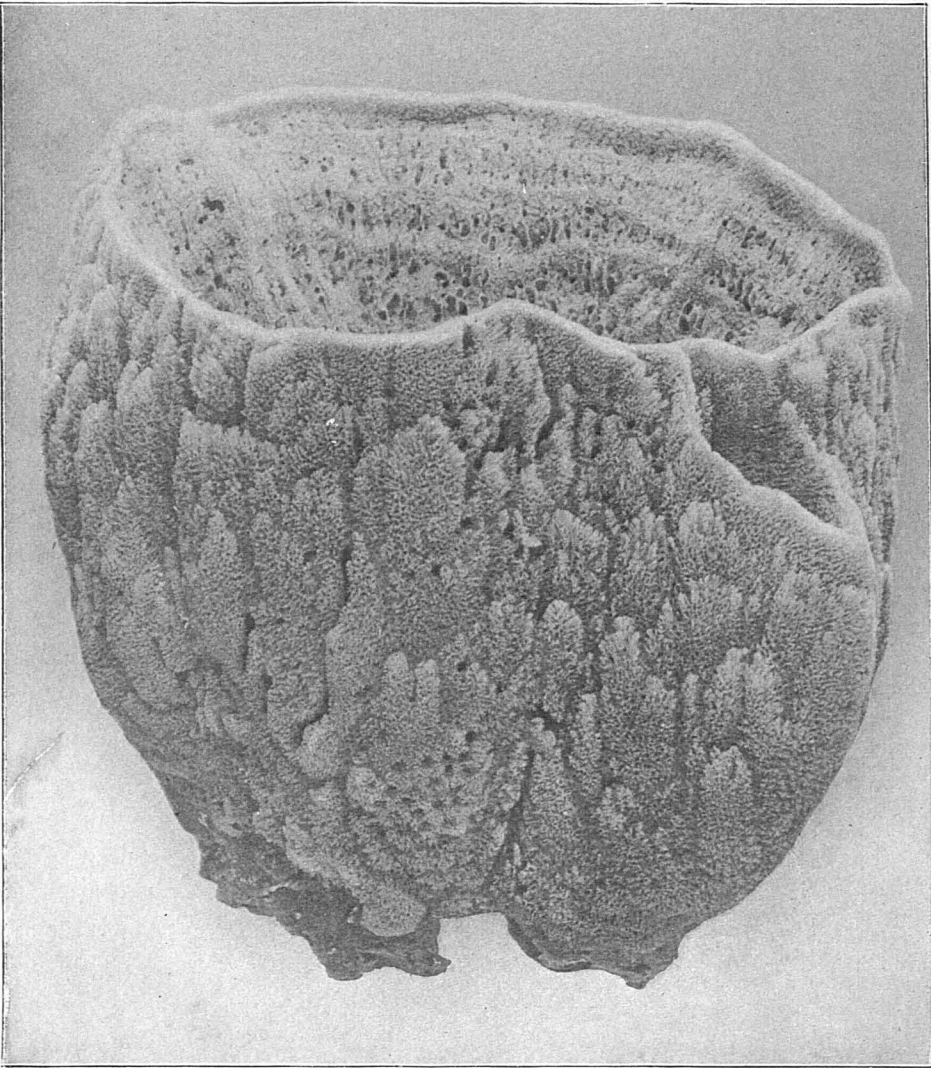


GRASS SPONGE. (Locally known as "Niggerhead.") From Matecumbe Key. Top view. Width, 14 inches.





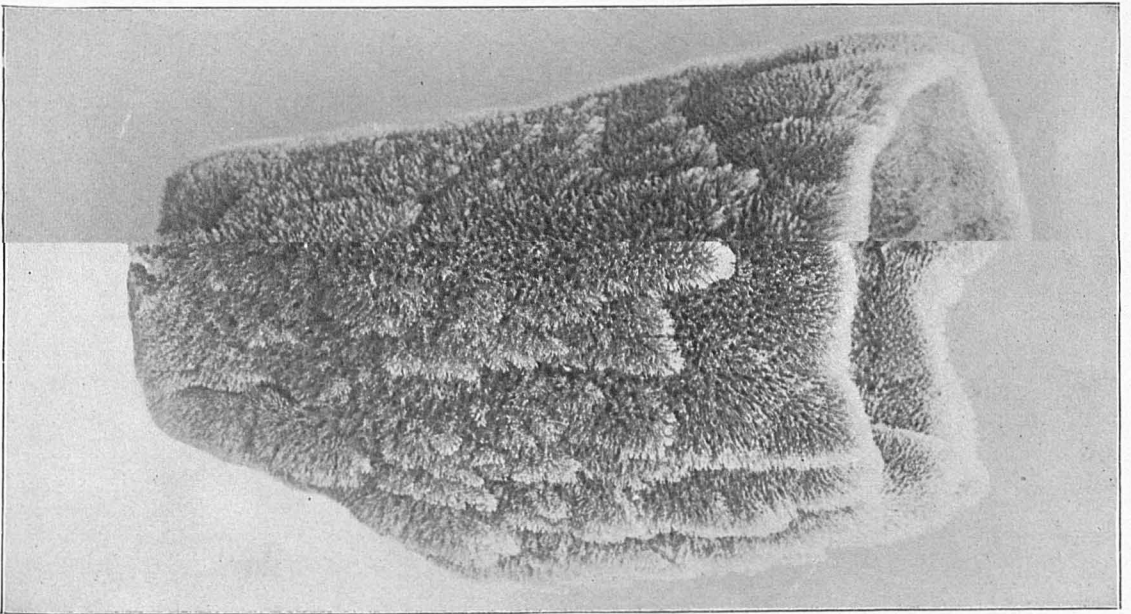




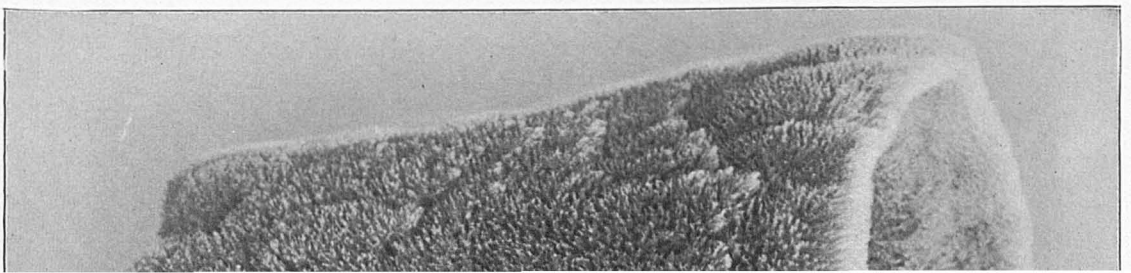
GRASS SPONGE. (Containing a large piece of coral in depression.) From Anclote Keys. Two views. Height, 15 inches. (Containing a large piece of coral in depression.) From Anclote Keys. Two views. Height, 15 inches.



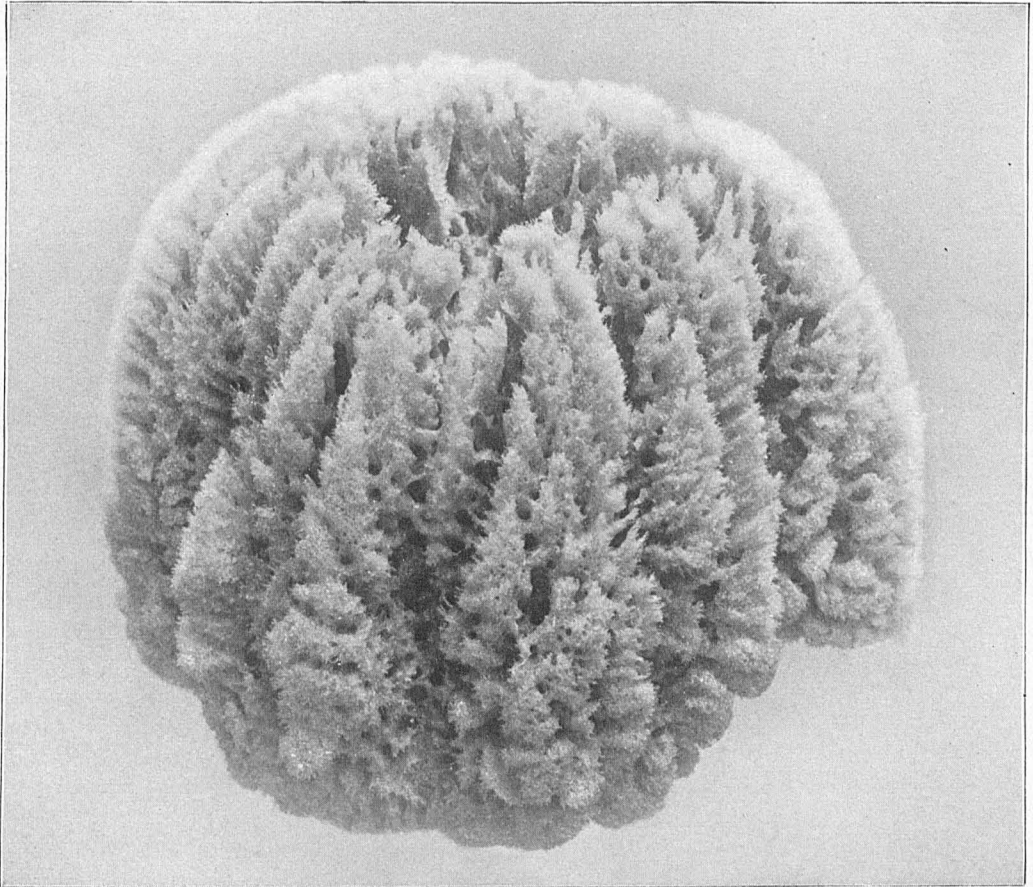
GRASS SPONGE. From Anchor Keys. Diameter, 9 inches.



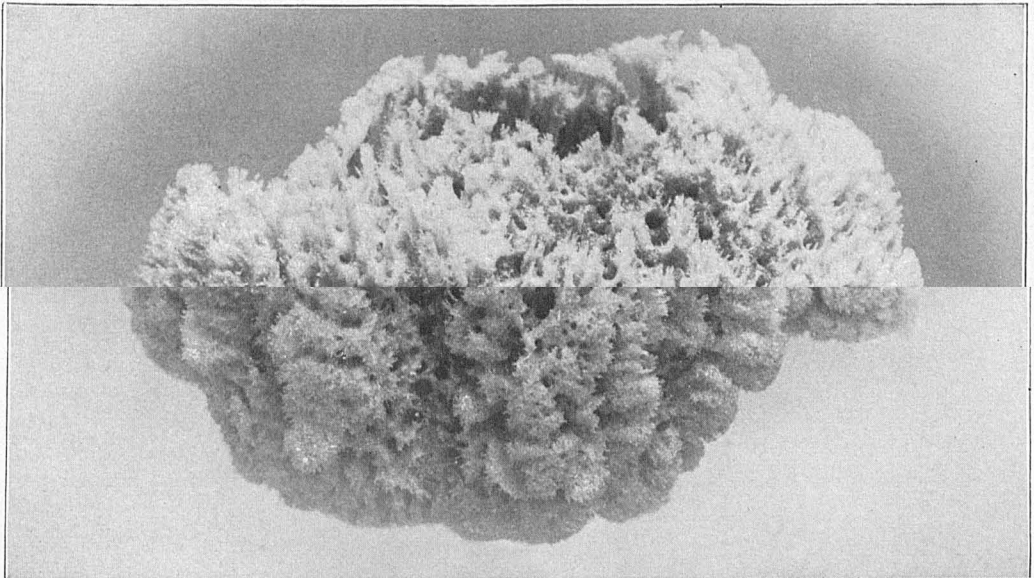
GRASS SPONGE. Diameter, 9 inches.



GRASS SPONGE. F



GLOVE SPONGE. From Florida Keys. Diameter, 7 inches



GLOVE SPONGE. From Florida Keys. Diameter, 7 inches

