THE SPONGE INDUSTRY FROM A BIOLOGICAL POINT OF VIEW

F. G. Walton Smith
Marine Laboratory, University of Miami

Discussions among those engaged in the sponge industry with regard to conservation, natural production and recovery from effects of disease are unfortunately, all too often, based upon the wildest speculations and upon popular beliefs which have no foundation in fact. What is more serious is that, in drawing up legislation for the control and conservation of these resources, the legislature is dependant upon those engaged in the industry for advice. As a result, the legislation finally enacted may sometimes fail to accomplish its purpose and may even be adverse in effect. This implies no fault on the parts of the legislators or of the industry, but rather a failure on the part of scientists to make the results of their investigations known in a suitable form and in such a way that the material is readily available to those most concerned.

The purpose of the present discussion is to give a brief summary of the known biological facts regarding sponges and to indicate how these may best be utilized in setting up sound conservation measures.

The commercial sponges, like nearly all other sponges, have a very porous structure. They spend their lives taking in water through one set of holes and ejecting it through others. The water enters through very small pores which pierce the outer skin and open into tubes or canals. (Fig. 1)

The canals spread throughout the sponge, giving off finer and finer branches until the endmost branches end in tiny oval chambers. Opening from these chambers are a second set of branches which take care of the outflow of water. The outgoing branches join with each other so as to form larger and larger tubes which eventually reach the outer surface. There the water is discharged through large openings.

The passage of water is brought about by the pumping action of the small chambers. The inside wall of each chamber is lined with tiny cells bearing whip-like hairs which continually lash the water. The movement of these hairs takes place in such a way that water is drawn in from the incoming canals and forced out into the outgoing canals. The water by its passage through the canal system enables the sponge to breathe. This is made possible by the cells lining the countless tiny chambers. They act in the same way as the gills of a fish, by taking in oxygen from the water and returning carbon dioxide to it.

The flesh of a sponge is very soft and must be supported by a skeleton just as in other animals. In the case of commercial sponges it consists of a mass of branching and interlocking fibers which occupy much of the body between the canals. The fibers are made of a horny substance very similar in chemical nature to the material of human finger-nails and hair. The sponge sold in the market consists of the fibrous skeleton alone, after the flesh has been allowed to rot and is cleaned off.

Sea water, no matter how clear it may appear, is full of numberous small particles, some of which are dead material, others various types of microscopic life. Countless numbers of these particles are carried with the water into the tiny chambers of the sponge. The whipbearing cells which line the chambers are able to trap the small particles in the sea water and to use them as food. After digesting them they are then able to pass

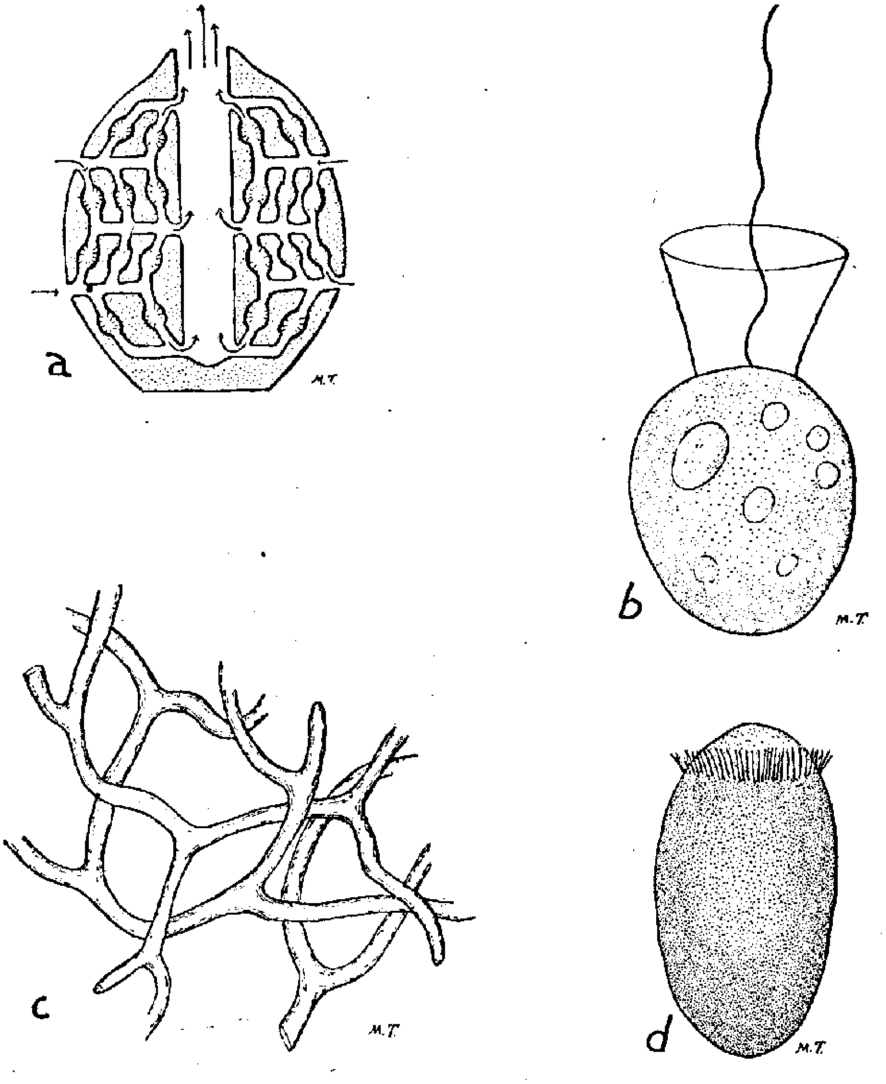

FIGURE 1. Structure of the Sponge. (a) Diagram of the canal system of a sponge. (b) Whip-cell (magnified about 2,000 times). (c) Fiber-skeleton of the sheepswool sponge (magnified about 40 times). (d) Larva of the sheepswool sponge (magnified about 1,200 times).

the nutriment on to other parts of the sponge.

Like all living creatures the sponges increase in size according to the amount of food they take in. Careful measurements of many hundreds of sponges growing in the waters of the Bahamas, carried out over a number of years, have shown that most sponges grow quite slowly. A sheepswool sponge, for instance, takes from four to five years to grow from one inch in diameter to five inches.

While many lowly animals, such as crabs or lobsters are able to regrow an arm or leg, the sponge has the further ability to regrow its entire body from even a small fragment of itself. Thus if a grown sponge were cut into small parts and each part were tied to or wedged against a rock, each piece would eventually become attached to the rock and grow into a complete normal sponge. Also, if a sponge were cut or torn from the bottom in such a way that the basal part remained attached, that part would continue growing.

Commercial sponges are able to reproduce sexually by producing eggs and sperm. These are formed in the flesh between the small chambers. When ripe, the sperm is released into the nearest chamber and is carried out by the water current into the ocean. Later on it may be sucked by the ingoing water into the pores of another sponge. It eventually reaches the small chambers and fertilizes the egg.

The egg, after fertilisation, remains in the sponge during the first stages of its development. At first it is white in color but later on it becomes black and a circle of small hair-like outgrowths appear at one end. At this stage it escapes into the nearnest chamber of the parent and is carried by the water currents to the outside. It is now known as a larva and it drifts about in the sea, carried by currents for several days. At the end of this time it settles to the bottom and becomes attached if it reaches a suitable surface, otherwise it dies. During the entire drifting period it is at the mercy of larger creatures which may eat it, so that out of the many thousands of eggs produced by each adult sponge only a small number survive.

Once attached, the larva rapidly changes shape and grows out into the form of a young sponge. During the early part of its life it grows at a relatively greater rate than when it is larger. It reaches maturity quite early and produces some eggs at all times of the year. The most intensive breeding appears to take place in April, May and June and also in November and December.

Sponges are damaged by a number of enemies. They are killed by exposure to fresh or brackish water for more than a short period. The greatest damage in recent years was caused by a microscopic fungus parasite which drifted with ocean currents from one sponge ground to another during 1939.

With these facts at our disposal it is now easy to realize that we cannot expect any miraculous sudden recovery from the 1939 blight, and that, on account of the slow growth of the sponge, it is very necessary to enforce adequate size laws with the utmost vigor. In order to allow reproduction to proceed at the maximum rate it would be wise to increase the wool sponge size.

Accurate and reliable records should be kept on the number and type of boats engaged in the industry, the region being fished, the productivity and quality of the sponges, and the prices paid for the sponges by the purchasers. Under existing conditions records are kept by several offices, but they are not adequate for conservation purposes, and are, in general, of little value in determining the trend of the natural sponge beds. Proper statistics would give nearly as much information as the more expensive scientific surveys on board vessels.

In order to hasten the re-establishment of the Gulf of Mexico sponge beds it is suggested that mature sheepswood sponges might be planted north of the Tortugas region on reefs carefully selected to present the proper conditions for their growth. Oceanic currents on the bottom have been found to move parallel to the shore and to the north. They would carry the drifting sponge larvae to other locations along the west coast of Florida and the now barren deeper grounds would become re-seeded. The economic possibilities of doing this on a large enough scale should at least be subject to careful study.

Sponges have great powers of regeneration. If a sponge is cut into small bits the individual gragments will each grow into a complete and normal sponge. The ability of sponges to grow from cut pieces makes it possible to cultivate sponges from cuttings of selected parent sponges. The small pieces together grow at several times the rate of the parent stock.

Extensive ranges of bottom suitable for sponge cultivation exist in the Florida Keys and at a few places near Tarpon Springs. A model sponge farm, similar to that which is now operating successfully in the Bahamas could well lay the foundation for commercial sponge plantations.

Although sponges cannot be grafted to produce a more desirable strain they can be selected for good qualities. Cutting could be made only from those sponges which posses all of the qualities of softness, water retention and resiliency which are required in a sheepswool sponge. It is probable that biologists would be able to develop a fast growing and resistant strain of wool sponges which would be of superior market quality.

The establishment of a sponge farm is advocated, both for the purpose of providing stock for the depleted beds and for encouraging and helping individual enterprise. Nevertheless it must be remembered that sponge planting is not a get-rich-quick or sure-fire venture. It offers limited returns for an investment, requires hard work to establish and is subject to risks greater than those of ordinary agriculture. The failure of early attempts to establish sponge cultivations in Florida was due to lack of knowledge and experience, but even with the benefit of the experience of recent successful plantations in the Bahamas it must not be thought that success must automatically follow.