Functions and Development of a Tropical Marine Laboratory

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A LITTLE OVER TWO YEARS AGO, the late Dr. Thomas Barbour was kind enough to draw attention to the newly organized Miami Marine Laboratory (*1*). With the end of the war and the focusing of attention once more upon peacetime objects of investigation, the present time is well suited to a discussion of the activities which would justify any considerable expenditure of energy and money in the future development of a tropical marine station. The increase in number of marine laboratories during the past half century renders it particularly important that a new station should fulfill a real need and that it should neither overlap in function the older, established institutions nor merely add unnecessarily to the number of smaller seaside laboratories. For this reason, considerable thought has been given at Miami to the possibility of developing aspects of marine biology and oceanography which are particularly suited to the area or which are not already being adequately covered elsewhere.

The growth and development of the sciences which converge in marine biology and oceanography arose from the early expeditions following Captain Cook's voyage in 1768. Further expeditions in which oceanographic sampling and other techniques were introduced took place in later years, culminating in the specialized cruises of the present day.

The work that ocean cruises are able to accomplish is limited, although it is indispensable for a knowledge of the fauna and flora of the open sea, of the nature and organisms of the sea bottom, and of the ocean currents and physical characteristics far from shore. It is not suited, however, for anatomical, histological, physiological, and embryological inquiries, for long-term investigations into seasonal variations of seawater and its plankton, or for close and careful coastal ecological studies. The need for these investigations brought into existence numerous seacoast laboratories after the opening of the celebrated Naples station, in 1872. These are to be found, with few exceptions, on seacoasts in temperate latitudes, and, as a result, the classical work in marine biology and oceanography refers principally to the open ocean or to these temperate shores. The centers of population and civilization are at neither the Poles nor the Equator but are in the temperate latitudes, while the great fishing industries are based on the chemically rich, shallow banks of the temperate Atlantic and Pacific. There have been no equivalent stimuli to marine biological and oceanographical investigations on tropical shores.

The volume of work turned out by stations in the temperate latitudes has been remarkable, and it is now true that the broad general features of the physics, chemistry, and biology of coastal waters in the higher latitudes have been blocked out. The general characteristics of the open oceans are also known in certain broad fundamentals.

In contrast, our ignorance of tropical shores and waters adjacent to them is profound. This is not hard to understand when we enumerate the marine laboratories of the tropics. One of the earlier tropical stations was that founded by the Carnegie Institution at Dry Tortugas, Florida, faunistically within the tropics, although geographically just outside. Inaccessibility was one of the factors that forced this station to close, much as it brought about the closure of Agassiz's laboratory on the island of Penikese. Some 40 years ago a station was opened on Bermuda which, although not in the tropics, was sufficiently close to them and sufficiently under the influence of the Gulf Stream to support a relatively impoverished tropical ocean fauna. This was closed during World War II, and now that it is again open, its comparative inaccessibility may somewhat restrict its usefulness, although its value as an oceanic base must not be underestimated. There are also small stations in the Philippines, in Hawaii, and at the University of Texas.

In addition to this hiatus in our knowledge of marine biology and oceanography, there is a further argument that may be advanced in favor of a tropical marine laboratory. It would fulfill a definite demand in providing unusual advantages for the study of the constituent sciences themselves, considered independently of oceanography. The terrific competition for food and space on the living coral reefs and the enormous variety of species, of adaptations, of feeding habits, and of methods of attack and defense, make it a classroom and a workshop for the study of fundamental branches of biology. Furthermore, the physiologist, behaviorist, ecologist, embryologist, or biochemist who uses marine animals and plants merely because of their convenience and not because of an interest in the ocean is immensely benefited by being able to work at a tropical station where the organisms are active the year round.

These conditions exist in the Miami area. Not only

is it tropical in the sense that its shores harbor the representative West Indian flora and fauna, but it also has accessibility, lack of which contributed to closing of the Dry Tortugas laboratory. Ocean beaches, mangrove swamps, and wide areas of coral reefs, shallow water, and flats form only part of the extraordinary variety of environmental conditions. The coral reefs are in shallow water so that collecting with a diver's helmet is perfectly practicable, and the Gulf Stream is closer than at any other part of the Atlantic Coast.

The islands of the West Indies and of the Caribbean Sea have many interesting problems. Various factors have made it difficult to establish a satisfactory marine laboratory on these islands, although this has been proposed many times and has again been broached in recent years (*2, 3*). The problems of the West Indies, however, are the problems of south Florida, and the accessibility of Miami by airplane, railroad, and boat, from the West Indies and the scientific centers of the United States alike, increases the opportunity for studying these problems here.

The above reasons, coupled with the necessity of carrying out certain phases of marine research important to the prosecution of the war in tropical waters, brought about the Miami Marine Laboratory as a logical process, greatly assisted by the cooperative interest of the Woods Hole Oceanographic Institution.

In order that the geographical advantages of the location may be utilized to their fullest extent, the aims and functions of the Laboratory are being formulated with care. In the first place, it is realized that in order to attain its widest usefulness a tropical laboratory must be more than a mere adjunct of one university. It must provide a definite service for biologists at large, and the requirements and opinions of these biologists must be considered in the further development of the institution.

It is further realized that in order to develop our knowledge of tropical oceanography and biology it is not sufficient to provide facilities for visiting investigators. There must be a permanent staff, however small, to work within a definite program of investigation, correlated with investigations already completed and others still continuing in temperate latitudes.

It is believed that a proper balance should be struck between academic and applied investigation, and that to some extent each gains by its proximity to, and relations with, the other. On the academic side the investigations which have been considered include biological studies of the more important marine flora and fauna, from the viewpoints of taxonomy, embryology, physiology, and ecology; the studies of seasonal plankton variations and their relations to chemical and physical conditions of the bay and open ocean; and the general question of total organic productivity. Hydrographical studies, including the dynamics of the Gulf Stream, should be carried out in collaboration with institutions engaged in this work elsewhere.

Applied marine science in the tropics has been somewhat neglected. Certain fields, such as sea-water corrosion, ship-fouling prevention, and preservation of submerged structures, may be investigated in the tropics with especial advantage, because of the enhanced rate at which the destructive agencies operate as compared with temperate waters, and because of the year-round opoprtunity for field work, unimpeded by climatic changes.

Not only south Florida but the whole of the West Indies are backward in the investigation of marine industries, except where they are of such a nature that Federal agencies may be called in. The natural production of these latitudes is lower than that of temperate regions, the importance of fisheries varying accordingly. Nevertheless, a limited program of fisheries work is justifiable, and it is hoped that future developments may fall somewhat in line with the recommendations of the Anglo-American Caribbean Commission (*4*).

The fishes that might provide reasonably large-scale commercial fishing in the West Indies are, with certain exceptions, the pelagic migrants, so that the most obvious phase of the work is the investigation of movement, life histories, and spawning habits of migratory fish, as well as the study of local fish.

Investigations of edible marine products not hitherto utilized will tend to ensure more economical operations for fishermen. The investigation of methods of handling may bring about the same end and should not neglect the methods of handling used at sea. The fisheries technologist should be concerned with the effectiveness of types of fishing gear employed, the collection of fishery statistics, and the evolution of sound conservation methods. The biochemist has his problems of utilization of by-products and the toxicology of tropical fish poisoning.

Training in the various fields of tropical marine science is equally important. Articles in the national journals of at least two countries have expressed the desirability of instruction in tropical biology as a part of the training of every professional biologist (*1, 3*). This is particularly true in view of the economic development of tropical countries in recent years. In keeping with the general policy, it is felt not only that courses should continue to be given by the staff of the Marine Laboratory, but that as facilities are increased, the faculties of inland and northern universities and schools should be encouraged to bring field classes here during vacation and, should they wish, give instruction themselves at times when the regular courses are not offered.

The educational plans of the tropical marine laboratory should also include consideration of the advisa-

bility of technical training, not only in the form of advanced academic and technological training for marine scientists and fisheries officers, but also a practical vocational short-term intensive training of fishermen selected for their leadership in the various communities of Florida and the West Indies, where government scholarships would be needed.

This program is, of course, ambitious and comprehensive. It will have served its purpose if put into practice in a few directions which appear most practical and receive the most encouragement. The program is, in fact, already being realized to some extent.

Seasonal changes in the chemical and physical content of the sea water, including phosphate, nitrite, salinity, and dissolved oxygen, are being studied by monthly observations at 11 stations chosen for their wide ecological differences. At these stations simple quantitative and qualitative plankton determinations are made. Parallel observations are being made on organisms attaching to the underside of floating rafts, in such a manner as to provide evidence not only of seasonal changes but also of succession.

The teaching program has not been neglected, and the elementary courses in marine botany and zoology started over 15 years ago are still being continued. In addition, graduate courses are now offered in the University in the fields of oceanography and marine biology. These include courses in oceanographical physics and chemistry, marine algology, the biology of fishes, ecology, including statistical fisheries techniques, and invertebrate taxonomy and embryology.

In applied fields of science the facilities and personnel of the Laboratory have been utilized by various naval and military groups and by the Woods Hole Oceanographic Institution for work of importance to the war effort. Surveys of the behavior and distribution of fouling organisms are now being continued independently by the staff. Preliminary work is also being carried out on deterioration of cordage in sea water and the influence of marine bacteria in deterioration of lubricated metal surfaces. A study has been made of the rate of growth, productivity, and the chemical utilization of tropical marine algae.

In spite of handicaps, a start at least has been made in the field of fisheries research, and an investigation is at present being conducted into the Florida spiny lobster industry, in collaboration with the State Conservation Department. A similar survey has also been organized for the Bahamas Government, utilizing government personnel. The use of the loggerhead sponge and other hitherto valueless marine products as a source of organic fertilizer has been investigated.

Since it has been suggested in some quarters that a tropical marine laboratory in south Florida or the West Indies should be part of a tropical biological laboratory covering both marine and terrestrial phases, mention may also be made of activities not strictly within the field of marine biology.

A relatively new field is the study of causes and methods of preventing deterioration of various materials and equipment under semitropical conditions such as exist in the mangrove swamps and the damper parts of the Everglades. The peacetime significance of this type of work, in which the Miami Marine Laboratory has recently been associated with an industrial laboratory under military contract, is becoming increasingly obvious. Fabrics, all types of electrical and other equipment and machinery, and the materials and finishes employed in building and vessel construction are subject to deterioration from the effects of salt air, moisture, and fungus growth in the tropics, and with increasing competition for trade in tropical countries, this factor will assume even greater importance. In south Florida field tests as well as laboratory investigations are possible in the mangrove and Everglades swamps.

The present quarters are of a temporary nature and do not offer altogether suitable accommodations for the staff, equipment, and motor vessel. Funds for operation are received partly from irregular contributions from other institutions, governmental agencies, and industrial concerns in return for participation in specific projects and partly from the general funds of the University of Miami. In order to facilitate further development it will be necessary to secure a permanent building and a more regular and extensive source of funds, not merely for specific projects but for general upkeep and maintenance, for the sustaining of fundamental research, and for provision of hospitality to visiting investigators.

The problem of a permanent building may shortly be solved. The Dade County Commission has agreed to collaborate with the University of Miami by building a $2,000,000 Oceanarium and Marine Laboratory. The Oceanarium is being planned by, and will be operated under, the direction of the Marine Laboratory staff, and adequate modern laboratory facilities will be provided.

Future development will depend upon the extent to which the facilities are utilized. In order that growth of the Laboratory may take place along the lines of greatest benefit to the sciences concerned and in order to encourage future participation and support, the recommendations and suggestions of interested scientists will be welcomed.

References

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