

24. Oceanographic Research at the Scripps Institution of Oceanography of the University of California.¹⁾

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The Scripps Institution of Oceanography is an outgrowth of an attempt made some years ago by Prof. W. E. Ritter, then professor of zoology in the University of California, to find a site for a marine biological station to be operated in connection with his department of the University. Among those active in establishing it were Dr. Fred Baker, Miss Ellen Browning Scripps, Mr. E. W. Scripps, and Mr. Julius Wangenheim. Through donations from Miss Scripps and Mr. Scripps a pueblo lot of 177 acres was acquired about two miles north of La Jolla, a two-story laboratory building, dedicated to Mr. George H. Scripps, and several wooden cottages were erected, and a road connecting with La Jolla was constructed. Mr. E. W. Scripps donated a yacht for oceanographic work.

In 1912 the entire property was turned over to the Regents of the University of California with the understanding that it should be an independent department of the University, and the Institution was named "The Scripps Institution for Biological Research."

Miss Scripps continued her donations to the institution and had erected for it a museum-library building and a reinforced concrete pier 1,000 feet in length. Mr. E. W. Scripps continued his substantial contri-

1) This paper is condensed from an article by me entitled "The Scripps Institution of Oceanography of the University of California", published in the California Monthly for September, 1926.

butions to the buildings and equipment of the institution. Both Miss Scripps and Mr. Scripps have made generous annual contributions to the funds for the support of the institution; and the University of California has made a regular allotment to it from funds appropriated by the State Legislature.

The first director of the institution was Prof. W. E. Ritter, who initiated a rather extensive program of oceanographic research, which was not confined to marine biology, as is attested by several papers on oceanic circulation and associated phenomena by Dr. G. F. McEwen. The biological researches were not confined to the sea, but were extended to include the investigations by Dr. F. B. Sumner on heredity and geographic races of the deer-mice (*Peromyscus*).

Before Professor Ritter's retirement in June, 1923, it was decided by the Regents of the University of California and the Scripps family to devote the institution to the study of the ocean. The proposed change would restrict the scope of the institution biologically to the sea but would extend its scope so as to embrace all aspects of oceanography. In accordance with its change of scope, the name of the institution was changed by the Regents of the University to Scripps Institution of Oceanography in October, 1925.

The foundation of the program of the institution is its provision for obtaining collections and field data. At present it owns a boat, purchased last September (1925) by means of funds derived from the sale of the yacht donated to it by Mr. E. W. Scripps. The boat is about 65 feet long, it has a net cargo capacity of 22 tons and can carry 2,600 gallons of gasoline. Its scientific operations, which so far have been confined to local waters, are in charge of Dr. E. G. Moberg. The boat is equipped with apparatus for recording temperatures at any depth and for collecting water, plankton, and bottom samples to depths as great as about 1,000 fathoms. There is also the institution's pier, which is a permanent hydrographic and meteorologic station, and on it are installed an automatic tide gauge (the property of the United States Coast and Geodetic Survey) and a thermograph, mentioned below, with two pens, one for the surface and one for the bottom. The institution maintains collecting and observing stations, largely through cooperation with the U. S. Bureau of Lighthouses, of Oceanside, Balboa, Hueneme, Santa Barbara, Pacific Grove, Farallon Light, Blunts Reef, Columbia River Lightship, and arrangements have been completed for a station at Scotch Cap Light, Aleutian Islands. The institution has been fortunate in enlisting the aid of the U. S. Coast and Geodetic Survey and

the U. S. Navy in its work. All of the Coast and Geodetic Survey vessels operating along the west coast of America and in the Hawaiian Islands are assisting and the Naval vessels on their cruise in the Pacific between March and November, 1925, obtained for the institution 21,500 meteorologic records and records of surface temperatures, 1,210 water samples, and 260 plankton samples, and reported over 1,000 soundings by the sonic method. Recently the Naval transports plying between Bremerton, Washington, and the Canal Zone are reporting meteorologic conditions and surface temperatures of the water and are collecting water samples. Assistance has also been rendered by the California Academy of Sciences. The total records and collections between July 1, 1924, and March 31, 1926, were as follows: meteorologic records and temperatures of the sea, 30,130; water samples for the determination of the quantity of salts in the water, 8,727; plankton samples, 3,100; bottom samples, not counted, several hundred.

Recently the Institution has acquired by means of funds contributed by the Southern California Edison Company, the Southern Sierra Power Company, and the Bureau of Light and Power of Los Angeles two thermographs for recording ocean temperatures. One instrument, already mentioned, has been installed on the institution's pier; and the other, with one pen for recording surface temperatures has been installed on the pier at Balboa. Arrangements have been made for placing a thermograph on one of the Los Angeles Steamship Company's vessels which plies between Los Angeles and Honolulu. The instrument has been ordered but it has not yet been received. A proposal that bears on the work of the institution is the projected oceanographic expedition of the ship *Carnegie* of the Carnegie Institution of Washington, and especially its intended work in the Pacific Ocean. An endeavor will be made to procure oceanographic data east of a line from the Hawaiian to the Aleutian Islands in an area in which there has been almost no oceanographic exploration. An attempt will also be made to obtain information in the offshore area which lies between lines from Los Angeles to the Hawaiian Islands and from Panama to the Hawaiian Islands.

It should also be mentioned that the institution in cooperation with the Carnegie Institution of Washington will conduct a seismological station. Piers for the seismographs have been erected and the instruments are now ready for delivery. It is intended to tie the seismographs and the tide gauge into the same time circuit.

The field records and collections are only the raw materials on which investigations are based. Since no man can cover the entire field of

oceanography, the researches must be divided into subjects and distributed among different investigators. The researches will, therefore, be discussed topically in the following paragraphs:

The investigations of ocean temperatures, the salinity of the waters, the determination of the velocity and direction of the currents, and the study of meteorologic relations are in charge of Dr. G. F. McEwen, who is assisted by Capt. S. W. Chambers, formerly of the Canadian Army. The salinity of all water samples received to date has been determined and virtually all data received have been tabulated, reduced, and plotted on charts, and nearly all mathematical computations have been completed. Doctor McEwen is contributing several papers to the program of this Congress.

The chemical investigations conducted at the institution are in charge of Dr. E. G. Moberg, who has completed elaborate studies of the hydrogen ion concentration of waters in this region, with reference to numerous determining conditions, and has determined the amounts of phosphate, nitrate, and silica in solution in the water. He has also made extensive investigations of the relative food value of the plankton, determining the total organic matter, the amount of ash, and the amounts of protein and fat. A summary of Doctor Moberg's researches are presented to this Congress in several short papers.

The investigations of the phytoplankton are in charge of Prof. W. E. Allen, who is studying the different samples to find out how many cells there are to a unit volume of water, the different kinds represented, and the variations in abundance and kinds according to many factors, such as season, temperature, salinity, geographic position, depth, and distance from shore. The work on the plankton is being brought into relation with the available data on physical conditions in the sea and the results of the chemical studies of Doctor Moberg. Professor Allen is presenting the results of these researches to this Congress.

The investigations of the zooplankton are in charge of Prof. C. O. Esterly, who devotes his time mostly to the study of copepods. He is studying them quantitatively as well as with reference to the different kinds represented. Professor Esterly has summarized for this Congress the results of the investigations of zooplankton at the Scripps Institution.

In the study of the numbers and kinds of small organisms in the samples taken from the sea, it is very important to learn the probable value of the samples as representing actual conditions in the sea. This is a difficult mathematical problem to which Doctor McEwen has devoted years of work and he has developed a new method of estimating the probable

value of the samples. A large memoir by him setting forth the method and presenting tables for applying it has been submitted for publication.

Besides the researches already described, Mr. P. S. Barnhart has been studying the local pelagic fish eggs and this summer he has hatched eggs in aquaria and has reared to identifiable size the larvae of the baracuda and bonito. Mr. R. C. Lewis is studying the food of the sardine and anchovy and has made interesting discoveries regarding these small fishes and their relation to the plankton. It is hoped to bring the studies of plankton into their proper relation to the local economic fishes.

Dr. F. B. Sumner is gradually closing out his work on the deer mice, and he will soon begin to study genetics in aquarium fishes and resume his long interrupted researches on the relations between fishes and their environments.

Marine bottom deposits have not yet received much attention from members of the staff of the institution, except to study samples for the foraminifera they contain. This is a group of organisms in which I am interested and considerable work is being done with both the fossil and the living forms. It is hoped that the investigation of marine sediments will later be one of the features of the institution's program.

The foregoing sketch of the work of the institution is an account of what has been or is being done, except that it is said that it is hoped that more attention may be paid to marine sediments. It is hoped that the existing departments may be strengthened and that the scope of the work may be extended by undertaking researches in marine bacteriology, photosynthesis, and numerous problems in chemistry.

Besides conducting its own researches, the institution welcomes visiting scientists who can use its facilities and many distinguished investigators avail themselves of the opportunities. Short visits have also been made to the institution by many persons interested in its work and by some who wished to study its methods of investigations.

The institution is open for specially qualified graduate students, and it is gratifying that the number appears to be increasing rather rapidly. During the summer just closing all the laboratory rooms were occupied either by the members of the staff, visiting scientists, or students.

The institution has a small museum and a small aquarium which are of interest to many visitors. The local marine biological collections are good and for some groups of organisms they are increasing.

During the past two years the property has been much improved, many repairs have been made, the most important of which was the restoration of the pier, made possible by a special State appropriation,

and extensive planting has been initiated, largely according to plans prepared by Prof. J. W. Gregg of the division of landscape architecture in the University of California. The seeds of many trees and shrubs not hitherto introduced into California have been received from correspondents in Australia and the grounds of the institution are not only improving in appearance but are becoming botanically interesting.

The Scripps Institution of Oceanography is the only institution of its kind in America and there are few of its kind elsewhere. It is operating in a small way, but it is believed that it is accomplishing important results. The kind of work it is doing is sorely needed for very many reasons, and it is earnestly hoped that it may grow and that it may thereby help California and the United States carry their appropriate share in the advancement of scientific knowledge.
