

## SCRIPPS INSTITUTION OF OCEANOGRAPHY

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LA JOLLA, CALIFORNIA, July 1, 1927.

*To the President of the University.*

SIR: I have the honor to submit the following report on the Scripps Institution of Oceanography for the year 1926-27:

*Work of the boat "Scripps"—*

The scientific work on the "Scripps" was in charge of Dr. E. G. Moberg, who was also the navigator. Work was confined chiefly to the months of July and August, 1926, and June, 1927. Trips were reduced to the smallest number that would give a fairly complete picture of the changes in the physical, chemical, and biological conditions of the sea during the period of study. The boat was used on forty-one days, during which about 2600 hauls for various purposes were made. On most of the forty-one days, except about ten days in August, trips were made to the regular stations five and ten miles offshore. In August, 1926, a cruise was made to Santa Barbara Channel. Temperatures and water and plankton samples were taken at 148 stations and at 25 of those, mostly off Point Dume, Point Hueneme, Point Concepcion, and Santa Rosa Island, subsurface serial sections were made. A number of bottom samples were obtained for Dr. P. D. Trask, who accompanied the boat on this trip.

In the spring of 1927, the boat was equipped with bilge keels, which decreased its rolling very decidedly and thus lessened the danger of injury to or loss of apparatus in rough seas.

*Physical oceanography—*

These investigations were in charge of Dr. George F. McEwen, assisted by Captain S. W. Chambers.

*Dynamical oceanography.*—In addition to calculating the surface drift in about twenty-five selected regions along the coast between Panama and Seattle, from temperatures and from winds, preliminary computations of circulation were made, by means of the Bjerknes method, from serial observations of density. The horizontal velocity relative to that of the bottom was computed at a series of depths for three pairs of

stations in each of the following coastal regions: Lower California, latitude 25° N, La Jolla, California, latitude 33° N, and Blunt's Reef, latitude 43° N.

In May, work was resumed on the theory of vertical ocean temperature gradients, evaporation, and radiation. Numerical applications of the theory to serial data were begun at stations 1 and 2 off La Jolla. An intensive study of the ocean data for the five-year period, 1916-20, compiled by the Imperial Marine Observatory at Kobe, was undertaken because of the encouraging results from the preliminary study of the ten-year series.

*Evaporation.*—Mr. C. Harritt, manager of the La Mesa, Lemon Grove and Spring Valley Irrigation District, offered the use of the Murray reservoir for evaporation studies, and a weekly series of serial temperature and other observations was commenced there on May 12. The direct measure of the evaporation in this reservoir is of special importance in checking the amount estimated from standard pan readings, serial temperatures (using McEwen's theory), and from insulated pan readings, surface temperatures, and humidity observations according to the Bowen-Cummings-Richardson method.

*Long-range forecasting.*—Early in 1927 a preliminary study was begun of ocean surface data for the Pacific, summarized by months and five-degree quadrangles by the Imperial Marine Observatory at Kobe for the period 1916 to 1925. These data were also used by Dr. C. F. Brooks while he was at the Institution.

*Summarizing ocean data.*—In order to summarize the large quantity of surface data on temperature, salinity, and wind, furnished by United States Naval transports between Panama and Seattle, a special form was devised, and appropriate charts were prepared.

*Ocean thermographs.*—A Negretti and Zambra thermograph for sea-surface temperatures was installed on the pier at Balboa, New Port Harbor, in August, 1926. A similar thermograph was installed, in February, 1927, on the Los Angeles Steamship Company's "Calawati," which makes one round trip per month between Honolulu and San Pedro, California. The records from both instruments are satisfactory.

*Salinity determinations and records of sea temperatures and winds.*—During the year the salinity of 4176 samples of sea water was determined, and 7977 records of sea temperatures, and 2257 records of wind direction and velocity over the sea were received by the Institution.

*Haber collections.*—Collections made for special chemical investigation by Professor Fritz Haber, of Berlin, total 640 in 2-liter bottles and 200 small samples for chlorine titration to check the salinity determinations made here of duplicate samples.

*Chemical Investigations—*

The chemical investigations at the Institution were in charge of Dr. E. G. Moberg, who was assisted for parts of the year by Miss Dorothy Curtis, Miss Gertrude Lewman, and Dr. H. F. Blum.

All the water samples collected on board the boat, except some obtained on the cruise to Santa Barbara Channel, were analyzed for phosphate, silica, nitrate, and hydrogen ion concentration. Similar determinations were made on samples of surface and bottom water collected daily at the Scripps Institution pier.

A paper on the method used in determining hydrogen ion concentration was nearly completed and considerable progress was made in preparing hydrogen ion and other data for publication. Three papers summarizing the work in this laboratory were submitted for presentation at the Pan-Pacific Science Congress at Tokyo.

*Biological investigations—*

*Diatoms and dinoflagellates.*—The studies of these organisms was in charge of Professor W. E. Allen, who was assisted throughout the year by Mr. R. C. Lewis and from July 1, to August 1, 1926, by Mr. Henry P. Dorman.

In the eight years since the introduction of standardized methods in handling phytoplankton at the Scripps Institution about eight thousand catches have been examined, most of them by Professor Allen, from regions as remote as Callao, Peru, and Dutch Harbor, Alaska (Aleutian Islands), but far the larger number have been taken along or near the coast of southern California. Except an Alaskan series for 1924, all series have been examined to the close of 1924, and a few of later date have been studied.

Five shoreline stations, three in southern California, one at the Farallon Light House, off San Francisco, and another at Scotch Cap Light House, Aleutian Islands, have yielded daily collections through most of the year just closed.

The Institution's boat, "Scripps," and three steamers of the United States Coast and Geodetic Survey have obtained collections off the coast of southern California, Oregon, Alaska, and the Hawaiian Islands. Many catches taken by the "Scripps" were from depths below the surface, at five-meter intervals to a depth of sixty meters.

From combined coastal and offshore sources there are now on hand over four thousand unstudied catches. New catches are accumulating at the rate of about seven per day.

In order to get information concerning the relation between diatoms and their animal associates in the sea, especially those animals having commercial importance, Mr. Ralph C. Lewis has made a concurrent study of seasonal differences in diatom productivity and of seasonal differences in feeding habits of sardines.

Sixteen papers dealing with marine biology, most of them reports on work with diatoms and dinoflagellates, have been published or submitted for publication by Professor Allen and his assistants in the year just closed.

*Copepods.*—Professor C. O. Esterly completed his study of the copepods collected from the Institution's pier six times daily, at four-hour intervals, between September, 1916, and August, 1918, and his manuscript has been submitted for publication as a Bulletin, Technical Series, of the Scripps Institution of Oceanography.

*Attachment of the free-swimming young and growth of sessile organisms.* This subject is of much importance in the study of the geographic distribution of organisms and of the organisms that foul the bottoms of ships. An arrangement has been made with Professor Wesley R. Coe, of Yale University, according to which, following a definite plan, wooden blocks will be suspended from the Institution's pier and at specified times will be taken from the water and forwarded to Professor Coe.

*Genetics and physiology of fishes.*—Professor F. B. Sumner has until now restricted his efforts to such preliminary steps as the preparation of working quarters, assembling equipment, and testing the fitness of one species for life in captivity and for breeding experiments. A special constant-temperature room in the basement of the Museum and Library building has been fitted for the researches.

*Genetics and geographic variation in deer mice.*—Breeding experiments have been discontinued by Professor Sumner, following the plan outlined in the preceding report of the Institution's work, and the living stock was brought to a close about the first of March, 1926. Although the amount of subsequent routine work (areal and colorimetric measurements of the pelage, computations, etc.) proved to be considerably greater than had been anticipated, it was still planned to terminate the *Peromyscus* studies upon the completion of this work and the publication of the results. A representative of the Carnegie Institution of Washington, who visited the Scripps Institution for the purpose, intimated that the former organization might find it possible to provide funds for the continuance of the *Peromyscus* project. Upon the recommendation of President John C. Merriam, the trustees of the Carnegie Institution have voted to grant to Professor Sumner the sum of \$2700 yearly for a period of three years.

A preliminary statement of the results of the genetic experiments of the past three years will, it is hoped, be possible before many months. It may now be said that Professor Sumner is convinced that considerable light will be thrown upon the genetic differences between subspecies and upon the probable nature of some of the transformations which have led to the origin of subspecies in nature.

*Foraminifera and marine bottom deposits—*

The Director of the Institution devoted most of the time he had for research purposes during the year to studies of fossil larger foraminifera. He was assisted by Mrs. E. G. Moberg. The collection of these organisms at the Institution is a very fine one and it is gradually coming into excellent condition for study and reference purposes. The study of the marine bottom deposits at the Institution was mostly confined to investigations of the foraminifera contained in them. Dr. Joseph A. Cushman has prepared an illustrated memoir on foraminifera off the West Coast of America, which it is planned to publish as one of the Institution's technical bulletins. Students and other investigators of the smaller foraminifera have worked on the Institution's collections, with the result that there are now several thousand slides bearing named mounted specimens. The collections at the Institution are being consulted by numbers of geologists and others interested in the group. During the year important additions were made to the collections.

The Institution has been able to help Dr. Parker D. Trask in his investigation of marine sediments as possible source beds of petroleum by furnishing him an opportunity to make collections of bottom samples on its boat and by providing laboratory facilities. This work, which is under the auspices of the American Petroleum Institute, is in the immediate charge of a Committee, of which the Director of the Institution is a member.

*Visiting scientists—*

Scientific investigators who utilized the facilities of the Institution for investigations during the year and the subjects on which they worked are as follows:

- Professor C. M. Child, University of Chicago; physiological investigations on *Corymorpha* and sponges, July 1–September 17, 1926, June 8–30, 1927.
- Professor B. L. Clark, University of California; foraminifera, July 1–19, 1926, June 13–30, 1927.
- Dr. Parker D. Trask; origin of possible source of beds of petroleum, under American Petroleum Institute, parts of July and August and Sept. 1–30, 1926.
- Dr. Myrtle Johnson, State College, San Diego; use of the library, August 16–29, 1926.
- Professor Wesley R. Coc, Yale University; nemerteans and the attachment of organisms which have floating larvae, September 17, 1926–June 30, 1927.
- Mr. A. M. Adamson, Commonwealth Fellow, St. Andrews, Scotland; marine protozoa, December 12–December 30, 1926.
- Professor C. F. Brooks, Clark University, Worcester, Mass.; physical oceanography and marine meteorology, March 9–April 26, 1927.
- Professor H. S. Reed, University of California, Citrus Experiment Station, Riverside; use of library and conferences with Doctor McEwen, April 8–12, 1927.

Besides those who worked at the Institution for considerable periods of time, there were numerous visitors, who came to inspect the Institution or to confer with members of its staff regarding special kinds of research or to do both.

*Lectures by visitors—*

Visitors who gave lectures at the Institution were as follows: Dr. C. M. Child, University of Chicago; Dr. N. M. Fenneman, University of Cincinnati; Dr. John A. Fleming, Carnegie Institution of Washington; Major A. F. Fisher, Chief Forester, Manila; Dr. E. L. Hewitt, San Diego; Mr. C. G. Abbott, San Diego; Dr. W. R. Coc, Yale University; Mr. Dean Blake, San Diego; Dr. C. F. Brooks, Clark University; Dr. Myrtle Johnson, San Diego.

*Students—*

The following is a list of students who worked at the Institution during the year, with their principal subjects:

Ralph Lewis, phytoplankton and the food of the California sardine, July 1, 1926–June 30, 1927.

Marion Wileox Moberg, foraminifera, July 1, 1926–June 30, 1927.

Richard D. Norton, foraminifera, July 1, 1926–January 22, 1927.

Gertrude Lewman, nitrogen compounds in sea-bottom muds, August 8, 1926–June 30, 1927.

The four students named above were registered at the Scripps Institution.

Mr. G. L. Whipple, an upper division student of the University of California at Los Angeles, studied foraminifera from July 1–August 27, 1926; and after graduating returned to the Institution in June, 1927.

Mr. Ora Huddleston, a graduate student in physiology of the University of California, conducted vestibular researches on sharks from May 18–June 30, 1927.

Mr. H. F. Blum, also a graduate student in physiology of the University of California, worked at the Institution from May 18–June 30, 1927.

*Attendance of members of the Institution's staff at scientific meetings—*

The Director of the Institution and Doctor McEwen attended the Third Pan-Pacific Science Congress in Tokyo between October 30 and November 11, 1926, and participated in excursions both before and after the Congress. During the excursions and during the sessions of the Congress the overseas delegates were the guests of the National Research Council of Japan. The hosts of the Congress deserve all possible praise for their courtesy, friendly hospitality, efficient preparation for the Congress, and successful management of it.

A list of papers presented to the Congress by Director Vaughan and Dr. McEwen, either on their own behalf or on behalf of other members of the staff of the Scripps Institution of Oceanography, was published in the annual report of the Institution for the year 1925-26. Director Vaughan was appointed chairman of two committees authorized by the Congress, viz., the International Committee on the Oceanography of the Pacific, and the Committee on the Coral Reefs of the Pacific.

During convocation week, 1926-27, Professor W. E. Allen took part in Philadelphia in a symposium on oceanography organized by the President of the Ecological Society.

In April and May, Director Vaughan, who is chairman of the section of Oceanography of the American Geophysical Union, attended the annual meetings of divisions of the National Research Council, of the National Academy of Sciences, and of the American Geophysical Union, and presented papers by himself and Dr. McEwen. While in Washington he conferred with governmental officials and other persons interested in oceanographic research, and while on his return journey to California he had conferences in Toronto, Vancouver, and Seattle.

The research work of the Institution was discussed during the year before several scientific bodies in California.

*Advisory Board to the Director of the Institution—*

During December, 1926, you appointed the following members of a board of advisors to the Director of the Institution: Dr. Fred Baker, San Diego; Mr. J. C. Harper, La Jolla; Mr. L. M. Klauber, San Diego; Dean C. B. Lipman, Berkeley; Dr. R. A. Millikan, Pasadena; Dr. W. E. Ritter, Washington, D. C.; Mr. N. B. Seofield, San Francisco; Mr. R. P. Scripps, Cincinnati; Miss E. B. Scripps, La Jolla; Mr. Julius Wangerheim, San Diego; and Dean B. M. Woods, Berkeley. Although it has not been practicable to have all the members of the board together at one meeting, there have been meetings of groups which have included most of the members. Those who have not been able to attend meetings have been personally consulted.

*Portraits—*

It is desirable to have in the Institution, portraits of those to whom its foundation is due. The Institution already possessed a good portrait of Miss Scripps. During the year Mr. R. P. Scripps presented a copy of a portrait of his father, Mr. E. W. Scripps, by Mr. J. Young Hunter; Dr. Fred Baker presented an enlarged portrait photograph of himself; and Miss Scripps presented an oil portrait of Dr. Ritter, painted by Mrs. Rieber, of Palo Alto. The Institution therefore now owns likenesses of the four persons who were most active in its establishment.

*Improvement of grounds and buildings—*

During the year arrangements were made and the contract let for paving, with four-inch oil macadam, the main road within the Institution grounds from near the north boundary of the Institution's property to the public highway at its south boundary, and for constructing a sidewalk and curbs and gutters along a part of the road.

Planting trees and shrubs according to plans announced in the preceding annual report of the Institution was pushed energetically. The total number of young plants put out was about fifteen hundred. Many of the plants are either new introductions to the State or represent new experiments for the wind-swept seaside environment of the Institution.

During the year the Institution's aquarium was reconditioned by replacing decayed by new tanks.

*Additions to scientific equipment and improvements within the laboratories—*

The major addition to the scientific equipment of the Institution during the year was the outfitting of a laboratory for breeding small fresh-water fishes and preparation of a laboratory for experiments on salt-water fishes.

During the late spring Wood-Anderson seismographs for east-west and north-south components were installed in the basement of the Museum-Library building by Messrs. H. O. Wood and M. H. Benioff, of the Carnegie Institution of Washington.

Important rearrangements were made within the main laboratory building by dividing the former aquarium room on the lower floor into three rooms, and the lecture room on the second floor into two rooms.

During the latter part of the year orders were placed for two large cases, one to contain an addition to the Baker-Kelsey collection of mollusks, and the other to hold hydrographic and other charts.

*Library—*

The accessioned books in the library now number 10,152, of which 226 were added during the year. Separate and unbound volumes number approximately 15,500, of which 12,144 are catalogued. The exchange list of the Institution has been considerably enlarged during the year and many scientific publications of value have been received by the library.

*Museum, Aquarium and Supply Department—*

Mr. P. S. Barnhart, Curator of the Institution's biological collection, reports that eleven mounted skins of local fishes and a plaster cast of a large spotted moray, prepared during the year, have added much to the attractiveness of the fish exhibit, and that progress has been made on the preparation of a handbook of southern California fishes.

*Special acknowledgments—*

Assistance received by the Institution during the year is gratefully acknowledged, as follows: the officers of the transports of the United States Navy plying between Bremerton, Washington, and the Canal Zone; the Submarine Division of the Navy in the Pacific, in command of Rear Admiral Ridley McLean, while voyaging from San Francisco to Honolulu and from Honolulu to San Diego; the Hydrographic Office of the Navy; the United States Naval Mission in Peru and the Peruvian Navy; the United States Naval Attaché in Chile; the officers of the Coast and Geodetic Survey in command of vessels operating along and off the West Coast and in Hawaiian waters; the Bureau of Lighthouses; and the Los Angeles Steamship Company.

Besides the help mentioned, the Institution has received other assistance and sympathetic support from numerous persons and organizations.

*Gifts—*

For the year 1925-26, the Institution received gifts as follows: Miss Ellen Browning Scripps, for the salary of the Director and general purposes, \$9000; supplemental contribution for general purposes, \$10,000; special contribution to a fund for landscape gardening, \$500; total, \$19,500.

*Needs of the Institution—*

During the past few years the scope of the activities of the Institution has been extended, there have been additions to the staff, and the number of visiting scientists and research graduate students has increased. The regular staff of the Institution now occupies so nearly all the available laboratory space that only a few further additions will render the present laboratory facilities inadequate for the staff. There should be continuously available for investigators not members of the staff of the Institution, a reasonable number of laboratory rooms. In order to meet these needs an additional laboratory building, of about the size of the present building, is essential at a very early date.

Another urgent need is the completion of the second floor of book stacks in the Institution's library.

It is highly desirable that the present wooden aquarium building be replaced by a more durable structure.

Respectfully submitted,

T. WAYLAND VAUGHAN,  
Director, Scripps Institution of Oceanography.