

SCRIPPS INSTITUTION OF OCEANOGRAPHY

LA JOLLA, July 1, 1926.

To the President of the University.

Sir: I have the honor to present the following report on the Scripps Institution of Oceanography for the academic year ending June 30, 1926.

It is not necessary to state the general program of the Institution since it has been explained in my two preceding reports and in several published articles by me, among which I mention "Oceanographic Investigations of the Scripps Institution of Oceanography, with Special Reference to Marine Hydrography" (Scripps Institution *Bulletin* No. 12, pp. 3-13), and "The Scripps Institution of Oceanography of the University of California" (*California Monthly*, September, 1926).

Grounds and buildings—

The outstanding repair on the Institution's property during the past year was the restoration of the pier, which had been deteriorating for some years and was beginning to be in a critical condition. All the disintegrated concrete was removed from the piles and connecting caps, fresh concrete was applied, and all surfaces, after covering with a cement wash, were coated with water resistant asphaltum paint. Certain of the piles were strengthened by the installation of sway bracing. The work was in charge of Herbert B. Foster, the University Engineer. The pier is probably stronger now than when it was first erected.

The road on the west side of the quadrangle in front of the Museum-Library building has been straightened and curbs and gutters have been constructed along the entire stretch of the road on the west side of the quadrangle. In connection with the construction of curbs and gutters a considerable amount of grading was necessary.

The repairs on the pier and the construction of curbs and gutters were made possible by means of a special state appropriation for the biennium of \$10,000, of which \$6954.20 was expended on the pier and \$1034.22 on the curbs and gutters.

The name of the Institution has been placed over the door of the Museum-Library building. The inscription, which is in antique bronze letters, reads "The Scripps Institution of Oceanography, University of California."

During July, 1925, J. W. Gregg, Professor of Landscape Design, College of Agriculture, visited the Institution and consulted with the director regarding the systematic development of the landscape architecture of the lower part of the Institution grounds, and later submitted plans. As soon as practicable work according to the plans was begun but little was accomplished until after A. Bornowski was employed in January, 1926, as the gardner of the Institution. Bornowski is a trained and experienced gardner and since he came to the Institution astonishing progress has been made in the development of the grounds. No actual count has been kept of the number of trees and shrubs which were put out but they probably aggregate as much as one thousand. Besides this planting Bornowski undertook to maintain two flower gardens, one on the south side of the Museum-Library building and the other across the road on the north side of the Museum-Library building. He has also maintained flower gardens in other parts of the grounds.

I received during the year, through Mr. R. H. Cambage, the seeds of about 95 species of Australian trees, shrubs, and vines which seemed likely to be suitable for use here. I had earlier received from Mr. Cambage seeds of ten species. An arrangement was made with the Acclimatization Garden of the United States Department of Agriculture at Torrey Pines for the germination of the seeds on shares. A part of the seeds of imported trees and shrubs was sent to the Department of Forestry, College of Agriculture of the University. The stocks of trees and shrubs derived from the Australian seeds and plants which have been raised by Mr. Bornowski aggregate about one thousand, all of which should be set out before the end of the rainy season in 1927. A few hundred plants will probably have to be purchased in order to complete the planting outlined by Professor Gregg.

It is hoped that within a relatively short time the grounds of the Institution will become attractive and that they will be botanically interesting because many of the trees and shrubs which are being introduced are new to California. A number of plants and seeds were also received from friends who are interested in the improvement of the Institution's grounds.

Among repairs which may be mentioned are the internal telephone service in the Museum-Library and Laboratory buildings and the partial reconstruction of the bridge between the Museum-Library and Laboratory buildings, and other smaller repairs. Work which was started during the academic year covered by this report but not finished includes repairs to the Institution's aquarium, the construction of two additional stalls to the upper garage, and reconditioning the tennis courts.

Additions to scientific equipment—

The most important addition to the scientific equipment of the Institution was the purchase in September of the purse seiner boat "Thaddeus." The purchase was made possible by the utilization of funds realized from the sale of the boat "Alexander Agassiz" which was donated to the Institution by Mr. E. W. Scripps. The "Thaddeus" is about 64 feet long, 15 foot beam, draft 6 to 8 feet, net capacity 22 tons, gasoline capacity 2600 gallons, engine 85 horsepower, speed 8 knots per hour, gasoline consumption 8 gallons per hour when operated at full speed. There are berths for ten persons. A cabin has been constructed on the after deck for use as chart and record room and for laboratory purposes. Arrangements have been made to change the name of the boat from "Thaddeus" to "Scripps," but the change has not been made effective at the time of writing this report.

The chemical laboratory has been reconditioned and a balance room constructed. Two thermographs were purchased with funds contributed by the Southern California Edison Company, the Southern Sierra Power Company, and the Bureau of Light and Power of Los Angeles. For one thermograph, which is installed on the Scripps Institution pier, there are two bulbs, one for recording bottom and the other for recording surface temperatures. For the other thermograph, which is installed on the pier at Balboa, there is only one bulb, which is for recording surface temperatures.

Additions were also made to the equipment of the laboratory for the study of sediments and foraminifera, and the preparation of a laboratory for the experimental study of fishes was started but not completed.

Although much progress has been made in equipping the Institution for different kinds of oceanographic work the equipment is not yet by any means complete. The expenditure of several thousand dollars additional is urgently needed.

Visiting scientists—

During the year the facilities for investigation were utilized by a number of scientific investigators, among whom may be mentioned Mr. Guy L. Fleming, Custodian of the Torrey Pines Park, who occupied one of the laboratory rooms of the Institution from July 1 until near the end of June. Dr. Myrtle Johnson, of the San Diego State College, worked here at different times during the year, particularly using its library in the preparation of a handbook of the littoral invertebrates of California. Dr. H. Boschma, of the University of Leiden, one of the Fellows of the National Education Board, studied the food and feeding habits of actinians during October and the first half of November, 1925. Miss Kathleen M. Drew, of Manchester, England, a Commonwealth Fellow,

spent about two weeks during the latter part of December and the first part of January, studying marine algae. Dr. H. S. Reed, of the Citrus Experiment Station, worked here for ten days during March. Dr. E. Beck utilized one of the laboratory rooms for several weeks during June for conducting experiments on the effect of radium on marine fishes. Dr. G. W. Hunter, of Pomona College and Science Service, worked in the library for several weeks during June. Dr. C. M. Child, of the University of Chicago, came to the Institution during the latter part of June to spend the summer conducting physiological experiments on the hydroid *Corymorpha*.

Besides those mentioned, visitors used the library of the Institution, and in some instances laboratory rooms, for short periods.

The Institution was fortunate in having lectures by a number of the distinguished visitors, among whom were Dr. J. W. Sherrill, Scripps Metabolic Clinic; Dr. G. W. Bartelmez and Dr. J. W. Glattfeld, University of Chicago; Dr. G. M. McBride, University of California, Southern Branch; Dr. Myrtle Johnson, San Diego State College; Dr. H. Boshma, Leiden, Holland; Dean B. M. Woods, University of California; Dr. B. W. Evermann, California Academy of Sciences; Dr. H. S. Reed, Citrus Experiment Station; Dr. E. L. Nichols, Professor Emeritus, Cornell University; Director Clinton G. Abbott, San Diego Museum of Natural History; Miss Mary Jeffers and Miss Florence Peebles, formerly Bryn Mawr College; Dr. D. R. Hoagland, University of California. The Fellows of the San Diego Society of Natural History held several of their meetings at the Institution and scientific lectures were delivered by Dr. L. M. Huey, of the San Diego Museum of Natural History, and Mr. L. M. Klauber, local authority on herpetology.

Students.—During the year there were registered as graduate students Miss I. D. Collins in chemistry, July 1 to December 31; George F. Sleggs, in planktology, September 11 to June 15; Miss Marion Wilcox, in paleontology, January 3 to June 30. In addition to the three students above mentioned who were regularly registered at the Institution, H. C. Hinshaw, graduate student, Department of Zoology, worked on certain protozoan parasites from July 1 to 31; Stephen Rook, an upper division student of the Southern Branch, studied foraminifera from July 1 to September 3; R. D. Norton, a graduate student from Berkeley, worked on foraminifera from May 17 to June 30; and Leslie Whipple, an upper division student of the Southern Branch, began work on foraminifera on June 28 and continued through the summer. Ralph Lewis reported at the Institution for work on planktology on June 24 and has continued beyond the first of July, 1926.

Scientific activities—

Conference.—On November 6 and 7 there was held at the Institution a conference on the physical oceanography and marine meteorology of the northeast Pacific and the climate of the western part of the United States. The papers presented at the conference at the writing of this report are in press as *Technical Bulletins* of the Scripps Institution of Oceanography. A list of the titles of the papers is given in Appendix A of this report.

The conference was attended by a number of interested persons, including officers of the Navy, the Coast and Geodetic Survey, and the Weather Bureau, and engineers and others interested in physical oceanography and the interrelation between physical oceanography and meteorology. The conference was decidedly successful and was followed rather promptly by an extension of the facilities of the Institution for obtaining oceanographic data, among which will be mentioned: (1) making meteorological records and records of surface temperatures and collections of water samples by the Navy transports operating between Seattle and Panama; (2) arrangements through the United States Bureau of Lighthouses for the establishment of a collecting and observing station at Scotch Cap Light, Aleutian Islands; (3) arrangements for the installation of a thermograph on one of the vessels of the Los Angeles Steamship Company, which plies between Los Angeles and Honolulu; (4) the consideration by the Carnegie Institution of Washington of making an attempt to conduct oceanographic explorations in two triangles in the northeast Pacific on which data are at present scanty or altogether lacking. One of these areas lies between lines from Seattle to Honolulu; thence north to the Aleutian Islands and from them to Seattle; the other lies between the coast of southern California and Central America and the ordinary steamship routes from Honolulu to Panama and from Honolulu to Los Angeles.

Preparation for Congress in Japan.—The Director of the Institution is the chairman of the International Committee on the Physical and Chemical Oceanography of the Pacific appointed by the Second Pan-Pacific Science Congress which met in Australia in 1923; Dr. G. F. McEwen is the chairman of the committee for the United States. Besides his duties in connection with this committee, the Director of the Institution was requested by the officers of the Third Pan-Pacific Science Congress, which will meet in Tokyo during the latter part of October and the first part of November, 1926, to assist in the organization of the scientific programs for the Congress. The members of the staff of the Institution have prepared for presentation at the Congress about fifteen scientific communications or reports. A list of the titles of the papers is given in Appendix B of this report.

Incidental activities.—The members of the staff have performed a considerable amount of incidental work which will not be described in detail. They have given many lectures and presented papers at scientific meetings. Last April the Director of the Institution was elected chairman of the Section of Oceanography of the American Geophysical Union. He is a member of a number of the committees of the National Academy of Sciences and of the National Research Council and is chairman of several of the committees.

Collection of data and material for study—

During the year the Institution has received great assistance from the United States Navy, the United States Coast and Geodetic Survey, and the United States Bureau of Lighthouses. It has continued to maintain its collecting and observing stations at Oceanside, Balboa, Hueneme, Santa Barbara, Pacific Grove, Farallon Islands, Blunts Reef, and Columbia River Lightship. The following data and collections were received:

Temperatures of ocean waters	16,379
Meteorological records	14,989
Water samples for the determination of salinity.....	5,982
Plankton samples, about	1,967

The progress made in the study of the data and material received will appear in the reports of the different scientific investigations.

In this connection it should be mentioned that the Institution has been active in assisting Professor Fritz Haber of Berlin in obtaining collections of water samples for special studies he is making on the amounts of precious metals in solution in sea water. The Institution interested the Coast and Geodetic Survey in collecting samples for Professor Haber, and the officers of the steamer "Pioneer," in addition to taking samples off the coast of southern California, are collecting samples for him off the coast of Oregon. It is expected that all of the samples he desired will be taken by next spring and that they may then be shipped to him with the accompanying records.

Investigations in physical oceanography—

These investigations have been in charge of George F. McEwen, assisted by Captain S. W. Chambers. The results of several special studies will be presented at the Third Pan-Pacific Science Congress in Japan. (Appendix B.)

Professor McEwen completed a draft of a paper entitled "A mathematical theory of temperature distribution in water under the action of radiation, evaporation, and the resulting convection," which was pre-

sented at the Japanese Congress. The finished manuscript should be ready to submit for publication shortly after the first of January, 1927.

A system of tabulating ocean data according to quadrangles, 30' on a side, has been worked out. One form is used for surface data and a different form for serial subsurface data. The object was to systematize summarizing large numbers of observations with reference to time and position and to reduce to a minimum the necessary labor. Detailed instructions have been prepared for using the forms. Standard charts were prepared on a Mercator projection on a scale of 100 miles = 5.642 cm. at the equator, showing the quadrangles and their numbers. A chart indicating the scale for latitudes from 0 to 54° was made to accompany the charts.

The tabulation of records has been kept nearly up to date, and the charting of certain results averaged according to quadrangles and months is in progress in order to find out what can be done toward estimating circulation from such data.

Weekly averages of temperature and salinity at all of the coast stations have been worked out nearly up to date, and represented graphically on tracing paper from which blueprints are being made.

Investigation of chemistry of sea water and of plankton—

These investigations have been in charge of E. G. Moberg, who was assisted from July 1 to December 31 by Miss Isabelle D. Collins and from January 4 to June 30 by Miss Dorothy Curtis.

During the past year the facilities for chemical work have been considerably improved. One of the laboratory rooms has been completely remodeled and refurnished so as to make it more suitable for chemical work. A large balance room has been constructed and a high grade analytical balance has been purchased.

The routine chemical work has been extended so as to include determinations of silica and nitrate. For both of these substances rapid and sensitive colorimetric methods have been adapted. The H-ion concentration and phosphate content have been determined on samples collected at the Institution pier daily throughout the year. Since the beginning of March, 1926, weekly series of water samples from various depths at two off-shore stations have been obtained and analyzed for H-ion, phosphate, silica, and nitrate content, and further analyses of plankton samples have been made. A paper dealing with the hydrogen ion concentration of sea water has been nearly completed.

Considerable time has been devoted to boat work, especially during 1926. From about March 1 to June 1 weekly collecting trips were made and on June 1 the number of trips was increased to three or four per week. It has also been necessary to make certain changes in the equip-

ment of the boat in order to render it more suitable for scientific work. Since many of the chemical substances in sea water must be determined within a short period after collecting the sample it is necessary on the longer trips to make the chemical tests on board. In order to do this one of the cabins on the boat has been furnished so as to serve as a chemical laboratory and some of the necessary apparatus has been ordered.

Biological investigations—

Phytoplankton.—These investigations have been in charge of W. E. Allen who was assisted from July 1 to August 31, 1925, and from June 15 to June 30, 1926, by H. P. Dorman from September 11 to June 15 by George F. Sleggs; and from June 24 to June 30 by Ralph C. Lewis. Professor Allen during November and December visited Washington to confer with Dr. Albert Mann regarding the study of diatoms and to examine the collections which are deposited in the United States National Museum. On the return trip to La Jolla, he attended the annual meeting of the American Association for the Advancement of Science in Kansas City, where he represented the Institution.

Considerable advance has been made during the year in studying the series of collections of diatoms and dinoflagellates. Much of this advance was made possible by the assistance of Dorman and Sleggs, who not only did routine work but prepared reports on certain series.

All series of surface catches made by cooperating steamers and yachts to the close of 1923, about 1000 catches (except completing the report on the Kemah series, Jacksonville to San Diego) have been studied and reports have been published or are ready for publication.

All series of surface and subsurface catches, about 800 catches, made by our own boats have been studied to the close of 1924, and reports on that work have been published or are ready for publication.

All series of daily collections made at piers, about 2500 catches, have been studied to the close of 1922 and the reports have been published or prepared for publication.

For special reasons certain series, about 600 catches, have been studied ahead of their chronological order, and reports have been published on some and partly prepared for publication on others. Included in these are the "Ohio" series of 1924 in tropical waters, the United States Navy series of 1925 in mid-Pacific and South Pacific waters, and the McEwen-"Pioneer" series of 1926, seaward from San Pedro.

Studies are in progress on:

1. Series of catches from piers (including Pacific Grove, in 1923) about 1400 catches.
2. Series of surface and subsurface catches by the Institution boat in 1926, about 400 catches.

The series on hand needing immediate attention are:

1. Piers, 1924, and piers and Farallon Light, 1925; about 2500 catches.
2. "Pioneer"-Alaska, 1924; "Guide"-Oregon, 1924; a few catches by both in 1925; a few catches by California Academy of Sciences in 1924; about 500 catches.

New material is now being received at an average rate of more than five catches per day.

Zooplankton.—During the past year C. O. Esterly has continued his work on the Copepoda of the pier collections. The correlations between abundance and season, time of day, and temperatures are still in progress. The preliminary work in arranging the data in form for estimating the significance of differences is well advanced and the completion of a memoir on the results of the investigations may be expected within about one year.

Interpretation of statistical data.—For a number of years George F. McEwen has been engaged in a study of the significance of random samples and he has completed the manuscript of a large mathematical memoir entitled "Methods of estimating the significance of differences or probabilities of fluctuations due to random sampling." This manuscript was favorably judged by Dr. E. B. Wilson of the Harvard School of Public Health and has been forwarded to the President of the University for his decision as to its publication.

Fish eggs and larval fishes—

During the year an attempt was made by P. S. Barnhart to identify pelagic eggs and the larval and post-larval stages of local marine fishes. Eggs of the baracuda, *Sphyraena argentea*, the bonita, *Sarda chilensis*, and the mackerel, *Scomber japonicus*, were collected, hatched, and identified.

Work on a handbook of southern California fishes was continued; fifty pen and ink drawings have been completed and the preparation of the manuscript is well advanced.

Foraminifera.—Considerable attention has been paid to increasing the Institution's collections of foraminifera, both recent and fossil. An arrangement was made with Dr. Joseph A. Cushman, of Sharon, Massachusetts, for a report on the foraminifera off the coast of North America from Oregon to Panama, and accordingly a set of samples representing over one hundred localities was sent him in March, 1926. Dr. Cushman has already returned to the Institution a named set of some of the species found in the vicinity of La Jolla. The list already given of students who have worked at the Institution during the year shows that there is much interest in this group of organisms. The collection is rapidly becoming an important one and for the American larger forms, particularly the fossils, is one of the two most nearly complete collections in the world.

Besides American material, there are also collections from India, the East Indies, Australia, and New Zealand, and material from other parts of the world is being received.

Heredity and geographic races of Peromyscus—

Work upon the Florida and Alabama series of mice has been continued actively by F. B. Sumner. The various character differences, linear and colorimetric, which distinguish the three geographic races under consideration have been carefully analyzed, and the results have been embodied in a paper appearing in the August (1926) issue of the *Journal of Mammalogy*.

Large numbers of first, second, and third-generation hybrids, and back-crosses of various types have been secured from matings among these various races. The majority of these hybrids have already been killed, measured, and skinned, but it has not been possible thus far to report upon the results. As one item of the routine work involved in these studies, it was necessary for Sumner personally to prepare 700 skins of these mice during the academic year just past, and at least 500 remain to be prepared. The animals have lived and bred satisfactorily and the outlook for genetic and variational results of importance is at present unusually favorable.

Breeding operations upon these mice have been practically discontinued and the animals are being rapidly reduced in number, as they attain the required age. A large series of living mutant types, which were reared at the Institution for many years, have been sent to Dr. Lee R. Rice, of the Museum of Zoology, University of Michigan. Dr. Rice plans to continue certain lines of study to which Professor Sumner has devoted considerable time.

By the close of the current calendar year (1926), all except a few of the present stock of mice will have been killed and utilized, but a small proportion of them will unavoidably remain for some months longer. Likewise, a large amount of mensural and statistical work remains to be done before the final reports on these studies can be prepared for publication, and even some fresh material must be trapped in Alabama before certain pressing questions can be answered. No new breeding experiments are contemplated, however.

The new quarters for genetic and physiological studies of fishes, located in the basement of the Museum-Library building, will be ready for occupancy before the end of the summer and a certain number of the necessary aquarium tanks have already been ordered. Upon the completion of these preparations, preliminary experiments will be commenced upon certain species of small fishes, with the aim of testing their suitability to the studies under consideration and of developing proper methods of caring for them.

Geological investigations.—The investigations on the geological aspects of oceanography have not received much attention, unless the work on the foraminifera, both recent and fossil, be included under them. Such investigations might with equal propriety be classified as biological or geological. The Director of the Institution has devoted considerable time to the study of certain fossil larger foraminifera and during the year prepared several papers for publication. From January 4 to June 30 he was assisted by Miss Marion Wilcox. It is hoped that within a short time definite researches on marine sediments may be initiated and that investigations in that field may become one of the important fields of activity in the Institution.

The *Library* now contains 9926 accessioned volumes and 12,144 catalogued reprints, 240 volumes and 1329 reprints having been added during the year. About 400 charts, the majority of which are not filed because of the lack of proper facilities, and approximately 1800 unbound volumes and reprints, which belong to sets, are systematically arranged but are not yet catalogued.

Museum, aquarium, and supply department—

Museum. Only small additions were made during the year to the exhibits in the museum of the Institution. Making of plaster casts and mounting skins of fishes too large to exhibit in any other way was begun. The cataloguing of the Snyder Marine Herbarium has been nearly completed, and the systematic arrangement of the Kelsey-Baker collection of shells is far advanced. A large amount of new material has been added to the biological collections.

Aquarium. From August 15 to the middle of October the care of the aquarium was assumed by the curator, but after that time it was taken over by a permanent attendant. The two largest tanks were unfit for use during most of the year and two others were in similar condition for about three months. During the restoration of the pier no fishing could be done from it and the aquarium itself was closed for about four weeks while the gravity storage tank was being repaired. Because of these handicaps there were only about 514 fishes and 120 invertebrates furnished to the live exhibits during the year.

All the aquarium tanks are gradually disintegrating and will soon need to be replaced. Plans and specifications for new tanks were submitted and six new ones are being constructed.

Attention should be called to the fact that the Museum and Aquarium are useful factors in the school life of this section. High schools and junior colleges from near cities and towns, and even from distant places like Santa Ana and Riverside, are sending their classes in biology once or twice a year to this Institution for educational purposes.

Supply department. The sales of the supply department amounted to only \$310 for the year. The small value of the sales, much lower than any previous year, was due to inability to obtain sharks locally, from the sale of which most of the revenue of the department has been derived in past years.

The contemplated use of a part of the laboratory-aquarium and the basement supply room for other purposes necessitated new quarters for the supply department. Cottage No. 14 was therefore set aside for this purpose and in it 265 square feet of concrete floor was laid for the injecting room, shelves were built, the plumbing was rearranged, and the supply material was moved to the new quarters.

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, and a supplemental contribution of \$7500.

The Director of the Institution personally expended \$700 on the maintenance and improvement of the Institution's grounds and bore the expense of the Conference on Physical Oceanography and Marine Meteorology held at the Institution on November 6 and 7, 1925.

Numerous gifts of specimens have been made to the Institution during the year but it does not seem necessary to make a special list of them.

Needs—

During the summer of 1926 all the laboratory rooms of the Institution were occupied, and two persons worked in each of three rooms. There is immediate need for an additional laboratory building of at least the size of the first floor of the present main laboratory building. The scientific staff of the Institution should be enlarged, the number of students should increase, and several laboratory rooms, at least three or four, should always be available for visiting investigators.

The present aquarium, which is in a wooden house, was erected as a temporary structure and is rapidly deteriorating. It should be replaced by a permanent structure. An aquarium possesses much educational value and is a necessary adjunct to any oceanographic institution which undertakes comprehensive marine work.

Respectfully submitted,

T. WAYLAND VAUGHAN,
Director.

APPENDIX A

PAPERS PRESENTED AT THE CONFERENCE ON THE PHYSICAL OCEANOGRAPHY
AND MARINE METEOROLOGY OF THE NORTHEAST PACIFIC AND THE
CLIMATE OF THE WESTERN PART OF THE UNITED STATES

November 6-7, 1925

- The Oceanographic Investigations of the Scripps Institution of Oceanography, with Special Reference to Marine Hydrography. T. Wayland Vaughan.
- Recent Oceanographic Work of the Coast and Geodetic Survey. Paul C. Whitney.
- Preliminary Report on Oceanographic Observations Furnished by the United States Navy during Recent Maneuvers in the Pacific. George F. McEwen.
- Aerological Work of the Naval Air Station at San Diego. J. W. Thomas.
- Forecasting Fog on the California Coast. Dean Blake.
- Ocean Temperatures and Seasonal Rainfall, a Review of their Relation Based upon Records of the past Nine Years in Southern California. George F. McEwen.
- The Northeast Pacific Anticyclone and its Relation to California Climate. E. H. Bowie.
- Forecasting Water-Power Supply for Hydro-Electric Plants of the Southern California Edison Company from Ocean Temperatures. A. Wilstam.
- The Value of Long Range Rainfall Forecasting to Irrigation and Water Supply Projects in Southern California from an Engineering Standpoint. Edgar Alan Rowe.
- Seasonal Forecasting and its Value to Agriculture in San Diego County. James G. France.
- Seasonal Forecasting and its Bearing on Forestry Problems. J. E. Elliott.

APPENDIX B

TITLES OF PAPERS BY MEMBERS OF THE STAFF OF THE SCRIPPS INSTITUTION
OF OCEANOGRAPHY TO BE PRESENTED AT THE SCIENCE CONGRESS
IN TOKYO, NOVEMBER, 1926

- Investigations on Phytoplankton at the Scripps Institution of Oceanography.
W. E. Allen.
- Investigations of Zooplankton at the Scripps Institution of Oceanography.
Calvin O. Esterly.
- Surface Drift in the Pacific Coastal Belt off North America. (a) Estimates of Drift from Wind Observations. (b) The Departures of the Temperature Distribution from the Normal Estimate from Surface Drift and Compared with Observed Departures. George F. McEwen.
- Application of the Bjerknes' Dynamical Theory of Oceanic Circulation to the North Pacific off Southern California and Cape Mendocino. George F. McEwen.
- Qualitative Review of a Theory of Vertical Temperature Gradients in Relation to Radiation, Evaporation, and Convection. George F. McEwen.
- Summary of Scripps Institution Data on the Physical and Chemical Oceanography of the Pacific. George F. McEwen.
- Report of the Chairman of the United States Subcommittee on the Physical and Chemical Oceanography of the Pacific Ocean. George F. McEwen.
- The Hydrogen Ion Concentration of Sea Water off the Coast of Southern California. Erik G. Moberg.
- The Phosphate, Silica, and Nitrate Content of Sea Water. Erik G. Moberg.
- The Food Value of Marine Plankton. Erik G. Moberg.
- International Cooperation in Oceanic Researches of the Pacific. (By special request.) T. Wayland Vaughan.
- Oceanographic Research at the Scripps Institution of Oceanography of the University of California. T. Wayland Vaughan.
- Researches in Oceanography in the Western Part of the United States, Alaska, and the Hawaiian and Philippine Islands.
- Report of Chairman, of Committee on Physical and Chemical Oceanography of the Pacific Ocean. T. Wayland Vaughan.
- Results of Recent Investigations of American Tertiary Larger Foraminifera. T. Wayland Vaughan.