

La Jolla, California

June 1, 1934

To the President of the University of California.

Sir: I have the honor herewith to transmit the report of the Scripps Institution of Oceanography for the year 1933-1934.

Improvements -

During the past year, by means of funds contributed by Mr. R. P. Scripps and from the estate of Miss Ellen B. Scripps, the Scripps Institution of Oceanography has been able to replace the gasoline engine on its boat SCRIPPS with a diesel engine, and to make numerous improvements. Now, living conditions on the boat are better than they have been before and the boat is equipped to do all of the ordinary oceanographic work to a depth of about 5,000 meters. Henceforth, it will be possible to make expeditions to a distance of between five and six hundred miles off-shore.

Expeditions and Oceanographic Data -

During the past year, in addition to numerous short trips off-shore from San Diego or La Jolla, one cruise was made on the SCRIPPS from La Jolla to San Clemente Island, thence to Santa Catalina and Balboa, and back to La Jolla. A series of stations was occupied for various oceanographic purposes, one of which included the collection of core samples of bottom deposits for chemical and bacterial investigation. Mr. R. H. Fleming spent about three months aboard the naval vessel HANNIBAL in the Gulf of Panama and off the coast of Costa Rica. He assisted in making oceanographic observations and collecting water samples at 127 stations.

While aboard the vessel he made numbers of chemical analyses for oxygen and phosphate, and collected surface plankton samples. A report on the results is in preparation. Mr. Roger Revelle was aboard the U. S. Coast and Geodetic Survey steamer PIONEER for ten days during July and assisted in making nine vertical sections for salinity and temperature off Point Arguello. He also made oxygen sections at each station occupied and collected bathypelagic organisms to study the interrelations between the vertical distribution of zooplankton and the oxygen content of the water.

The quantity of oceanographic data received at the Institution during the past year is given in the accompanying table:

	<u>Salinity</u>	<u>Temperatures</u>	<u>Wind</u>	
		<u>Water</u>	<u>Air</u>	
U. S. Transports	0	4333	769	4333
U. S. Lighthouse tenders	192	965	765	965
U. S. Coast and Geodetic Survey ships	(273)*/	(273)*/	0	0
SCRIPPS	(287)*/	(287)*/	0	0
Shore Stations: La Jolla to Scotch Cap - - -	2610	2610	365	1880
Grace Line ships, Valparaiso to Central America	0	1975	1975	0
U. S. Navy: RAMAPO and HANNIBAL	(1050)*/	(1050)*/	0	0
Supplementary data off Lower California; Central, North, and South America. VELERO III, MAZATLAN	118 ^{#/}	173 ^{#/}	0	101
TOTALS - - - - -	4530	11,666	3874	7279
GRAND TOTAL - - - - -		<hr/> 27,349		

*/ = subsurface

^{#/} = various depths

In addition to the data indicated in the table, the Institution has a sea-water thermograph installed on the U. S. Lighthouse Tender LUPINE and the U. S. Naval Tanker RAMAPO. Two of the three thermographs installed on Panama Pacific Line steamers plying between New York and San Francisco were provided by the Scripps Institution, and arrangements have been made to receive photostat copies of all their records. A recording current meter of the pendulum type has been designed for use on the sea bottom and an experimental model is under construction.

Physical Oceanography and Marine Meteorology -

Dr. McEwen continued his studies of vertical and horizontal circulation in the sea along and off the west coast of the United States, making use of data on winds as a cause, and the distribution of temperature and salinity as effects, of circulation. The results of this investigation which has been a long-continued one have been submitted for publication. Dr. McEwen carried on investigations of the amount of water each storm supplies to a water shed in connection with the California Forest Experiment Station at Glendora. It is expected that this project will be a long-continued one, ten or fifteen years. The investigations on seasonal weather forecasting have been continued in spite of the very much reduced financial support.

In connection with the investigations on sediments at the Scripps Institution certain statistical problems have been studied and progress has been made in their solution. Some of these problems are closely related to the differentiation of species and sub-species by appropriate statistical treatment of the measured characters. A number of numerical tables have been prepared for convenience in application, and a valuable

collection of references, abstracts, and reprints dealing with modern statistical methods has been made.

Mr. H. R. Byers continued his researches on the air masses of the North Pacific and he has prepared an extensive paper which has been accepted for publication in the Scripps Institution Bulletin, technical series. He also completed the manuscript of an article entitled, "Equivalent temperature as a physio-climatic element."

Chemistry -

The work in the chemical laboratory has largely dealt with substances and conditions in sea water that have been previously investigated. The chlorinity, plant nutrients, oxygen, and the various components of the buffer mechanism have been determined on samples collected regularly at the Institution's pier as well as on samples collected from various depths off the coast of southern California by the boat SCRIPPS.

In a previous report the Institution's investigation of the buffer system or the hydrogen-ion-regulating mechanism of sea water has been mentioned. During the past year a paper on this subject has been completed and published in the technical series of the Bulletin of the Scripps Institution under the authorship of Moberg, Greenberg, Revelle, and Allen.

Further laboratory studies of some of the components of the buffer system have been in progress throughout the year. For example, water samples have been analyzed for boron and titratable base, including a series of surface samples collected by the U. S. S. RAMAPO, between the California coast and the Philippines, and several vertical series taken by Mr. Fleming and Mr. Revelle on the HANNIBAL and PIONEER, respectively. It was found that for all the localities and all the depths represented the ratio of both boron and base to the chlorinity was practically constant.

A study of importance in comparing the results of determinations of titratable base or alkalinity obtained by different methods was carried out in cooperation with Dr. P. H. Mitchell of Brown University. The base content of a number of sea water samples was determined both by Dr. Mitchell's modification of Thompson and Bonnar's method, and by the direct titration method used in this laboratory. The results were found to agree within the limits of the errors of the methods.

Microbiology -

Dr. C. E. ZoBell, in charge of microbiology at the Scripps Institution, reports that a large proportion of the bacteria in the sea are able to ammonify numerous substances. Five new species have been isolated which produce ammonia from low concentrations of urea in sea water. Nitrosifiers and nitrifiers have been recovered with regularity from bottom deposits in relatively shallow water, but similar methods have failed to reveal their presence at depths greater than 500 meters. Nitrate-reducers are encountered very infrequently and they are functional only under unusual conditions. Observations on the influence of temperature, organic matter, pH, redox potentials, and salinity on the activities of nitrifying and denitrifying bacteria indicate that in the sea the redox potential is perhaps the most important factor.

Analyses of over 40 bottom deposit samples from depths to 1300 meters show the existence of a large and varied microflora which is clastically active against cellulose, starch, and proteinaceous substrates. Aerobes predominate, but the ratio of anaerobes to aerobes increases with the depth of the core strata. The reduction potential of most of the

cores approaches that of the hydrogen-electrode and in vitro hydrogen overvoltages may be produced due to microbial action. Sulphate-reducing bacteria are common in the mud samples.

It has been found that while immediately following initial isolation marine bacteria have specific sea-water requirements, they are readily acclimatized to become physiologically indistinguishable from fresh-water species. At least 88 new bacterial types from the sea have been characterized.

Miss Esther C. Allen has noted that the usual sequence of events in the fouling of submerged surfaces is first the adherence of bacteria and kindred growths, followed by the attachment of barnacles, Bryozoa, hydroids, and other organisms. Bacteria and, to a lesser extent, diatoms play an important role in the fouling of marine structures.

In collaboration with Mr. Nelson A. Wells, the etiological agent of a highly fatal infectious dermatitis of Fundulus parvipinnis and other marine fishes has been isolated and identified as Achromobacter ichthyodermis, n. sp., and a paper published on the results.

Phytoplankton -

Professor W. E. Allen has continued his studies of phytoplankton of the La Jolla region, devoting most of his time to the preparation of the manuscript of a report on the results of ten years of daily collection at the end of the Institution's pier. Professor Allen has continued studies of fouling organisms along the lines initiated several years ago by Prof. Wesley R. Coe of Yale University. Miss E. E. Cupp has completed a manuscript entitled, "A critical study of certain distinguishing

characters in three closely allied plankton species of the diatom genus Nitzschia and their relations to certain environmental conditions." This paper was submitted in partial fulfillment of the requirements for the doctor's degree. Miss Cupp has also prepared a report on the plankton samples collected by the VELERO III between San Diego and Panama.

Foraminifera -

Prof. T. W. Vaughan during the year published a number of papers on fossil foraminifera. A publication of the Scripps Institution Bulletin, technical series, entitled, "The temperature-and depth-distribution of some Recent and fossil foraminifera in the southern California region," by M. L. Natland, is one of significance both to students of the ecology of marine organisms and to geologists. During the year Mr. Earl Myers succeeded in completely working out the life history of a local species of foraminifera known as Patellina corrugata. A short note entitled, "Multiple tests in the foraminifera," was published in the Proceedings of the National Academy of Sciences (vol. 19, no.10, pp.893-99,1933). The complete report, entitled, "The life history of Patellina corrugata, a foraminifer," presented in partial fulfillment of the requirements for the doctor's degree, is now ready for publication, and the results were presented by Professor C. A. Kofoid at the recent meeting of the National Academy.

Physiology of Marine Invertebrates -

Notes on the work done during the past year are as follows. During the last twelve-month period an investigation has been made by Dr. D. L. Fox and Dr. G. W. Marks on the digestive enzymes of the plankton-feeding

Mytilus californianus, with a view to determining the food that it can utilize and must remove from the sea. Its fecal ribbons have been examined for correlative information. The findings from these investigations will be correlated with Buley's studies of the gastric contents and Miss Austin's studies of other features of this mollusc. Studies on the effect of oxygen in the inactivation of catalase are being continued, using a number of marine animals and plants. A paper dealing with the subject entitled, "The inactivation of mussel catalase by oxygen," appeared in the Journal of Biological Chemistry (vol. 103, p.269, 1933).

Another investigation in progress is concerned with the amounts of dissolved copper in sea water, the tolerance of a number of marine molluscs for this toxic cation, and the possible accumulation of it by the animals.

The mussel has in its digestive tract an enzyme or enzymes capable of hydrolyzing the poisonous glucoside amygdalin, with the production of a reducing sugar (glucose) and free hydrocyanic acid. Out of 69 bacteria, 6 actinomyces, 3 molds, and 2 yeasts investigated, two-thirds of the bacteria, and all the other forms excepting one of the yeasts, possess the ability while living to produce HCN from amygdalin. The mussel enzyme hydrolyzes amygdalin in the absence of microorganisms. A paper dealing with the subject has been prepared.

In cooperation with Dr. F. B. Sumner an investigation of considerable length concerning the carotenoid pigments in certain marine fishes has been completed and published under the title, "A study of the variations in the amount of yellow pigment (xanthophyll) in certain fishes and of the possible effects upon this of colored backgrounds" (Jour. Exp. Zool., vol. 66, pp.263-301, 1933).

During the year seven articles have been published from the section of physiology, two are in press, another has been prepared for publication, and three are in the process of preparation.

Fish Biology -

The work in fish biology consisted in a continuation of studies of the relations of marine fishes to their environment. The chief subjects of investigation were as follows: (1) The yellow (carotenoid) pigment of fishes, which is partly responsible for the striking adjustments of these animals to the color of their surroundings in nature, was investigated by Dr. Sumner, in cooperation with Dr. Fox of the physiology section.

(2) Studies were carried out by Dr. Sumner upon the relations of different parts of the visual field to the color responses of fishes. A new technique was devised, whereby the animals were forced to look through transparent caps which were fitted over the eyes, these caps being variously colored or partly obscured by opaque areas.

(3) Investigations of the oxygen consumption of fishes were continued by Mr. N. A. Wells. The relations of the metabolic rate to activity, temperature, season, size, sex, and some other factors were determined in part, and certain phases of the work were brought to a definite conclusion. Mr. Wells presented a paper entitled, "Variations in the rate of respiratory metabolism of the Pacific killifish, Fundulus parvipinnis, in relation to temperature, season, age and sex," in partial fulfillment of the requirements for the doctor's degree.

(4) Certain diseases of fishes were investigated by Mr. Wells in collaboration with Dr. ZoBell of the section of microbiology, as has already been stated.

Marine Bottom Deposits -

During the year two rather large undertakings have been brought to completion. One of them is the study by Mr. E. M. Thorp entitled, "Calcareous shallow water marine deposits of Florida and the Bahamas," which was presented in partial fulfillment of the requirements for the doctor's degree, and the other is an investigation by Mr. Roger Revelle on the deep-sea bottom samples collected in the Pacific by the CARNEGIE. Mr. Revelle has also prepared a paper entitled, "The physico-chemical factors affecting the solubility of calcium carbonate in sea water," which will be published in the Journal of Sedimentary Petrology. During the year much attention has been paid by several members of the staff of the Institution to oxidation and reduction in the ocean. This subject is a meeting ground of oceanography, geology, chemistry, and a considerable range of biological phenomena, therefore the members of the staff of the Institution representing each one of these sciences have cooperated in the investigation.

Dr. Robley D. Evans, assisted by Mr. Arthur Kip, is making a study of the radio-active substances in sea water, in marine plants and animals, and in the bottom deposits off the coast of southern California. They are also making similar analyses of core samples of deep-sea sediments kindly supplied by Dr. Ph. H. Kuenen from the collections made by the WILLEBRORD SNELLIUS in the East Indies, and by the Hydrographic Department of the Imperial Japanese Navy by the ship MANSYU in the southwest part of the North Pacific.

Miscellaneous Activities -

Professor Sumner was on semi-sabbatical leave from July 1, 1933, until January 15, 1934. During his absence from the Institution he devoted his time to work on various scientific and human problems on which he is preparing a volume, and to an experimental test of the possible effects of

visual stimuli upon the hair color of mammals, a grant for which had been made by the National Research Council.

Director Vaughan was officially absent from duty at the Institution from July 1 to December 31, 1933, in order to devote his time to the preparation of a report for the National Academy of Sciences on the state of knowledge of the different ocean basins and on the present status of oceanographic research in the different countries, with emphasis on those aspects of oceanography that require international cooperation for effective investigation. But even while on leave from the University he devoted some time to Institution affairs. Beginning in September and extending through December, he conducted a series of seminars in which the results of his study of the work in dynamical and chemical oceanography at various institutions in Europe and Japan were presented to the members of the staff. On January 1 he returned to duty at the Institution and resumed most of his usual work, except that he continued to give some time to the preparation of the report above mentioned for the National Academy.

Attendance at Scientific Meetings -

Professor Moberg attended the meetings of the American Association held in Boston at the end of the year and presented a paper before the Ecological Society.

The meeting of the Western Society of Naturalists at Pacific Grove was attended by Dr. Vaughan who presented a paper.

In January members of the Society for Experimental Biology and Medicine living in southern California met at the Scripps Institution. Papers were presented by Messrs. Fox, Myers, Wells, and ZoBell of the Institution's staff. Messrs. Moberg and Vaughan also attended the meeting.

During Professor Sumner's residence in Tucson he gave papers before

meetings of local organizations, the Experimental Station Research Club, Department of Agriculture, and the Bio-ecological Society.

Professor McEwen presented a paper at the Southern California Section of the Mathematical Association of America which held a meeting in March at Riverside.

Director Vaughan attended the meetings of the National Academy and the American Geophysical Union in Washington during April, and reported on the activities of the Scripps Institution at the latter.

Publications -

During the year a total of more than fifty papers were published by members of the staff or in cooperation with the Institution. Three numbers of the Institution's technical bulletin appeared. Several papers are now in press and a number are ready to be submitted for publication.

Students -

Students registered at the Scripps Institution and the subjects on which they worked are as follows:

Easter E. Cupp - Both semesters - Plankton diatoms.

Richard H. Fleming - Both semesters - Chemical problems of sea water.

Maynard Harding - Summer session, 1933 - Chemical problems of sea water.

Earl H. Myers - Both semesters - Life history of foraminifera.

Roger Revelle - Both semesters - Deep-sea sediments in the Pacific.

Eldon M. Thorp - Both semesters - Shoal water marine bottom deposits.

Nelson A. Wells - Both semesters - Effect of temperature changes on oxygen consumption of fishes.

Vida Watkins - Summer session, 1933 - Tide pool organisms.

On May 19, 1934, the University of California granted the degree of doctor of philosophy to four students at the Scripps Institution. Their names, together with the titles of their theses, are as follows:

Easter Ellen Cupp, "A critical study of certain distinguishing characters in three closely allied plankton species of the diatom genus Nitzschia and their relation to certain environmental conditions."

Earl Hamlet Myers, "The life history of Patellina corrugata, a foraminifer."

Eldon Marion Thorp, "Calcareous shallow water marine deposits of Florida and the Bahamas."

Nelson Alfred Wells, "Variations in the rate of respiratory metabolism of the Pacific killifish, Fundulus parvipinnis, in relation to temperature, season, age, and sex."

Visiting Investigators -

Visiting investigators during the year, with the subjects on which they worked, were as follows:

Daisy E. Clarke, July 1 - August 3; Foraminifera.

Esther Allen, throughout the year; Organisms occurring on newly submerged surfaces.

Dr. Ancel B. Keys, Harvard University, July 6 - 11; Respiration of fishes.

Dr. Louis Giltay, Royal Museum of Natural History, Brussels, Belgium, July 1- 10, 1933; Ecology of the inter-tidal zone.

Dr. C. H. Abbott, Department of Zoology, University of Redlands, July 1 - September 2; Studies of sea-shore life.

Dr. P. H. Mitchell, Brown University, July 24 - 29; Measurement of carbonates and buffering substances.

Mrs. Sherwin Wood, Department of Zoology, University of California, July 29 - August 2; Kissing bugs associated with brush rats in connection with germs of sleeping sickness.

Father Bernard Doucette, S. J., Manila Observatory, Manila, P.I., August 2 - 19; Study of movements of air masses over the North Pacific Ocean.

Miss Elizabeth Deichmann, Museum of Comparative Zoology, Harvard University, August 8 - September 7; Corals.

- Mr. M. L. Natland, Shell Oil Company, Long Beach, various times throughout the year; Foraminifera.
- Mr. D. W. Gravell, Gulf Production Company, Houston, Texas, August 30-31; Foraminifera.
- Dr. Parker D. Trask, U. S. Geological Survey, Washington, D. C., September 6 - 21; Geological formations in the vicinity of Los Angeles with reference to the origin of petroleum.
- Dr. H. B. Torrey, ^{Stanford University,} /September 20 - 27; Physiology of Corymorpha.
- Dr. F. P. Shepard, University of Illinois, various times throughout the year, and May 2 - 31, 1934; Submarine valleys.
- Dr. Erich Wasmund, University of Kiel, Germany, October 26 - 28; Hydrology.
- Mr. G. Leslie Whipple, Standard Oil Company, January 25-26, March 17-19; Foraminifera.
- Dr. N. W. Rakestraw, Brown University and Woods Hole Oceanographic Institution, March 5 - 9; Chemistry.
- Dr. W. L. F. Nuttall, Sedgwick Museum, Cambridge, England, May 9; Examination of foraminifera.
- Mr. LaPlace Bostwick, Key West, Florida; Cultivation of pearls in abalone, April 25 - May 31, 1934.

Lecturers -

Lectures were given by visitors as follows:

- Dr. L. Giltay, Royal Museum, Brussels
- Dr. A. B. Keys, Harvard University
- Dr. E. H. Edmondson, University of Hawaii
- Prof. Beno Gutenberg, California Institute of Technology
- Dr. Parker D. Trask, U. S. Geological Survey, Washington, D. C.
- Dr. Harry B. Torrey, Stanford University
- Dr. C. A. Kofoid, University of California
- President Robert G. Sproul, University of California
- Dr. Erich Wasmund, University of Kiel, Germany
- Dr. Francis P. Shepard, University of Illinois

Mr. Laurence M. Huey, San Diego Natural History Museum
Prof. W. P. Kelley, Riverside Experiment Station
Mr. C. B. Perkins, San Diego Zoological Society
Dr. H. L. Haywood, Grinnell College, Iowa
Prof. W. G. Waterman, Northwestern University
Dr. N. W. Rakestraw, Brown University and Woods Hole Oceanographic
Institution.
Dr. Lauriston Marshall, U. S. Department of Agriculture.

Visitors -

In addition to the visiting scientists who actually conducted investigations at the Institution and those who delivered lectures, a number of others visited the Institution for scientific conferences or to inspect its scientific work. Such visitors included the following:

Dr. G. van Iterson, Technical University, Delft, Holland
Mr. Clem Copeland, Department of Water and Power, City of Los Angeles
Prof. J. Makiyama, Imperial University of Kyoto, Japan
Dr. H. G. Kugler, Trinidad, British West Indies
Dr. Co Ching Chu, National Research Institute of Meteorology, Nanking,
China
Dr. Arnold Heim, Zurich, Switzerland, formerly Sun Yat Sen University,
Canton, China
Mr. M. N. Bramlette, U. S. Geological Survey, Washington, D. C.
State Assemblyman George B. Bowers, San Diego.
Mr. F. J. Hansen, Educational Committee, San Diego Chamber of Commerce.
Mr. H. E. Keyes, Research Department, Miami Copper Company, Arizona
Dr. Robley D. Evans, Department of Physics, University of California
Dr. Hanzlik, Stanford School of Medicine
Dr. H. H. Strain, Carnegie Institution of Washington, Stanford Uni-
versity.

Prof. F. O. Gilchrist, Pomona College

Messrs. P. H. Van Etten, G. B. Meyer, Garfield Stubblefield, and Wing,
State Division of Water Resources.

Captain Claude Mayo, 13th Naval District, Seattle, formerly Commander
U. S. S. RAMAPO

Dr. Harry Ladd, St. Louis, Mo.

Dr. Florence Peebles, California Christian College, and seventeen
students of the Department of Biology

Dr. R. E. Marsell, University of Utah, Stanford University

Dr. Chester K. Wentworth, Honolulu Board of Water Supply

Lieutenants N. K. Dietrich, J. B. Goode, Ensign W. R. Lefavour,
U. S. S. MARBLEHEAD

Miss Kate Karmelich, State Fisheries Laboratory, Terminal Island

Dr. Catherine V. Beers, University of Southern California, and twenty-
four members of an adult education class in zoology.

Lieutenant Asahina, Hydrographic Department, Tokyo, Japan

Dr. K. Ito, Tokyo Imperial University, Japan

Dr. C. McLean Fraser, University of British Columbia, Vancouver

Dr. Waldo Schmitt, U. S. National Museum

Mr. Walter H. Chute, John G. Shedd Aquarium, Chicago

Dr. Raymond B. Cowles, University of California at Los Angeles

Forty members, Biological Club of Santa Monica Junior College, and
various other groups of students from high schools and
junior colleges in southern California.

Dr. W. H. Osgood, Curator of Zoology, Field Museum of Natural History,
Chicago

Mr. Adriaan van Rossem, in charge ornithological collections, California
Institute of Technology

Dr. J. P. Buwalda, California Institute of Technology

Secretary of Agriculture Henry A. Wallace

Dr. W. R. Gregg, Chief, U. S. Weather Bureau

Library -

During the year 287 bound volumes and 640 reprints were accessioned in the library, making a total of 13,684 bound volumes and 25,789 catalogued separates. Besides these, more than one thousand volumes, reprints, and charts, dealing with important discoveries about the sea have been received by the Institution from various countries in Europe and the Orient since Director Vaughan's return from his trip around the world.

Museum -

Mr. Barnhart, curator of the Institution's biological collections, reports several accessions to the museum during the year: a large specimen of the snake fish, Ophichthys triserialis, from Mr. Carl Vermillion of La Mesa; a trunk fish, Ostracion sp., from Mrs. Ansel W. Gillis of Oceanside; a large specimen of polished shell-rock from Mr. O. M. Reutinger of San Diego; a wolffish, Alepisaurus aesculapius, from Mr. Ben Wolf of Oceanside; a collection of fishes, mollusks, and other invertebrates from San Felipe, Gulf of California, from Mr. Carl Johnson, and ninety-nine species of Pacific shells from Dr. Fred Baker. A painted cast of a 60-pound yellow-finned tuna, Neothunnus catalinae, and several mounted small fishes were added to the museum exhibit.

Many requests for the identification of marine animals and plants have been received.

Besides scientific visitors and several groups of students, 3508 visitors to the museum and aquarium registered.

Aquarium -

Some repairs have been made in the aquarium during the past year. Electric lights have been installed; old lead-pipes furnishing water were replaced by pipes of heavier material; and two of the old 150-gallon tanks

were replaced by new tanks of 260-gallon capacity. Seven other tanks will need to be replaced during the coming year.

During the year about 400 fishes and 460 invertebrates were exhibited in the aquarium tanks.

Although facilities for experimental work are rather limited, the use of the work room and the two reserve tanks has been extended to Mr. LaPlace Bostwick for experiments in abalone pearl culture.

Other activities of the curator included the collection of material for research purposes and for the aquarium, answering inquiries and the identification of specimens for outside sources, and the general care of the museum and the collections of the Institution.

Special Acknowledgments -

Besides the additions to the museum other important collections have been received at the Institution during the year. Among these will be mentioned specimens of corals from the western Tropical Pacific received from Dr. H. Hattori, Biological Laboratory, Imperial Palace, Tokyo; specimens of the genotypes of a number of genera of corals from the U. S. National Museum; foraminifera from the Red Sea received from Dr. Cyril Crossland, Marine Biological Station, Ghardaqa, Egypt; 300 slides representing living species collected by Mr. M. L. Natland between Long Beach and Santa Catalina, California; fossil foraminifera and corals from Professor Henry V. Howe, Louisiana; fossil foraminifera from Mr. Stephen H. Rook, Louisiana, Mr. W. R. Forrest, Antigua, Mrs. R. H. Palmer, Cuba, and Professor R. Speight, New Zealand.

The Scripps Institution gratefully acknowledges assistance in its scientific work from the United States Navy, the U. S. Coast and Geodetic Survey, the U. S. Bureau of Lighthouses, the Los Angeles Steamship Company, the Grace Line, and the Panama Pacific Lines.

Contributions -

For the year which closes on June 30 the Institution has received \$24,500 from the estate of Miss Ellen B. Scripps, and \$5,000 from Mr. R. P. Scripps. In addition to these two contributions Mr. R. P. Scripps and the estate of Miss Scripps contributed \$5,000 each, a total of \$10,000, towards a fund for the replacement of the gasoline engine on the boat SCRIPPS by a diesel engine, and for other renovations and improvements on the boat. Mr. R. P. Scripps also made a special contribution of \$450 towards the grounds fund of the Institution. The Los Angeles Department of Water and Power contributed \$1,000 for aid in the support of the Institution's meteorological investigations. Director Vaughan contributed \$650 towards the maintenance and improvement of the grounds, and donated many books, periodicals, and reprints to the library.

Concluding Remarks -

During the year a number of investigations which have formed parts of the Institution's research program for several years have been brought to conclusion or significant progress has been made. Since the more important accomplishments have been specifically mentioned in the account of the scientific work of the Institution it does not seem necessary to present a special summary of them.

As we are still in the throes of the depression the Institution is fortunate in that it has been able to carry on so much of the work that was on its program. Until we have recovered from the present distressing conditions it would be out of place to look forward to any expansion of the activities of the Institution beyond what they now are. The only contemplated modification of the present program is that as soon as the boat SCRIPPS is again put into commission it is intended to initiate a

more intensive program of operations at sea than the Institution has hitherto been able to prosecute because the boat was not adapted to such work.

Although under present conditions expansion of the work of the Institution may not be expected, the Institution's property should be maintained in good condition and not be permitted to deteriorate. The pier has not been renovated since the year 1925-26. Considerable repairs should now be made on it, and both the wood and iron work should be repainted. It has been hoped that this work would be provided for either out of NRA funds or out of SERA funds. The material for the renovation of the piles was delivered at the Institution, but the workmen to do the job have not yet been provided.

The bad lands west of the road northwest of the Director's house are a recurrent source of trouble. There is more or less continuous danger of undermining the road leading up the slope northwest of the Director's house and caving of the roadway. The undermining and threatened caving should be controlled by the erection of bulkheads, which need not be of expensive construction. Redwood piles and boards, if properly installed, should give protection for many years.

There is danger of the collapse of the wooden bulkhead on the west side of the Institution's property and north of the north end of the present concrete bulkhead. The wooden bulkhead should be replaced as soon as possible by a bulkhead of concrete.

Perhaps the hope may be ventured that at some time the Institution may get an adequate aquarium. The exhibits which we now have in the small aquarium attract many visitors. A better aquarium would be made an adjunct to the Institution's instruction and research program.