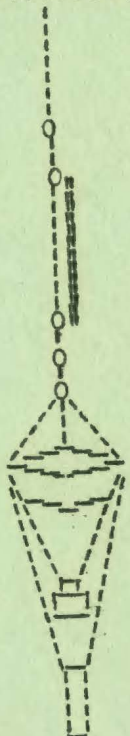


OCEANOGRAPHY

comprises the study of the history, constitution, and behavior of the earth

floor which lies beneath and around the ocean waters; the currents in the sea; the physical and chemical properties of the water, their relation to the circulation, their influence upon organisms, and their effect on geological processes. It deals with the organisms in the sea and their relations to their environment; also with the relations of the ocean water and the overlying atmosphere, thereby aiding in the understanding of weather and climate. The aim of oceanography is to understand the varied phenomena occurring within the sea, its relations to the underlying earth's crust and to the overlying atmosphere. Oceanography deals with everything in and of the sea.

THE  
SCRIPPS  
INSTITUTION  
OF  
OCEANOGRAPHY  
  
LA JOLLA  
CALIFORNIA



OUTLINE OF SCIENTIFIC WORK  
at the  
Scripps Institution of Oceanography  
University of California  
La Jolla, California  
1934

Inquiries concerning the Scripps Institution have been so many and so varied that it has seemed worth while to prepare the following summary of some of the scientific investigations now being carried on by members of the staff, and in cooperation with other organizations. Particular studies may last many months or only a few weeks, but they fit into a general program as outlined below.

I. Oceanographic Data and Work at Sea.

Many of the conditions that exist in and around southern California are not determined or caused locally but in some very remote areas because of the fact that the water and the atmosphere over the water are in constant motion. Hence, if we wish to understand the conditions prevailing along our own coast we must know something about other parts of the Pacific.

The Scripps Institution boats: The SCRIPPS is used periodically throughout the year in local waters; one voyage of two weeks in September, 1933; a number of special trips.

There is also a small boat with an outboard motor which is used for local collecting purposes. Recently some dredging has been done from it.

Carnegie Institution of Washington's yacht CARNEGIE. Dr. E. G. Moberg was aboard about six weeks between San Francisco and the Hawaiian Islands in 1929.

U. S. Navy: The Scripps Institution receives surface temperature records from the transports plying between Bremerton, Washington, and Balboa, Panama, and occasionally from other vessels.

The Institution receives from the naval tanker RAMAPO, which plies between the Pacific Coast of the United States and the Philippines, temperature records and water samples for various purposes, and a thermograph is installed on it.

Mr. R. H. Fleming was aboard the U.S.S. HANNIBAL about two and a half months in 1933 in the Gulf of Panama and off the coast of Costa Rica.

U. S. Coast and Geodetic Survey: The Institution has continuously received water samples, surface and sub-surface temperature records, and marine bottom deposits since 1924.

Mr. Roger Revelle was aboard the PIONEER about two weeks during the past summer and occupied a series of stations off Point Concepcion.

U. S. Bureau of Lighthouses: A thermograph is installed on the LUPINE which plies between San Francisco and Seattle. Thermograph records and water samples are taken whenever at sea.

Panama Pacific Company: Thermographs are installed on the CALIFORNIA, PANAMA, and VIRGINIA which ply between the California coast and New York.

Los Angeles Steamship Company: A thermograph, for six years on the CALAWAII, is now being repaired and will be installed on the DIAMOND HEAD.

Grace Line: The SANTA MARIA has for years supplied records of surface temperatures and meteorological conditions between Panama and Santiago, Chile.

### Collecting and Observing Stations:

Institution's pier: Permanent hydrographic station at which are installed a thermograph for reading temperatures on the bottom and at low-tide levels; self-recording tide-gauge, the property of the U. S. Coast and Geodetic Survey. Samples of water for chemical examination and for study of the plankton content are collected daily; in addition to these uses, samples for many other purposes are collected at frequent intervals. The pier is also used as a site for making numerous experiments on organisms and on inorganic processes in the sea, and for landing in connection with work on the SCRIPPS.

Balboa, California: Water samples, temperature records.

Point Hueneme: Water samples, temperature records, plankton samples.

Pacific Grove: Water samples, temperature records.

In cooperation with the U. S. Bureau of Lighthouses:

Farallone Light: Water samples, temperature records.

Off Cape Mendocino Lighthouse: Water samples, temperature records.

Columbia River Lighthouse: Temperature records.

In cooperation with the Byrd Antarctic Expedition II:

Bottom samples, water samples, bacteria from the animal life.

The collections and data obtained on even a very short cruise may require months of study. It is difficult to give an idea of the amount of work ahead of the staff in the quantity of oceanographic data, records, and samples of various kinds received at the Scripps Institution during the years 1929-1933, as indicated by the following figures:

<u>Salinity</u>	
Surface	14,560
Serial	2,488
<u>Water temperature</u>	
Surface	48,397
Serial	2,626
<u>Air temperature</u>	10,252
<u>Wind</u>	40,062

## II. Dynamical Oceanography and Marine Meteorology, Professor G. F. McEwen, in charge.

Part of the work of this section consists in the study of the circulation of the ocean waters of the Pacific, especially in that part of the Pacific which is adjacent to the California coast and the countries to the southeast. The circulation of the waters of the ocean controls the physical and chemical features of the water masses and these features, in turn, control virtually all the processes taking place in the sea.

Investigations of the depth of penetration of light of different wave lengths into sea water are in progress.

The studies which have been made in the hope of finding a basis for seasonal weather forecasting are known to everyone in this community. The foundations of this work consist in records of conditions, temperature and salinity, at the surface of the sea, and a considerable variety of meteorological data. The meteorological phenomena influence the circulation of the ocean water, and this circulation has an influence on climate, on the distribution of organisms, and on the geological processes in the sea.

The Institution is cooperating with the State Division of Water Resources in the study of problems of evaporation and the limits of the intensity of rainfall, to guide in the construction of check dams and canals. It is also cooperating with the U. S. Forest Service in the study of problems of the conservation of water and of soil erosion.

III. Chemistry of Sea Water,  
Professor E. G. Moberg, in charge.

Sea water is a complex solution of numerous chemical substances, though common salt is by far the most abundant. Information concerning the quantity and chemical activity of some of these substances is essential in connection with practically all types of oceanographic investigations.

The chemical processes taking place in the ocean, both in the water and at the bottom, are studied in order to understand the geologic history of a large part of the earth now above water and the origin of many deposits of useful minerals. The variation in the quantities of certain chemicals in the water is determined with great accuracy in order to provide a means for calculating the direction and speed of currents which can be measured by direct methods only in shallow water.

Finally, all life in the sea, whether plant or animal, depends ultimately for its food upon chemical substances dissolved in the water. Consequently, numerous studies of the local and seasonal variation in the quantity of nitrates, phosphates, and other "plant nutrients" are made in order to gain a better understanding of the conditions that determine the production of life in the sea.

IV. Bacteriology,  
Dr. C. E. ZoBell, in charge.

Bacteria play a role in the production of food for other marine organisms. Bacteria are themselves consumed as food by many marine animals, and they also, by their activities, produce substances which are used as food by plants; the plants in turn furnish food for the animal life of the sea. Therefore, bacteria are probably indispensable for the maintenance of all forms of life in the sea. Bacteria are the responsible agents for many of the chemical and physical changes that take place either in the sea water or on the ocean bottom and are of geological importance.

Unfortunately, some bacteria cause diseases in marine animals. Several such diseases have been observed. Recently a species which has killed many bay smelt, killifish, and others, has been identified in cooperation with the laboratory of Fish Biology. A study of its temperature relations has suggested a means of controlling this particular disease.

V. Physiology of Marine Organisms,  
Dr. D. L. Fox, in charge.

Investigations in the physiology of marine organisms are in progress with special reference to their adaptation for life in the sea. Organisms, in order to live in the sea, need to possess many special adaptations. Among these may be mentioned ability to live in the concentration of salts in sea water and to withstand changes in the concentration of the salts. They need to adapt themselves to the variations in the amount of oxygen in the sea water; they must be able to digest at least parts of the material which they swallow in order to get their food. Many animals swallow a variety of things but can digest only certain parts of what they swallow. There are also special adaptations to light, heat, and many other variable factors in the sea.

One of the subjects to which special attention is being paid is the food and the digestive processes of the California mussel and a peculiar marine worm which is found locally in abundance. These studies are being extended as rapidly as possible to other organisms which are available in the waters adjacent to the Institution. Marine organisms, besides being themselves conditioned by the environment under which they live, produce changes in the conditions which surround them. Therefore the organisms must be studied from a number of different points of view.

VI. Marine Bottom Deposits and Foraminifera,  
Director T. Wayland Vaughan, in charge.

More than two-thirds of the face of the earth is covered by material which has been laid down on the bottom of the present ocean. More than half of the material exposed on the land surfaces was once on the sea bottom. If we are to understand the conditions under which the rocks composing most of the surface of the earth were formed we must go to the sea and study what is happening there. Furthermore, many of the economically important geological products have been derived in one way or another from materials that were laid down on the sea bottom. Investigations of sea-bottom deposits have for the past ten years formed a part of the program of the Scripps Institution.

Among the important components of marine bottom deposits are the remains of organisms, most of which are small, known as foraminifera. One deposit which is named from these organisms, known as Globigerina Ooze, covers one fourth of the face of the earth. Besides being important as rock formers, these organisms are of value to geologists in solving problems in economic geology, especially the structural relations in oil fields. The study of this group of organisms in a variety of different ways has for about ten years been a part of the program of the Scripps Institution.

VII. Fish Biology,  
Prof. F. B. Sumner, in charge.

For a number of years the oxygen consumption of several species of local fishes has been investigated and a number of papers have been published. It is obvious that knowledge of this subject is essential for understanding the relations of organisms to the conditions under which they live in the sea.



Some marine fishes, as well as other marine animals and some terrestrial animals, possess the capacity to change color to accord with the color of different kinds of background. Such adaptations are among the natural means of protection. Dr. Sumner has for years been active in investigations of this kind. During the past few years several additional investigations of the subject have been completed.

One of the subjects of particular importance in understanding the life of fishes is to know something of the diseases that affect them, and this knowledge is of immediate practical importance to those keeping fish in aquaria. One piece of work which has just been completed in cooperation with the bacteriological laboratory is the determination of the cause of a disease which has killed many specimens of killifish.

VIII. Phytoplankton,  
Prof. W. E. Allen, in charge.

Among the important sources of food of small animals of various kinds in the sea are minute plants known as diatoms and other minute organisms called dinoflagellates, considered by some to be plants, by others to be lowly animals. For fifteen years the numbers of these organisms have been counted for measured water samples collected throughout the year at some places, and at irregular times at other places. The purpose has been to get an idea of the variation in abundance and kinds of the organisms according to season, proximity to the shoreline, and depth. Many papers have been published on this subject.

IX. Fouling Organisms.

The study of fouling organisms was undertaken in compliance with a request, in 1927, from Captain Henry Williams of the Construction Corps, U.S.N. Two papers by Prof. W. R. Coe of Yale University have been published on this subject in the technical bulletin of the Scripps

Institution. Professor Allen and Mr. James Ross assisted in the investigation which has been continued by Professor Allen. Dr. ZoBell has studied the attachment of bacteria to glass slides submerged in the ocean, and the relation of such growths to the subsequent fixation of other organisms. He has been assisted by Miss Esther Allen. Dr. Fox has studied the organisms that attach themselves to the inside of the Institution's salt-water-supply pipe and has obtained important information on the difference in behavior of two species of barnacles. He has also suggested a method for cleaning the inside of the pipe of incrusting organisms.

X. Museum, Aquarium,  
Mr. P. S. Barnhart, in charge.

Although the museum and aquarium are small affairs, they are visited every year by thousands of people. The museum has in it only exhibits of local conditions and of local organisms. In the aquarium is maintained a continuous exhibit of a considerable variety of local fishes, shore animals, and sea weeds. Biology classes come from as far away as Los Angeles and Claremont to study the exhibits and the life along the shore.

The Baker-Kelsey collection of shells of the Pacific region, and the Snyder collection of marine algae are among the best of their kind. The collection of foraminifera is also excellent and it is being steadily increased.

One of the desires for the development of the Institution is a good moderate-sized aquarium, which would be of both educational and scientific value.

Mr. Barnhart is preparing an illustrated catalogue of the fishes along and off the coast of southern California. He has completed over two hundred drawings and hopes to finish the manuscript soon.

## XI. Seismograph.

The seismograph in the basement of the museum is one of the net of seismographs installed in southern California by the Carnegie Institution of Washington and the California Institute of Technology. The records are sent to the central laboratory in Pasadena.

## XII. Library, Miss Tillie Genter, librarian.

The library contains about 14,000 volumes, either bound or ready for binding, and about 30,000 reprints. The Institution subscribes to over one hundred periodicals, foreign and domestic, and receives as exchanges another two hundred. Among publications received are government reports from the Department of Agriculture, the Bureau of Fisheries, and the Geological Survey. In addition, there are six hundred maps and charts of the oceans, including topographical maps of the western United States, and nearly 2500 lantern slides of life and conditions in the seas. The reports of scientific investigations at the Institution are published in its Technical Bulletin and in other American and foreign scientific journals. For work in oceanography and related subjects this library is among the important reference libraries of the world.

## XIII. Research Boat SCRIPPS, Professor E. G. Moberg, in charge.

The SCRIPPS is a sturdy sixty-four foot boat, powered with a diesel engine, has a cruising range of two thousand miles, is equipped with special gear and apparatus for procuring all types of observations and collections for oceanographic studies, and is provided with a laboratory for making chemical analyses of sea water on board. Recent additions to the equipment will make possible more extensive cruises than have heretofore been practicable.