

OCEANOGRAPHIC WORK AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY, UNIVERSITY OF CALIFORNIA, DURING THE PAST YEAR

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In these notes on oceanographic investigations at the Scripps Institution of Oceanography, only those in the fields of physical oceanography, marine meteorology, the chemistry of sea-water and marine bottom-deposits will be mentioned.

The Scripps Institution, as aids in its investigations in physical oceanography and related subjects, has continued to receive water-samples and records of sea-surface temperatures and meteorological data, partly through the cooperation of the Bureau of Lighthouses, from the pier of the Scripps Institution at La Jolla and the pier at Balboa, from Pacific Grove, Hueneme, Farallon Islands, Blunts Reefs Light-Ship, and lighthouse-tenders Lupine and Sequoia. Information has also been received from the United States Naval transports, the vessels Guide and Discoverer of the United States Coast and Geodetic Survey, from the Escuela Naval at Callao, Peru, and the Grace Line ships between Valparaiso and Central American ports. The Institution has a water-thermograph installed on its own pier, on the Los Angeles Steamship Company's S.S. Calawaii, which makes fortnightly trips from Los Angeles to Hawaii, and on the United States lighthouse-tender Lupine. During the year 3,123 salinity-determinations were made at the Institution and 10,453 records of temperature, 9,766 records of wind, and 2,860 records of air-temperature were received.

Thermographs recording condenser-intake temperatures have been installed on four steamers of the Canadian Pacific Company since 1923, and the records have been reported regularly to Director John Patterson of the Meteorological Service, Toronto, Canada, but no provision had been made to work up the material collected since September 1923. During the past year by means of a cooperative arrangement with the Scripps Institution the work has been completed to date. Copies of the tabulations for the period 1923 to 1930 have now been made available.

Arrangements were made with the United States Weather Bureau for having original records of sea-surface temperatures, winds, and air-temperatures copied on special forms for use at the Scripps Institution. This work was done by Miss Edith M. Fitton and Miss Dorothy E. Chapin, assistants of Charles F. Brooks in the Department of Meteorology at Clark University.

The tabulation of data for an area of about fifty one-degree quadrangles in the San Francisco region of the Pacific collected since 1898 has been completed. This material will be used in connection with other surface-data in the eastern North Pacific for investigating surface-drift and the problem of seasonal long-range forecasting.

Serial observations at station 1, ten miles west of the Scripps Institution's pier, have been summarized, and progress has been made with the observations at station 2, five miles offshore. Weekly and monthly averages of all shore-station data have been worked out to date, and mimeographed copies are available for distribution. Blue-prints of seasonal curves plotted from weekly averages are also available for distribution. Tabulation of surface-observations at sea according to 30-minute quadrangles and weeks or months has continued as usual. Entering the data collected during the past seven years on especially prepared charts was commenced in April. It is planned to carry on an investigation of surface-drift, using this material as a basis.

During the year Dr. McEwen published the following papers:

- A survey of some of the methods used in modern dynamical oceanography. *Contrib. Marine Biol.*, Stanford Univ. Press, 57-68, 1930.
- Hydrographic sections and calculated currents in the Gulf of Alaska, 1928-1929 (with Thos. G. Thompson and Richard Van Cleve). *Rep. Internat. Fish. Comm.*, No. 4, 36 pp., 1930.
- Review of "The Sea," by H. A. Marmer. *Geog. Rev.*, v. 20, 707-708, 1930.
- Seasonal rainfall forecasting based on Pacific Ocean temperatures. *Calif. Citograph*, v. 16, 3, 22, 23, 26, 1930.
- Our rainfall: How is it formed and what becomes of it? *Sci. Mon.*, v. 31, 385-400, 1930.
- Indicated seasonal precipitation for 1930-31 in selected regions of California (with A. F. Gorton). *Bull. Amer. Met. Soc.*, v. 11, 169-171, 1930.
- Results of evaporation studies conducted at the Scripps Institution of Oceanography and the California Institute of Technology. *Scripps Inst. Oceanogr. Bull.*, Tech. Ser., v. 2, 401-415, 1930.
- A limnological study of lakes and reservoirs of San Diego County. Published in abstract in the Proceedings of the Water Supply and Purification Section, School of Citizenship and Public Administration, Univ. S. Calif., Los Angeles.
- A summary of basic principles underlying modern methods of dynamical oceanography. In volume on Oceanography of series The Physics of the Earth, *Bull. Nation. Res. Council*.

Investigations of problems of evaporation were continued during the summer at the Scripps Institution by N. W. Cummings and Burt Richardson. The following papers were published:

- N. W. Cummings, Alignment diagram for "R" of the energy evaporation-equation. *Mon. Weath. Rev.*, v. 58, 142-144, 1930.
- N. W. Cummings, Certain limitations on the possible value of the ratio of heat losses by convection and by evaporation at a water-surface. *Mon. Weath. Rev.*, v. 58, 144-146, 1930.
- Burt Richardson, Evaporation as a function of insolation. *Proc. Amer. Soc. Civ. Eng.*, v. 56, 945-960, 1930.

Cummings prepared a report outlining a new method of determining transpiration and he calibrated a monel metal "sinker" 25 cc volume in order to check salinity-determinations made at Scripps Institution.

Richardson made a number of test-measurements of the intensity of solar radiation at various depths in the sea and prepared for publication a report entitled "The photoelectric measurements of the penetration in sea-water of light (wave-length 2,900 to 4,800 Angstrom units)."

A. F. Gorton continued his studies of the problem of long-range forecasting of seasonal rainfall on the Pacific Coast of North America. In addition, he investigated the problem of forecasting air-temperatures in the central region of Southern California.

Records of the Institution's apparatus for recording the intensity of solar radiation (pyranometer) were analyzed and found to throw much light on the optical transmission- and reflection-characteristics of fog, haze, and clouds.

Gorton applied the method of strato-analysis to records of precipitation, stream-flow, and lake-levels in Brazil, Australia, and South Africa, as well as regions of the north temperate zone, and discovered the same fundamental periodicities in the southern hemisphere as in the northern. He published the following papers.

- Note on progress of seasonal weather-forecasting in California (with Agnes Partridge). *Bull. Amer. Met. Soc.*, v. 11, 149-150, 1930.
- Long-range weather-forecasting. *Electrical West*, v. 65, 112-115, 1930.
- Indicated seasonal precipitation for 1930-31 in selected regions of California (with G. F. McEwen). *Bull. Amer. Met. Soc.*, 1930.
- Forecasting seasonal precipitation. *J. Amer. Inst. Elec. Eng.*, v. 49, 996-1001, 1930.

- Pyranometer-records assist in distinguishing between haze and clouds (with S. W. Chambers). *Month. Weath. Rev.* (in press).
- Long-range weather-forecasting in California. *Los Angeles Times, Sunday Magazine Section* (in press).
- La Jolla ocean-temperatures during the upwelling period and their values as indices of atmospheric temperature and domestic gas-consumption during the winter season. *Bull. Amer. Met. Soc.* (in press).

Last year's report contained a rather complete outline of the chemical investigations in progress at the Scripps Institution and for that reason only those studies that have received particular attention during the current year are mentioned in the present report.

Further work on the determination of calcium in sea-water, carried out by Dr. P. L. Kirk of the Division of Biochemistry, University of California Medical School, indicates that a micro-method, which is rapid enough for routine work, will give results of the same order of accuracy as those obtained by standard methods. The studies of the interrelation between carbon dioxide, hydrogen-ion concentration, and the total base in sea-water are also being continued. Attempts have been made to find a suitable method for the determination of boron in sea-water and some progress has been made. In order to increase our knowledge of the inorganic nitrogen compounds in the sea, determinations of the nitrite-content of the water in this locality have been carried out at regular intervals during the past year.

During 1930 the following papers have been published:

- E. G. Moberg and H. W. Graham, The distribution of oxygen in the Pacific as an index of the circulation of water. *Dept. Terr. Mag., Carnegie Inst., Washington, Rep. and Comm. Stockholm Assembly, Internat. Geod. Geophys. Union, Sec. Oceanogr.*, 95-97, June 30, 1930.
- E. G. Moberg, H. R. Seiwel, H. W. Graham, and J. H. Paul, The phosphate-content of the surface water in the Pacific as related to the circulation. *Ibidem*, 98-100, June 30, 1930.
- E. G. Moberg, Distribution of oxygen in the Pacific. *Contrib. Marine Biol., Stanford Univ. Press*, 69-78, Sept. 1, 1930.
- E. G. Moberg, Circulation of the waters of the Pacific Ocean as indicated by their physical and chemical properties. (*Nation. Acad. Sci.*) *Science*, v. 72, 374, 1930.

The investigations of marine bottom-deposits conducted at the Institution during the past year included the completion of a paper entitled "Descriptions of some deep-sea bottom-samples from the western North Atlantic and the Caribbean Sea" by Eldon M. Thorp, which is now in proof as a bulletin of the Scripps Institution, Technical Series, volume 3, No. 1, University of California Press. During the year Mr. Thorp has very nearly completed the preliminary description of the shoal-water calcium-carbonate sediments collected by T. W. Vaughan in the Bahamian and Floridian regions between 1908 and 1915. This study when completed will give information on a variety of shoal-water calcium-carbonate sediments in the region from which the specimens were collected, and a basis for comparison of the different kinds of sediments over the range of conditions from the beaches and very shallow water to abyssal depths in the sea.

The Scripps Institution received a complete set of the deep-sea samples collected by the Carnegie on its last cruise. The mechanical analyses of all samples, of which the quantity of material was sufficient, have been nearly completed and arrangements have been made for the detailed description of the different samples.

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