

UNIVERSITY OF CALIFORNIA
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SCRIPPS INSTITUTION FOR BIOLOGICAL
RESEARCH

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LA JOLLA, July 1, 1924.

To the President of the University.

SIR: I have the honor to present the following report of the activities of the Scripps Institution for Biological Research for the academic year ending June 30, 1924:

Doctor W. E. Ritter, the first Director of the Scripps Institution for Biological Research of the University of California, retired on June 30, 1923, after having served as Director of the Institution since its foundation in 1912. Prior to Doctor Ritter's retirement, the Board of Regents and the President of the University of California, after receiving the approval of the Scripps family, decided to convert the Institution into one for oceanographic research, and having made that decision, the President of the University inquired of me if I would accept the directorship of it. It was, therefore, with the understanding that it should be devoted to oceanographic research that I accepted the directorship of the Institution. In this connection it should be stated that under the directorship of Doctor Ritter investigations in physical, chemical, and biological oceanography were prosecuted at the Institution. These investigations will be not only continued, but it is intended to expand and strengthen them, and to them will be added researches in those fields of oceanography which are of geologic significance.

A few administrative changes have been made and others are contemplated so as to bring the activities of the Institution into accord with the proposed modification in purpose and policy. The most important change is the abolition of the office of business manager, and the assumption of the business management of the Institution as well as the direction of its scientific work by the present director. Mr. W. C. Crandall, former business manager, resigned at the end of April, after a long term of faithful service. He preferred resigning to being transferred to other work under the office of the Comptroller of the University.

A change which is intended but which has not yet been effected is to detach the important researches of Professor Sumner on heredity in *Peromyscus* from the Institution and transfer them to Berkeley.

Although I was appointed Director of the Institution by the Regents of the University during June, 1923, I was not able because of prior

engagements to assume office until February 1, 1924. From July 1, 1923 to January 31, 1924, Professor F. B. Sumner was Acting Director.

Since I assumed office, I have been engaged as follows: (1) The physical establishment of myself, my library, and collections of specimens shipped for scientific study mostly from the U. S. National Museum and the U. S. Geological Survey. (2) Familiarizing myself with the property, the business affairs, and the present scientific work of the Institution, and taking over the personal direction of these matters. (3) The establishment of contacts and making arrangements for coöperation with other departments of the University of California and with other scientific institutions. In order to develop this side of the Institution's activities, I attended meetings of the American Philosophical Society, the National Academy of Sciences, and the National Research Council in Philadelphia and Washington during April and May, and had conferences with many people regarding the work of the Institution. (4) The preparation of a general statement on "The Scripps Institution—its present work in oceanography and suggestions for its future development," and the delivery of two lectures on the Institution, one before the La Jolla Men's Club on June 7, and one before the University Club of San Diego on June 27. Popular lectures on corals were delivered at the San Diego Museum of Natural History on March 30, and at the Southwestern Museum, Los Angeles, on May 18. (5) Some scientific work on manuscripts and collections brought with me or sent me from Washington. The manuscript of an address, "Oceanography in its Relations to other Earth Sciences," delivered as retiring president of the Washington Academy of Sciences, was finally revised and sent to press, and considerable work was done on an unfinished study of the larger foraminifera, mostly American Tertiary fossils.

Special attention should be called to the bad physical condition of the pier, the supply tank for salt water, and the roads of the Institution. Additional bookshelves for the library are now needed. The physical property of the Institution should be restored to good physical condition at the earliest possible date.

Visiting Investigators.—During the year facilities of the Institution for investigation have been utilized by several visiting scientists. They are as follows:

Dr. Myrtle Johnson, of the State Teachers College in San Diego, has continued the preparation of a handbook of the littoral marine invertebrates of the Pacific Coast of the United States. She was at the Institution during the summer of 1923 and a part of June, 1924.

Dr. S. Mogallis, of the College of Medicine of the University of Nebraska, studied the blood of marine invertebrates, principally that of the lobster, during July and August, 1923.

Dr. S. R. Williams, of the Department of Zoology of Miami University, Ohio, spent several months during the spring of 1924 working on Myriapods.

Dr. Roy L. Moodie, of the College of Medicine of the University of Illinois, spent most of a sabbatical year at the Institution studying the literature and writing manuscript on the indications of diseases in fossil vertebrates.

Professor C. M. Child, of the Department of Zoology of the University of Chicago, came to the Institution in June to study certain physiologic problems for which the hydroid *Corymorpha* is particularly well suited.

Professor N. L. Gardner, of the University of California, has made the Institution a base for collecting marine algae along the Pacific Coast beginning late in June, 1924.

Mr. Guy L. Fleming, Superintendent of Torrey Pines Park, resides on the Institution's grounds and has a room in the laboratory building of the Institution permanently assigned to him for use in connection with his botanical studies.

It is desired that the facilities for investigation afforded by the Institution be utilized as fully and broadly as is possible.

Students at the Institution.—Mr. R. R. Huestis was a student with Professor Sumner during the latter half of 1923, and completed a thesis for his doctor's degree on the inheritance of microscopic hair characters in pure races and hybrids of *Peromyscus*, and he received his degree in May, 1924.

Mr. E. G. Moberg has been registered as a graduate student throughout the year and was in continuous residence except for a few months spent at Berkeley, where he passed his preliminary examination for the doctor's degree. He has also completed the amount of research work in chemistry, mostly biochemistry, necessary for the degree, but conditions at the Institution made it impracticable for him to finish his thesis during the past spring.

Mr. N. W. Cummings registered for work in physical oceanography with Professor McEwen, but he did very little during the year.

For the ensuing year several courses in oceanography are offered to graduate students by the Institution. It is hoped that fellowships in the different branches of oceanography may ultimately be provided.

Scientific Researches by the Institution.—The scientific work of the Institution will be discussed under five headings, as follows: (1) Physics of the ocean and general arrangements for collecting data and material for study; (2) chemistry of the ocean; (3) marine biology; (4) geologic oceanography; (5) studies of heredity in *Peromyscus*.

*Physics of the Ocean and General Arrangements for Collecting
Data and Material for Study*

Daily surface temperatures, collection of water samples, and micro-plankton hauls are being taken as usual at the following coast stations: La Jolla, Oceanside, Hueneme, and Pacific Grove. Since the summer of 1922 daily temperature observations have been made from the Columbia River lightship, and both temperatures and water samples taken from the Blunt's Reef lightship, off Mendocino. These lightship observations have continued for nearly two years. It was decided to discontinue the collections from Point Arguello, Santa Barbara, and Montara, and work was stopped at these stations late in 1923. After due consideration it appeared that the best return for the cost would be expected from the six stations now furnishing data and collections.

The Institution's boat work by means of a chartered twenty-ton fishing boat at stations five and ten miles off La Jolla was resumed the middle of May. The programme includes intensive hydrographic and chemical observations, and collections at a series of depths, two days per week. Work on a water bottle of special design by Mr. James Ross, technician of the Institution, had progressed far enough for a trial early in June. This instrument is greatly needed, especially for the chemical work, and it may provide temperature observations without the use of reversing thermometers.

Weekly serial temperatures have been taken in the deep part of Sweet-water reservoir since the first of the year. The plan is to continue these observations till the end of 1924, thus including the five months' period of boat work and the seasonal extremes.

The U. S. Coast and Geodetic steamer "Guide" was equipped with special apparatus for sound-ranging experiments and sonic sounding experiments off the Pacific Coast. During the trip from the Atlantic Ocean to San Diego, November-December, 1923, 46 samples were collected at various depths and the salinities were determined at the Institution. During a three-day trip off San Diego the officers of the "Guide" coöperated with Messrs. McEwen and Moberg in collecting 139 serial samples and temperatures. The hydrographic data on file at the Institution, as well as those collected while the "Guide" was here, proved to be especially suited to the computation of depths and distances by means of the theoretical velocity of sound through sea water. Arrangements have been made for special observations and collections from the "Guide" during the period from May to November, 1924, in the coastal region from San Francisco to Seattle.

During August-September, 1923, 70 water samples and temperatures were taken from the Marquesas Islands to San Diego by the captain of the "Ohio," Mr. E. W. Scripp's yacht. From January to March, 1924,

he made several cruises, taking samples and temperatures as follows: 30 from Balboa to Callao, Peru; 15 from Bolivar, Ecuador, to Callao; 15 from Bolivar to the Galapagos Islands; 27 from the Galapagos Islands to Balboa; 70 from Balboa to San Diego.

In April, 1923, the U. S. Bureau of Fisheries turned over to the Institution for salinity determinations over 800 water samples collected by the U. S. Coast and Geodetic Survey. These samples were taken along courses about sixty miles apart from each of three survey boats, "Surveyor," "Wenonah," and "Lydonia," on courses from Chesapeake Bay in the Atlantic through the Caribbean Sea and Panama Canal and thence to San Diego.

By courtesy of the U. S. Weather Bureau photostat copies of ship's meteorological and hydrographic records along courses between San Francisco and the Hawaiian Islands were made, and are on file here. There are 1200 separate reports, each giving Greenwich noon observations for seventeen days, making about 20,000 observations during the period from 1916 to 1923, inclusive.

The investigation by Assistant Professor McEwen of the relation of seasonal rainfall in Southern California to ocean temperatures taken during the summer before has been continued. The negative correlation between ocean temperature departures and seasonal rainfall departures has again held during this, the seventh, year of the record. The report is given in the October, 1923, Bulletin of the American Meteorological Society.

Tidal data at stations exposed to the open ocean are needed by the Coast and Geodetic Survey for their investigations of mean sea level, and in connection with ocean waves caused by seismic disturbances. The pier of the Scripps Institution has been selected as one of several such exposed stations for the location of a standard recording tide-gauge. The gauge was received at the Institution during the latter part of June and arrangements for its installation were completed. G. F. McEwen has been appointed tide observer.

Besides the operations above indicated, arrangements are under consideration for special investigations in coöperation with the U. S. Coast and Geodetic Survey in the area between San Francisco and Point Conception. As a part of this work, a particularly detailed study of Monterey Bay has been proposed.

Use Made of the Oceanographic Data, and Interpretation of the Data

Assistant Professor McEwen has charge of this section of the Institution's work. All data obtained are filed systematically, for ready reference. This is a first requisite. Thus, requests for information about the ocean that come in from time to time can be answered, in so far as available data are adequate. Results are also summarized in various

ways, partly as a matter of routine in accordance with a uniform plan, which experience has shown to be of general value; and partly to meet special requests or in connection with special studies. These latter results are also kept on file.

By empirical methods of averaging data in various groups for comparison, it is possible to obtain a general idea of average conditions and the usual seasonal departures from such conditions. Also extreme values tabulated with reference to place and season are found by inspection.

Since one of the main problems undertaken by the Institution is marine ecology or the quantitative investigation of the relations of the marine organisms to their environmental factors, the individual physical and chemical observations form an essential part of the fundamental data upon which biological conclusions are based.

With the accumulation of data, various relationships between observations are suggested by suitable tabulations or graphs. Such results suggest various specific problems which can be formulated mathematically, and whose solution aids in interpreting and explaining oceanic phenomena in accordance with general principles of physics. Thus the data are made to yield indirectly a more thorough and extensive knowledge of the physical and chemical conditions of the region than could be obtained by empirical methods alone from tabulations or graphs.

Data pertaining to this Pacific coastal region have provided the source of various specific problems capable of quantitative treatment, using the precise methods of mathematical physics. Oceanic circulation may be investigated as a dynamical problem, in which the circulation is deduced from the observed values of the various elements which combine to cause the circulation. A good deal of progress has been made in this method, although under conditions often met with in practice serious difficulties arise in the application of such methods. On the other hand, the circulation, whatever may be its cause, is the cause of a disturbance in the distribution of properties of the water. For example, the circulation distorts the isotherms and isohalines. In attempting to relate these effects quantitatively to the circulation which produces them, a fundamental problem arose concerning the causal relation of the vertical distribution of temperature and salinity to solar radiation and evaporation in the absence of a current, vertical or horizontal. Accordingly a good deal of attention has been given by Professor McEwen to a quantitative formulation and solution of this fundamental problem, which has been considered by others only in a qualitative way. The departure from the studies of circulation has opened up a new and interesting field involving observations on bodies of fresh water as a control, and as a means of providing sufficiently complete data under not too complex conditions for initial theoretical trials. A theory has thus been developed which appears to be fundamentally correct, and capable of being readily applied. The

application has, for practical purposes, demanded the computation of several mathematical tables. This time-consuming task is nearly finished, and numerous applications of the theory of fresh water data have given very satisfactory results. It is the intention to resume the investigation of oceanic circulation, making use of the results already obtained in attempting the solution of this fundamental problem, to which former studies of circulation gave rise.

It is evident from the foregoing statement that the Scripps Institution is gradually covering with its investigations of ocean physics much of the northeastern Pacific; but the researches are not yet adequate either in the physical problems being investigated, or in the intensiveness of the study of certain areas believed to be particularly significant.

With reference to the first deficiency mentioned, the Institution is making no measurements of solar radiation, its studies of ocean temperatures are not sufficiently refined, and the penetration of light into sea water is not being investigated by it. Among the important problems of oceanography and meteorology is the determination of evaporation from water surfaces. One method of attacking the problem is based upon the relation between the rate of change of heat-energy of the water body and the rate of gain and loss of heat by the absorption of solar energy, the flow of the water, and evaporation. It has been found possible to deduce these rates of gain and loss of heat from temperatures and salinities alone, but measurements of the other factors, especially solar radiation, would be of great value in checking the accuracy of the theory, and making further refinements.

Although most of the temperature records received by the Institution are sufficiently accurate, continuous records of temperature are needed for a number of ocean routes. Procuring such records depends on the availability of suitable oceanographic thermographs. Although the designs already made for such thermographs promise a successful solution of the problem, additional experiments are needed. It is also desirable to procure thermographs that can be used at depths below as well as at the surface of the ocean.

The Institution at present has no funds with which to purchase the equipment needed for the three lines of investigation above indicated; viz., measurements of solar radiation, experiments on oceanographic thermographs, and measurements of the penetration of light into sea water. Besides the equipment needed, there should be added to the staff of the Institution a physicist who could help with the investigations and who could also assist Dr. McEwen in the presentation and interpretation of data bearing on dynamic oceanography.

With reference to the second deficiency in the investigations of the physics of the sea, continuous, intensive observations are needed in three areas believed to be particularly significant. These areas are: first, from

San Francisco to Point Conception; second, from Cerros Island to Cape San Lucas, Lower California; third, an area within the Pacific High Pressure region, in a square bounded by latitude 30° and 35° N. and longitude 145° and 150° W. A plan for investigations in these areas has been drawn up by Dr. McEwen. It is probable that the data for the first area, San Francisco to Point Conception, at least for the winter months, may be obtained through coöperation with the Coast and Geodetic Survey, but there are at present no provisions for work in the second and third areas. These provisions need to be made.

Chemistry of the Ocean

The chemical investigations, which have until now been conducted at the Institution, have been altogether from the biologic standpoint. These investigations, which have been in charge of Mr. E. G. Moberg, have yielded highly important results, but there are other aspects of the chemistry of the ocean which also need to be studied. Among these aspects are the relative solubility of the sea salts in the presence of one another and the effects of the electrolytes in sea water in flocculating and precipitating fine particles suspended in sea water. The chemical composition of marine bottom deposits also needs further investigation.

Mr. Moberg's researches during the past four years have covered the following subjects: the nitrogen compounds in solution in sea water; chemical analyses to determine the relative food value of plankton with reference to seasonal and other variations; and the hydrogen ion concentration in sea water, with special studies of its variation according to season, depth, time of day, and heights of tide, and its relation to the abundance of plankton. He has accumulated a large body of data, which he is preparing for publication. In fact, were it not for the time he has had to spend on boat work, many of the results of his investigations would now be ready for press. He has recently undertaken investigations of the oxygen dissolved in sea water and of the amounts of carbon dioxide, silica, and phosphorus in sea water. Professor Hosmer W. Stone of the Southern Branch of the University of California came to the Institution in June to assist in work on certain special problems, particularly the CO₂ problem in sea water. During April, Professor C. L. A. Schmidt of the Department of Biochemistry of the University visited the Institution to advise regarding its work in biochemistry.

Mr. Moberg may be depended upon to take care of the investigations in biochemistry and the gases, silica, and phosphorus dissolved in sea water, but he should now have continuous assistance. Another chemist, primarily a physical chemist, should be added to the staff of the Institution, for the purpose of studying problems of solubility and of flocculation by electrolytes and doing some analytical work on the mineral parts of bottom deposits.

Marine Biology

The biologic investigations of members of the staff of the Institution have been confined to planktology. Assistant Professor W. E. Allen has devoted his attention to quantitative studies of the diatoms and dinoflagellates; Professor Esterly has continued his investigation of the copepods; and Dr. Christine Essenberg has worked on both copepods and the appendicularia group of the tunicates.

The major duties of Assistant Professor W. E. Allen consisted in the study of diatoms and dinoflagellates according to methods previously adopted. Pier collections at Oceanside, Point Hueneme, and the Institution have been made almost daily throughout the year, and an inshore series of somewhat similar continuity has been obtained from Pacific Grove, where the collector wades out a short distance and dips up the water for filtering.

Microscopic studies and reports on examination of material for the past year have been largely devoted to boat collections, but the microscope work on pier collections for 1921 at Oceanside, Point Hueneme, Santa Barbara, and the Institution's piers has been finished. Professor Allen has also examined and completed a report on the half-hour collections taken at the Institution's pier for two days at the time of the solar eclipse in September, 1923. A report on the collections taken by Mr. P. S. Barnhart in Mexican waters in 1922 has been accepted for publication by *Ecology*. A report on the collections made by the U. S. Coast and Geodetic Survey steamer "Pioneer" between La Jolla and Seattle is in the University of California Press. Professor Allen has finished the microscope work and written a report on a series of collections made by the yacht "Ohio," belonging to Mr. E. W. Scripps, between Callao, Peru, and San Diego, California, and he has begun the microscope study of the Alaska series of collections taken by the U. S. Coast and Geodetic Survey steamer "Pioneer" in 1923.

An important indication of the work of this year is that it seems to be adding to a gradually accumulating body of evidence that some areas of the sea are not only more productive than others but that the more productive areas are strongly influenced by drainage from the land. The evidence is by no means conclusive but its suggestiveness is too strong to be ignored. While this is according to theoretical expectation and is in agreement with evidence from other regions, it is important because it exhibits one favorable point of attack upon plankton problems and because it may open the way to understanding certain fluctuations in the abundance of marine fishes.

Plankton collections are now being received at a rate of about 2000 catches per year, which is about double the capacity of Professor Allen

to report on, and there are in storage about 3000 catches not yet studied. It is therefore obvious that additional assistance in the study of the plankton is urgently needed.

Professor Esterly devoted his time during July and the first half of August, 1923, and a part of June, 1924, to counting the number of copepods in the pier hauls made between September, 1916 and September, 1918, dealing particularly with the groups that had not been segregated into genera and species. He hopes to complete these counts during the summer of 1924 and to prepare his report on them during the following academic year (1924-25). During the academic year 1923-24, he completed a report on the copepods collected by the U. S. Bureau of Fisheries steamer "Albatross" in San Francisco Bay, which has recently been printed in the University of California Press.

Dr. Christine Essenberg spent most of the first half of the year in rewriting and readjusting her monograph on Copelata. The rest of the year was devoted to studies of plankton distribution, to studies of the morphology and behavior of some zoo-plankton, and to rearing marine larvae. The following papers were prepared for publication: Copelata of the Coast of California; Imperfect Digestive Tract of Appendicularia; Degeneration and Gradual Death of Oikopleura; and Plankton Distribution at the Pier of the Scripps Institution for Biological Research.

Statistical Studies.—In our quantitative plankton investigations the difference between the average abundance (number of organisms per unit volume of sea water) corresponding to different value of a given environmental factor, temperature, for example, is the basis of generalizations regarding the relation of the organisms to their environment. In practice the number of organisms found per haul taken under approximately the same conditions, in so far as the observations made indicate the conditions, varies greatly for the different hauls, also a comparatively small number, 10 to 30 hauls, is available for computing each average. Again, the departures of individual hauls from the corresponding average do not even approximate the Baussian or normal law of error. Accordingly, in order to test the statistical significance of the difference between any two averages, a special method adapted to these peculiar conditions was needed. Such a method has been developed by G. F. McEwen, and was presented in 1920 at the St. Louis meeting of the American Mathematical Society. Its usefulness has since been confirmed by numerous practical tests in marine plankton and other experimental and ecological studies. For example, Messrs. Chase and Denny, chemists in the U. S. Department of Agriculture, Laboratory of Fruit and Vegetable Chemistry, Los Angeles, have a paper in the press dealing with a field study of the chemical properties of citrus fruits in which they made wide use of this statistical method.

Computations of a set of tables for facilitating the application of the method are nearly complete, and it is the intention to publish the tables, together with an explanatory text, this summer.

Special Preliminary Statistical Studies of Pier Hauls by G. F. McEwen.—In order to determine whether or not the pier hauls, taken at four-hour intervals from August, 1916 to 1918, were quantitatively significant, the following preliminary test computations were made. Twenty-five days, during which all data were complete, were selected from each of six two-month periods, so distributed throughout the two-year interval as to show seasonal differences and to provide corroborative evidence. The successive approximation method developed by Michael and McEwen was applied to *Acartia tonsa*, the environmental factors considered being temperature, salinity, tide, upwelling velocity (indicated by the reduction of the temperature below the normal), and light intensity (indicated by time of day). A presentation of the results of these computations to the staff of the Institution resulted in the conclusion that more extensive and detailed work of the same kind should be undertaken. The preliminary results were encouraging. Moreover, any one capable of using a Monroe calculating machine can do the computing, after the work is laid out, thus enabling one in charge of the work to obtain results with a comparatively small expenditure of time.

The biologic investigations conducted at the Institution are important, and are yielding results of evidently increasing value in understanding the abundance and composition of the marine plankton and the factors that control its fluctuations in abundance and composition. But the investigations are still too narrow in their scope. They should be expanded so as to include the origin of the nitrogen compounds in the sea. There should be intensive investigations of marine bacteria, especially of those that cause decomposition on the bottom and in the water of the ocean, and of photosynthesis in marine organisms. The Institution needs as a member of its staff a bacteriologist who is also a biochemist.

The investigations suggested above would consider phenomena that underlie the plankton studies now conducted by the Institution. Above the present plankton studies lies knowledge of the fate of the organisms considered. In order to discover this the organisms that feed on the plankton need to be studied. As a part of such an investigation, the embryonic fishes and their food and the food of the smaller fishes should be specially investigated so as to tie the work of the Institution into that of the California Fish and Game Commission. The importance of such researches in understanding the fluctuation in abundance of commercial fishes has been established, and they should be undertaken in California.

There are other biologic investigations that should be undertaken at the Institution, but the two above mentioned appear to be those of most outstanding importance.

Geologic Oceanography

Prior to my assuming the directorship of the Institution, no attention was paid by it to the geologic aspect of oceanography. Although a programme has been drawn up for such investigations, to present it as a part of this report would make this report unduly long. Therefore, it will merely be stated that coöperation with the Earthquake Committee of the Carnegie Institution of Washington is under consideration, and seismographs may be installed in the basement of the museum-library building of the Institution. As soon as I can do so, I shall devote most of my scientific activity to studies of marine sediments. In order to prosecute such researches the necessary laboratory equipment must be procured, and a specialist in the study of marine sediments should be added to the staff of the Institution.

During the first part of May, on my return journey from Washington, I visited Great Salt Lake, and through the courtesy of the Inland Crystal Salt Company, I have received samples of Great Salt Lake water and bottom deposit and samples from each of the successive settling tanks of the Company.

The Institution has received and is receiving large collections of marine bottom samples, accompanied by full hydrographic data, from the U. S. Coast and Geodetic Survey.

Studies of Heredity in Peromyscus, by Professor Sumner and Mr. Huestis

Professor Sumner brought to a close an experiment in transplanting to La Jolla subspecies of mice from the Mojave Desert and from Humboldt County, California. After eight years (8 to 12 generations) and six years (4 to 6 generations), respectively, these two races, which are very distinct from one another, showed not the least trace of convergence under the influence of a common environment. This experiment affords evidence of the relatively high stability of subspecific characters. The evidence rests upon exact measurements, statistically treated.

Professor Sumner has concluded a preliminary experiment, lasting two years, in which mice of several subspecies were subjected to an extremely dry atmosphere. Although the animals born in the dry room were slightly paler while in the juvenile pelage, no changes were detected in the adults which could be interpreted as representing an approach to the type of coloration shown by desert races.

(Matters referred to in the last two paragraphs have been embodied in a paper sent to the *American Naturalist*.)

Professor Sumner subjected to color tests with the tint-photometer the skins of the pure-race and hybrid mice used by Mr. Huestis in his study of the inheritance of microscopic hair characters; also graded the feet of the same series of mice, according to depth of pigmentation. Statistical

analysis brought to light additional data regarding the inheritance of these characters. (Paper written under joint authorship of Sumner and Huestis, to appear in Biological Bulletin.)

He conducted a discussion with Professor W. E. Castle on whether "genetic agencies affecting size are exclusively general in their action," or whether they may not be largely local and specific. (Proc. Nat. Acad. Sci., Nov., 1923, May 1924.)

He visited and participated in the Cincinnati meeting of the American Association for the Advancement of Science and affiliated societies; and later visited museums and laboratories at Washington, Baltimore, Philadelphia, New York, Cold Spring Harbor, Cambridge, Boston, Chicago, and Tucson.

He made an extended visit to northwestern Florida and southern Alabama, to throw light on agencies concerned in a particularly striking case of the effect of the environment on the color of a mammal, and collected living material for studying this problem according to genetic methods.

Mr. Huestis completed, about January 1, his work upon his thesis on the inheritance of microscopic hair characters in pure races and hybrids of *Peromyscus*, this work being done entirely at the Scripps Institution. During the second semester, he completed at Berkeley certain courses still required in his minor subject (zoology). Degree of Ph.D. conferred in May.

Library.—The library now contains 9466 volumes and 10,094 separates, 587 books and 1373 pamphlets having been added this year, the Director giving 80 volumes and about 1000 reprints. The personal library of the Director, which contains works not in the Institution library, is available for use by investigators working at the Institution. The library has been made an official depository of the publications of the U. S. Geological Survey. The Carnegie Institution of Washington has presented a large number of charts to the library.

Museum, Aquarium, and Supply Department.—These three departments are in charge of Mr. P. S. Barnhart. Most of the work in the museum has been of a routine nature. However, several mounted fishes and the mounted head of a swordfish have been added to the exhibits, and an exhibit showing the jaws of the different Elasmobranch fishes is well advanced and the series should be completed soon. The Kelsey-Baker collection of Pacific mollusks has reached such proportions that a new case will be needed soon. This collection now represents 3386 species. From July 1, 1923, to June 30, 1924, there were 4981 visitors registered. Between one-half and one-third of the visitors register. The Museum and Aquarium buildings were closed during the month of October.

The weekly trips to the San Diego fish markets have proved of value in procuring rare specimens of fishes which come in from time to time,

as well as in furnishing sharks and other Elasmobranchs for the supply department. In this way a valuable collection of fishes from Magdalena Bay was obtained. Other material is also collected, such as parasites of fishes, and data are obtained on spawning conditions and seasons.

Advantage of all good low tides during the year is taken for procuring specimens from along shore for the aquarium and the supply department. Regular monthly collections of diatom material are made for Dr. Albert Mann of the Carnegie Institution of Washington.

The installation of lead piping throughout the aquarium has improved the quality of the water furnished to the tanks and lessened the labor of keeping the aquarium clean. However, there is still a great amount of rust which accumulates in the feed pipe from the gravity reservoir. This pipe is old black iron and forms a goose-neck trap between the reservoir and the aquarium. A direct overhead galvanized iron or a lead pipe would improve very materially the quality of water and reduce still further the labor and aggravation due to rust-saturated water. Monthly cleaning of the storage and gravity reservoirs has improved the quality of the water. The old drain troughs which carried off the overflow from the aquarium had to be replaced with new drains.

During the year there has been between 1200 and 1300 specimens supplied to the aquarium. In the 19 small tanks there is a constantly changing exhibit of from 35 to 50 species of marine animals.

The sales from the supply department for the year July 1, 1923, to June 30, 1924, amounted to \$703.66. With the exception of the price list furnished upon application, no special effort to advertise has been made. As this department only handles local forms of marine life and the western demand for such material is not great, it is doubtful if the business will increase very much. Recently a biological supply house or company has located on this coast, which may also lessen our sales. Three large shipments of live fishes have been made to the Steinhart Aquarium in San Francisco, and several shipments have also been made to the Long Beach Aquarium.

Besides the work mentioned above, Mr. Barnhart assists in the boat work of the Institution, furnishes material to visiting scientists, and aids the Station's engineer from time to time. Recently he has undertaken some work on embryonic fishes.

Gifts to the Institution.—For the year 1923-24 the Institution has received gifts as follows:

Miss Ellen Browning Scripps, for the salary of the Director and general purposes, \$9,000.

Mr. E. W. Scripps for specific purposes, \$5,000.

Carnegie Institution of Washington, books, hydrographic charts, and measuring instruments.

U. S. National Museum, specimens of foraminifera and other material not yet listed.

U. S. Geological Survey, publications, including a complete set of the geologic folios issued by it.

T. W. Vaughan, about 80 volumes and 1000 reprints.

Concluding Statement.—Perusal of this report will, I believe, show clearly that important advances have been made during the year in all lines of research prosecuted at the Institution, and I wish to express my appreciation of the devotion, energy, and enthusiasm of every member of the scientific staff, and also my appreciation of the faithful service of the clerical, mechanical, and labor employees of the Institution.

Since my arrival at La Jolla cordial relations have been established with the other departments of the University engaged in contiguous and more distantly related fields of endeavor, and the desire to work sympathetically and helpfully with the other scientific institutions of the State appears to be cordially reciprocated.

This report should contain a record of the invaluable help the Institution and I personally for my scientific work have received from three of the Federal Governmental bureaus. They are the Geological Survey, the National Museum, and the Coast and Geodetic Survey. These institutions have done everything possible to further the interests of the Scripps Institution, and I feel that the success of the Institution in certain matters is and will be largely due to the spirit of helpfulness manifested by several of the important bureaus of our Federal Government. Besides those mentioned, there are other bureaus which are equally ready to help whenever they may be called upon. The Carnegie Institution of Washington deserves thanks similar to those extended to Governmental institutions in Washington.

Respectfully yours,

T. WAYLAND VAUGHAN,
Director.