SCRIPPS INSTITUTION FOR BIOLOGICAL RESEARCH

La Jolla, July 1, 1923.

To the President of the University.

Sir: I have the honor to present the following report of the Scripps Institution for Biological Research, for the academic year 1922–23:

Planktology.—The researches in Planktology are now so well standardized that they vary but little from year to year, except in the progress made. Continued experience shows that although our methods are not ornate or elaborate, they are highly practical. So far as the study of problems of the microplankton are concerned, we are in a position to go ahead with the utmost confidence in the fundamental reliability of our methods.

Three technical papers have been published by W. E. Allen, Associate Professor of Biology, and three others are now awaiting publication. These all deal with various phases of the micro-phytoplankton. Besides the results on the phytoplankton already published and ready for publication by Mr. Allen, substantial progress can be reported on the application to the zooplankton of the methods of collection and laboratory treatment developed for the phytoplankton.

The method of successive approximation, worked out several years ago by G. F. McEwen, Oceanographer, and the late E. L. Michael, for handling the quantitative problem of correlation between plankton data and data on environmental factors, has been so modified and standardized that much of the labor of computation can be done by competent assistants. With such help and with the coöperation of Dr. Esterly, Dr. McEwen has now applied the method to the field data for one species of Copepod, *Acartia tonsa*. The effort to begin with was in the nature of a preliminary designed to ascertain whether the collections made from the pier are quantitatively significant as indicated by consistency of results as between blocks of data covering distinct periods of time. Such consistency being clearly indicated, the collecting can be continued with assurance of valuable results; and the method can be applied as broadly and in as great detail as the general character of the collections and the assistance available for doing the laboratory work, warrant.

Slowly and laboriously, but surely, we are getting light on the influence exerted upon the minute life of the sea by the different environic factors to which the organisms are subject.

A particularly significant step in applying these methods to the zooplankton has been taken during the year by Dr. Helen E. Murphy, who has been a member of the research staff of the institution. This step has consisted in a preliminary quantitative study of the whole mass of microscopic animals contained in the pier series taken from July, 1922 to May, 1923; and in another series from September, 1919 to February, 1920. Among the interesting results of this study may be mentioned the preponderant place in the whole mass held by the embryonic and larval stages of the various species. Numerically seventy to eighty per cent of the total marine zooplankton of this region is composed of immature forms whose generic identity is unknown.

It is gratifying to be able to refer again, as in my last two or three reports, to the coöperation of outside agencies in the field work in oceanography, both biological and physical, which the institution is now receiving.

One noteworthy aid of this sort during the year, on the plankton side, was received from a combined Mexican-American cruise to Guadalupe Island and other points on the coast of Lower California. The vessel was furnished by the government of Mexico. The primary purpose of the expedition was to gain information about various economically important marine mammals, birds, turtles, and fishes occurring in that region, some of which are imminently threatened with extermination by over-killing for commercial purposes. The scientific members of the expedition consisted of several representatives from the National Museum and other departments of the Mexican government; and of representatives from the California Academy of Sciences, San Francisco; the San Diego Natural History Society; and the Scripps Institution.

With the other work done, a good series of plankton catches was taken by the standard method of collecting now used at the Scripps Institution. A partial examination of this series has been made by Mr. Allen, and results significant in several ways are indicated.

Another important coöperative aid in plankton collecting was given by the *U.S.S. Pioneer*, a vessel of the United States Coast and Geodetic Survey, detailed for determining soundings on the California coast. Plankton series which were taken on runs from San Diego to Cortes Bank supplement collections being made in this region by other means. A preliminary examination of the material has also been made by Mr. Allen.

Deserving of special mention in connection with the work in marine biology is a series of experimental studies on the ecological succession among the fixed diatoms and some other algae, prosecuted by Professor O. T. Wilson of the University of Cincinnati. The observations, made by

suspending in the sea from the pier, objects upon which the organisms could settle, were continued through several months during the winter and spring. Although the time devoted to the investigation was too short for anything like final results, enough was done to show this to be a fertile method of learning what is going on in the sea among organisms of these classes. It is to be hoped that the work can be continued at some future time.

Another important forward move in the oceanographic programme relates to certain aspects of the chemistry of the sea. Studies have been made under three headings: (1) the determination of nitrogen compounds in the sea-water; (2) the biological and chemical analysis of plankton; and (3) the determination of the alkalinity (hydrogen ion concentration) in the sea-water.

Although a number of highly interesting results are indicated by the total work, it is felt that the data are not extensive enough yet to warrant drawing conclusions for publication. This work is being made possible by special gifts by Miss Scripps.

As a conclusion to this biological part of the report it is a satisfaction to be able to say that a purely cursory "comparison of notes" between some of the statistical investigations being made on the "catches" of commercial fishes at the San Pedro laboratory of the California Fish and Game Commission, and the planktonic and physical investigations of the Scripps Institution, suggests interesting results after a time from bringing together these data from these two wholly independent research enterprises. The San Pedro investigations, which are in charge of Dr. W. F. Thompson, are promising of results as important to a scientific knowledge of the fishes concerned as to the fishing industry. Dr. Christine Essenberg, whose extensive paper on the taxonomy of the Appendicularia of the San Diego region has been presented for publication, has been on leave during this year.

Physical Oceanography.—Extension of coöperation in the field work is perhaps the most outstanding advance during the year in this department. The long recognized need of temperatures and water samples from at least as far north as the limit in that direction of upwelling water, has been partially met by the coöperation of the United States Light House Service.

Daily temperatures have been furnished since late last summer from the Columbia River Lightship, and both temperatures and water samples have been sent from the Blunts Reef Lightship off the Mendocino coast, California. As these stations are considered strategic for certain phases of the upwelling phenomenon, it is confidently expected that the data from them, taken in connection with those from the other northern stations, which have been contributing data for several years, will yield important results.

Arrangements have been made with the United States Coast and Geodetic Survey for the installation by the Survey of a standard tide gauge at the end of the institution's pier. This tide gauge will be directly advantageous to the oceanographic work of the institution, since tidal observations have been part of the institution's undertakings for several years.

The institution has recently taken over a piece of experimental work aimed at the development of a more satisfactory recording thermometer for subsurface temperatures than any now in use. The instrument known as the "Harvard Deep-Sea Thermograph" has been developed thus far under the direction of Harry Clark on a plan suggested by Professor R. A. Daly of Harvard University. Considerable work and some expense will be required to complete it as a practical working instrument. But the experience with it so far is promising, and temperature taking is so basic in the institution's programme and the thermometers now available are so far from satisfactory, that it seems eminently worth while for the institution to continue the experiments now that the interest of the Harvard scientists has been diverted into other channels.

Dr. McEwen's theoretical research on the vertical temperature gradients in large bodies of water has reached results now nearly ready for publication. A report on the work was presented by him at the April meeting in Washington of the American Geophysical Union, under the title *A Mathematical Theory of Temperature Distribution in Water Due to Solar Radiation, Evaporation, and Convection.* This investigation brings under a general view a number of phenomena in the physics of the ocean, not heretofore brought together for treatment.

The local ocean temperature-rainfall relation based on temperatures taken at the institution's pier has held roughly true for another year. Again as for the five preceding years the rule that negative temperature departures are followed by positive departures in seasonal rainfall, and that positive temperature departures are followed by negative rainfall departures, has prevailed. The extension of temperature observations to additional stations on the coast may be expected to test still further the validity of this rule.

Heredity and Environmental Influence.—A new experiment was started slightly more than a year ago to test the effect of changed external conditions upon organisms. This consists of a device for subjecting mice of the genus *Peromyscus* from the humid coast region to artificially produced higher temperature and lower humidity, characteristic of the interior desert region, the mice being born and reared under the altered conditions. Although the experiment has been in progress only about a year, certain changes of interest are recognizable. Two and a half months in the fall of 1922 were spent in the field by Dr. Sumner, part of the time accompanied and assisted by Mr. R. R. Huestis. The places

of operation were San Francisco Mountain and Painted Desert, Arizona. The purpose of the work was to test the effect which previous observers in this same region have believed the dark volcanic background of the locality has on the coat-color of mammals living there.

Considerable differences were found, as other collectors have reported, between the races inhabiting the volcanic district and those inhabiting the nearby desert areas, the animals of the darker background being somewhat darker than those from the lighter background. But strong evidence was obtained that these differences are not induced by differences in color-tone of the background, but by differences in climate of the two localities. The expedition was a joint undertaking of the Scripps Institution and the Museum of Vertebrate Zoology of the University of California, the latter's representative being Mr. H. S. Swarth.

No small part of the winter was devoted by Dr. Sumner to working up the field data obtained by the expedition. And deserving of mention is the fact that the use of the Hess-Ives Tint Photometer in studying the colors of the extensive series of skins of the different races, combined with the statistical methods available for such studies, makes possible far more accurate and significant conclusions than can be reached by the usual methods employed in natural history investigations of this general type. Dr. Sumner has now compiled and published the results of his experiments, extending over some six years, on hybridizing three subspecific groups of wild mice, the compilation being drawn from several extensive technical papers published at different times as the work has progressed and one containing much new material, now ready for publication. It is fair to say, I think, that these investigations are unique in at least one respect: they embody a more serious effort to combine critical work in the taxonomy, distribution, and genetics of the subspecies of a single full-fledged species than has hitherto been made. From the standpoint of the ideas that have determined the research policy of the Scripps Institution during the last decade and more, this is important as a concrete illustration of that idea.

It has long been my conviction, based on rather general grounds, that such well-nigh complete divorcement of problems and researches from one another as has occurred latterly in biology must lead to scientific disaster sooner or later. Certain it is that the phenomena themselves with which the problems deal are not so divorced. They are tied up with one another in the closest, most complex fashion. If Dr. Sumner's work should be somewhat influential in bringing to pass a more healthy, more truly scientific relation among these three biological provinces, I for one should consider that the support given it by the Scripps Institution had been justified quite apart from any specific, technical results that may have been reached. But that the

work is far from devoid of such results even this short summing up makes obvious.

Conformably with the general idea that has made the Sumner investigations a consistent part of the institution's program are the studies made by the director on the food habits of the California woodpecker *(Melanerpes fornicivorus bairdi)*.

Although these have at no time figured technically as belonging to the programme of the institution, and have not been mentioned in previous reports, they appertain so definitely to an important aspect of the relation of organisms to their environment, that it seems proper that this work should now be mentioned as another exemplification of the ideas which have determined the policy of the institution.

Special gifts by Mr. E. W. Scripps and Miss Ellen B. Scripps have, as in previous years, helped greatly in the work, especially the research work proper, of the institution; $4800 was contributed by Mr. Scripps, mostly for assistantships; and $1800 was contributed by Miss Scripps.

Library.—333 volumes and 1120 pamphlets have been added during the year. This brings the total volumes to 8971 and the pamphlets to 8721.

More perhaps than in any previous year have members of the staff participated variously in activities not directly connected with the research work of the institution. Most of these activities might be broadly characterized as educational. They have included lectures and addresses before various clubs and other organizations; participation in semi-scientific discussions; and written contributions to journals and papers of general circulation.

Deserving of special mention in this connection has been the newspaper articles on scientific subjects written by Mr. Allen. These have been sent bi-weekly to more than thirty papers in California, several of which publish nearly all of them. Most of them this year have had more or less bearing on conservation, and on biological matters which concern public welfare.

Judged by such means as are available for testing the worth of such efforts it may be confidently said that the institution's policy of the last few years of furnishing popular scientific articles to the newspapers has been amply justified.

The list of visiting scientists who have used the facilities of the institution, and of professional people who have been domiciled here for longer or shorter periods, continues long.

General Business Items.—So rapidly was the foot of the still unprotected sea cliff at the southwest corner of the grounds cutting away that it was thought necessary to construct the requisite piece of retaining wall even though funds therefor could be had only by diverting them from other much needed improvements of the grounds and buildings.

The work was consequently done, Mr. Crandall having reduced the expense to the minimum by having most of the labor performed by regular employees and utilizing certain materials already owned by the institution.

The water supply has been greatly improved by connecting the portion of the system supplying the houses on the higher ground with the new La Jolla main from the Hodges reservoir. Ample force for fire protection as well as for all domestic uses are thus secured. The improvement cost $1800, $800 of which was given for the purpose by Miss Scripps.

Recently the passenger carrying service heretofore maintained by the institution has been taken over by the La Jolla Auto Stage Line. The new service is fully as efficient, and not much more expensive to regular passengers than the old and is a saving to the institution of nearly $1000 a year.

The retiring time for all academic officers of the University of California as fixed by the regents brought to an end a year ago the regular term of office of the institution's present director. However, unforeseen circumstances arose at that time which made it seem to the president and regents, and also to the director that the retirement should be postponed for a year.

The year now being up, the present becomes the last annual report under the directorship that has been coexistent with the life of the institution. It would seem from this that something might be appropriately said relative to what has already been done towards securing a new director. And the appropriateness of including a little on this subject is increased by the fact that important change of policy to accompany the change of administration has been recommended by the retiring director and favored by the out-going and in-coming presidents of the university. The recommendation is that the new director be selected with sole reference to the work upon the ocean and its life and that as rapidly as may be without harm to any of the investigations now in progress, the programme be made exclusively oceanographic, the understanding to be that both the biology and the physiography (understood to include every physical aspect of the ocean) be included in the programme on an equal footing. The suggestion is that an institute of oceanography be aimed at that shall finally have a scope and character measurably worthy of the Pacific, the greatest of all the oceans; and worthy also of the greatness of the United States as a nation and of the State of California. Cognizance is taken of the fact that although the United States fronts extensively upon the two main oceans of the earth, on both of which she is vitally dependent, there is not within her whole domain a single institution devoted to the science of the ocean.

It is recognized that the carrying out of such an ambitious plan would have to be a matter of years, so extensive and expensive would be the manning and physical appliances necessary. But when viewed in the light of what has already been accomplished in this domain by the institution during the brief period of its existence, and with the small means at its command; and especially when the whole matter is viewed also in the light of what has been accomplished in the same general domain by other instrumentalities in other parts of the world, it is not felt that the plan is unreasonably ambitious. And it is confidently believed that under the right leadership something approximating what is suggested can be brought about.

The proposal, it may be said, has been widely discussed with scientific men of the country whose scientific interests are kindred to those here involved, and also with Mr. E. W. Scripps and Miss Ellen B. Scripps, all of whom have endorsed it.

Nor should the opportunity be allowed to pass of saying something on the pertinent question of how it happens that some of the work of the institution now and for several years past has been entirely outside of the oceanographic field, thus making a rather radical change of programme necessary for the carrying out of such a plan as that contemplated. It is believed that a mere setting forth of a few historic facts will enable any one interested to answer the question correctly for himself. The first of these facts is that a cardinal tenet of the director's whole professional career has been that the only legitimate goal of science is human welfare. Numerous publications during the last thirty years furnish ample testimony on this point. The much defended claim of "science for its own sake" by one school of scientific investigators, and the advocacy of science just as "mental discipline" by one school of the pedagogics of science, have been definitely opposed in various of these publications. The "humanization of science" employing a phrase just now coming into vogue, has always been a basic principle with the director. Another fact ascertainable from the writings as indicated is the special emphasis which the director's conceptions of science and of human welfare have led him to place on the importance of *research,* not merely in *some* fields or on *some* problems but in *all* fields and on *all* problems, of science.

The matter-of-fact next to be mentioned, and for which there is also published evidence, is particularly important. It is that to the appeal made to Mr. E. W. Scripps by the aims and proposals of the director as based on the conceptions of science and of human welfare just mentioned, has been due, largely if not wholly, the financial support which the institution has received from not only Mr. Scripps, but from Miss Scripps.

The institution would never have developed to its present state of efficiency and promise even in the marine field had it adhered strictly to its original efforts in that field. It would not for the reason that the work in that field was too indefinite in the earlier years as to both scope and purpose to have secured the financial support of Mr. and Miss Scripps or the best executive efforts of the director.

The real character and meaning of the marine programme as it stands today can be understood only by viewing it as part of the broader ideas which from the very outset have animated the whole undertaking and which have become more sharply defined and more differentiated with the experience and the reflection that have accompanied the intervening years.

An indispensable, though, not adequate of itself, element in bringing the marine work to its present state has been the fact that a business man of wealth was willing to invest his money in the ideas of a scientific man, which ideas were regarded by most of the persons implicated as visionary.

While no one would be more positive than the retiring director in refuting any such notion as that his efforts in "philosophical biology" have developed the marine programme to where it now is, at the same time he feels secure in affirming that without those efforts the programme would not have been thus developed.

One who would really understand how it happens that the outgoing director is recommending that from now on this enterprise devote itself exclusively to oceanography, must undertand likewise how it happens that he passes from the directorship of the institution into active participation in the development and work of other wholly distinct enterprises made possible by funds coming from Mr. Scripps.

Respectfully submitted,

WM. E RITTER,
Director.