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SCRIPPS INSTITUTION FOR BIOLOGICAL RESEARCH

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La Jolla, Cal., July 1, 1915.

To the President of the University,

Sir: I herewith respectfully submit my report for the year July 31, 1914, to June 30, 1915:

Just at present the vitality of the Institution is manifesting itself more conspicuously than usual in physical development. A wharf, an essential element in the building plans fixed upon when the decision was reached to locate on the site now occupied, is in process of construction. Bids had been received and a contract for the work was about to be signed with the Russell, Greene & Foell Company of Los Angeles in August, 1914, when the outbreak of the European war so upset the value of securities and prices of building material that both Institution and prospective contractors were glad to drop negotiations. But in April, 1915, Miss Scripps announced her purpose to give the Institution an additional $100,000 during the ensuing two years, primarily for development purposes. Because of this it was determined to build the wharf at once. The former prospective builders not caring to enter the competition again, the Mercereau Bridge and Construction Company of Los Angeles, which had been among the original bidders, were given the contract, their figures having been revised somewhat to meet the small modifications in the plans of construction and the new conditions.

The contract, or contracts, for there are four of them—are for a wharf, a salt water pumping equipment, a salt water storage and sedimentation reservoir, and a retaining wall. The wharf

will be 1000 feet long, with a floor width of about 20 feet and 25 feet at the outer end. The piles, two to the bent, will be of reinforced concrete. The bent beams will be concrete, but the rest of the superstructure will be wood.

The contract cost of the wharf and other elements mentioned, and including a small storeroom on the wharf, two sets of davits at the sea end of the wharf, and electric wiring for the structure, will be $34,002.50. Of this, $26,954 will be for the wharf itself.

The contract calls for the completion of the entire work in 170 days from May 6th, the date on which the contracts were signed. About November first, consequently, the finished structure should be turned over to the Institution.

The years of delay in reaching a fulfillment of this part of the Institution's plans may have important advantages, for it has enabled us to learn much about the behavior of the sea and movable shore material in this locality. As an example, the wharf is being located three hundred feet farther to the north than it would have been had it been built three years ago. This is because the heavy storms of winter have revealed that smoother and better water can be reached at this point than with the same length of wharf immediately in front of the laboratory.

Again, by the delay the work is now in the hands of contractors who have had the experience of building two other concrete wharves, one at Huntington Beach, the other at Hermosa Beach, California.

In reply to repeated inquiry as to how the wharf is to be used, the general statement may be made that it is expected to perform two wholly distinct functions in connection with the marine work of the Institution. It will furnish a landing place for boats, and it will make possible the obtaining of a better and more ample water supply for the salt water aquaria than is otherwise possible. The pump for the circulatory system will be placed at the outer end of the wharf, consequently well beyond the ordinary line of breakers, and the intake pipe will be about twelve feet from the sea bottom. This will secure a water supply largely free from suspended substances of all kinds which are always present in water at the immediate shoreline, or near

the bottom on a sandy shore like that upon which the Institution is located. There are other important though secondary ways in which it is hoped the structure will be useful, but it is not worth while to dwell upon these now.

Under construction at the present time and part of the new developmental plans are a garage which will accommodate three automobiles, a service building near the entrance to the wharf, and a public aquarium building. These are all small, inexpensive structures which are classed as temporary, but will meet the needs for which intended for a number of years, and will add greatly to the efficiency of the physical "plant". The more ample garage, which will be constructed of corrugated iron, will be an important element in the solution of the transportation problem. The service building and public aquarium, besides being useful in themselves, will serve the further purpose of freeing the research laboratory building of various encumbrances. The combined cost of these three structures will be about $4000.

During the year there have been built with money coming from the former construction funds a specially constructed "mouse dormitory," costing about $650, for Dr. Sumner's experimental work, and a small garage at the director's residence. The mouse house is placed in a canyon to the east of the main buildings, the object of thus detaching it being to secure protection from the salt-laden sea breezes, fire, and marauding cats, dogs, boys, etc. It is surrounded by a strong, high wire fence. The building has accommodations for some 1000 mice, together with storeroom for provisions, and ample working space.

While the most objective and easily seen growth of the Institution now taking place is physical, an internal, less striking but not less important growth is going on, largely as an immediate consequence of Miss Scripps' new gift.

From the beginning the ideal and the idea of Miss Scripps and Mr. Scripps, as well as of the scientific director, has been that the Institution should not only carry on investigations but should take positive measures to make the results of those investigations available for the good of the world at large. *Public service through scientific research* has been the watchword.

Any one intimately acquainted with scientific investigators and familiar with the exacting, time-consuming character of nearly all kinds of investigation, knows that this is a difficult idea to put into practice. Most investigators undoubtedly have the more or less positive hope and belief that their work will be useful to somebody, some time, in some way, even though just to whom and when and how they frequently do not venture to inquire very closely.

Some investigators—and it must be admitted that the number, especially in the United States, has been too large—take the ground that the general public is quite incapable of comprehending even the essentials of their work, and so have no legitimate interest in it. The contention is that most of what has some appearance of public interest is in reality a craving for the sensational, or is the expression of a merely passing curiosity; or, so far as there is genuineness at all in it, this is animated solely by the desire of personal advantage, usually economic.

But that love of truth for the investigator's own gratification exclusively is never the whole motive of the investigator is clear from the fact that publication in some form is almost always counted as an essential concomitant of investigation. The written and printed account of one's research, howsoever recondite and hard to understand, presupposes at least a few interested, appreciative readers. It is only a question of the size of the audience to which he would tell his story. An audience of some sort he always wants and expects. And there is little doubt, despite a rather common notion to the contrary, that the great majority of investigators want their work to be widely known—as widely as there is sufficient general intelligence in the community to comprehend its larger import.

From this direction alone, then, and quite apart from the more important consideration of debt to the public because of opportunities afforded, and of the still higher sense of duty in behalf of the general good, the problem of getting the results of scientific investigation before the public is a real one for investigators themselves.

At any rate, whether or not this is true of research men generally, it certainly is of those connected with the Scripps Institution; and as members of the Board of Management of the Institution, they are now resolved to see what can be done with it. The carrying out of this resolution is part of the developmental plans for the next two years, made possible by Miss Scripps' latest gift. The fundamental principle laid down is that whatever is done in the way of popularizing must be strictly subordinate to research. It shall never be permitted to encroach seriously upon investigation. The theory is held that within certain limits, and under certain conditions, popularizing can be done with no impairment, indeed, often with real advantage, to research. For one thing, the design is that the greatest possible saving of the investigator's time shall be practiced by the employment of assistants for tasks that may be as well done by such persons as by the investigator himself.

It is too early to go into the details of what is proposed. Enough to speak briefly of the plan adopted, the execution of which is being now entered upon.

Three quite distinct means of disseminating information are to be used. During the summer of 1916 it is proposed to offer a few formal courses for science teachers and other students already well grounded in the elements of the subjects to be treated. The aim of these courses, so far as concerns the research men who give them, will be primarily to set forth the results which their own studies are arriving at and the methods being employed in these studies.

Formal announcement of the courses will be published during the winter and will be distributed widely, especially to teachers of biology and physical geography. Besides these specialized courses, a general course will be offered to assist teachers in gaining acquaintance with the marine fauna of the region, guidance in this being in the hands of members of the Institution occupied with the aquarium and museum.

A second mode of information giving will be through the public aquarium and the museum. These will be developed with special reference to illustrating the researches being prosecuted

by the Institution. They will, consequently, be made to supplement the specialized courses of instruction offered by the investigators; but it is also designed that the museum shall be a sort of simplified and objectified exhibit of the methods and results of the researches being carried on for the benefit of all visitors to the Institution.

The aim will be to so dispose and describe the installations as to enable visitors to understand that while the Institution is extremely desirous that everybody may know what it is doing and how it is doing it, it still must, in the interest of carrying on the actual work of investigation, hold the research laboratories to be not open to visitors except on special occasions and under special conditions.

The location and design of the new fire-proof library-museum building which it is proposed to erect during the coming year will have these requirements expressly in view.

The third means of popularization to be resorted to is the public press, especially the daily newspaper press. Exactly what course of effort the Institution will take toward promoting better relations between the newspaper and the research laboratory (both surely so vital to modern civilization, even though standing near the opposite poles of it) is not yet marked out. About all that has so far been done is to resolve that some effort in this direction shall be made.

The reasonable solicitude felt by some members of the scientific staff as to this formal entrance upon efforts to publicly disseminate the results of investigation, we hold to be safeguarded by the fact that the policies of the Institution are determinable by a Board of Managers composed largely of investigators themselves. It seems fair to assume that while all acts of the Board are subject to approval by the Regents of the University, in a matter of this kind the purposes of the Local Board would always receive the approval of the superior body.

Again, some apprehension has been expressed that the aid given by the State might be used as an instrument to prevent the Institution from carrying out its research policy and thrusting it into an industrial and pedagogical career, especially if

the Institution itself voluntarily touches these matters. But here we venture to believe ourselves safe, because of our ability to convince those charged with the responsibility of dispensing State money, of the fundamental importance of scientific research, and the obligation of the State to support it. This view we hold with the greater confidence from the fact that the two state appropriations so far received have been accompanied by express official acceptance of these principles.

Mr. P. S. Barnhart has been added to the permanent staff of the Institution during the year, to serve as collector, and, for the present, as curator of both aquarium and museum. Mr. Barnhart's extensive practical acquaintance with the marine fauna of Southern California and his experience in handling boats and in general "field observations" at sea have already made him seem quite indispensable to several of the activities of the Institution.

Mr. H. O. Falk joined the staff in August, 1914, as secretary to the scientific director and assistant librarian. His efficient service in both capacities has resulted in his retention for the ensuing year.

Miss Inez Smith, who has been assistant to Professor Kofoid in his work on the dinoflagellates of the San Diego region, chooses to pass to other fields of labor at the close of her present engagement.

During May and part of June Mr. Holden, from the Museum of Vertebrate Zoology at Berkeley, was employed at the Institution as assistant to Dr. Sumner in the preparation of 400 mice skeletons for the measurements of certain bones, which appear to be undergoing slight modification by the captivity of the animals.

The severe storms of the past winter and spring tore out the kelp beds along the coast to an unusual extent. To obtain accurate information as to the mode and rate of regrowth of kelp, primarily in the interest of utilizing the plant for the production of fertilizers, Mr. M. B. Nichols, teacher of botany in the Oakland High School, and a special student of the seaweeds, has been secured to carry on the study during the summer. He is working

in connection with Mr. Crandall, who is a special agent of the Bureaus of Soils of the United States Department of Agriculture for work on kelp and the kelp beds.

Dr. Sumner moved with his family to La Jolla in August, 1914, and the fact that he was obliged to locate in the village and not on the Institution campus, in order to have school facilities for his children, brings conspicuously to the front one of the important questions with which the Institution is confronted on the side of the development of the "colony".

The residence of Dr. Sumner at the Institution having completed his eligibility, as defined in the by-laws of the Local Board, to membership in that body, he was elected to the Board at the regular meeting held on May 21, 1915.

Mr. E. P. Van Duzee, who had served as librarian for nearly two years, resigned in July, 1914, to accept a more advantageous position in the Entomological department of the University of California. His service to the Institution's library was most efficient, and his loss is keenly felt.

Director Ritter was granted leave of absence from the Institution from October 1 to December 1, 1914, in order to visit various men and places and institutions of the United States, primarily in the interest of the Institution.

More visiting scientists than ever before have made use of the Institution in one way or another during the year. Thus far no charge has been made to such persons; but with the increase of facilities and provision for transportation and living accommodations it will be best for the Board to consider some definite policy to be pursued on this matter.

From August 3 to 7, 1914, the Institution gave a course of lectures and demonstrations in San Diego on the economic resources of the sea and the utilization of them. The aim was to make the course appeal as directly as possible to the fishing and kindred interests, the speakers all being chosen with reference to their special fitness to deal with practical aspects of the topics treated. Those participating were Drs. C. A. Kofoid, of the University of California, B. M. Allen, of the University of Kansas, and Messrs. W. C. Crandall and P. S. Barnhart, of the Scripps

Institution. The course was given under the general auspices of the University of California Extension Division, and was introduced by the Director of the Division, Dr. I. W. Howerth.

Although the lectures were less well attended than we had hoped and rather expected, yet a few men actively connected with sea industries availed themselves to the full of the information offered.

The rapidly growing and already important fisheries on the coast of Southern California, particularly that of canning the Long Finned Tuna, is raising many problems that call loudly for scientific treatment. I have repeatedly joined my voice with those of the fishermen in urging upon the Bureau of Fisheries of the Federal Government and other officials, national and state, the desirability of giving real attention to the situation growing up in this quarter, so far without much effect. Attention is called to the possibility, even the probability, of the development here before many years of a fishery nearly if not quite as valuable as the salmon industry of Alaska; and it is obvious to all familiar with the situation that questions of both scientific and economic importance are coming on. The wisdom of meeting such questions in their incipiency rather than waiting till, by a drifting policy, complications have arisen that might easily have been avoided, would seem obvious enough.

The Scripps Institution is in position to be of some use in an incidental way, and is doing what it can very gladly. But to undertake to answer even the legitimate inquiries being constantly put to it by the cannery men and by those who do the fishing would entail a complete abandonment of the investigations now being prosecuted and the entrance upon others in several respects wholly different. Mr. Barnhart, who joined the Institution in the late fall of 1914, had been studying the tuna industry for several months as a special agent of the Bureau of Fisheries; but in the brief time devoted to the inquiry and with the inadequate facilities at his disposal it was impossible for him to do more than travel along the edges of the problem. The report on his work, which is now nearly ready, and which, though quite inadequate when judged from the standpoint of what is

needed, is yet filled with interesting and valuable information, and will be better in several respects than it could have been but for the author's connection with the Institution since his service with the bureau terminated. The best informed man there is on the scientific side of the tuna industry, is now connected with the Institution. This fact can hardly fail to bring it to pass that the Institution will play a considerable part, even though incidentally, in the further development of this industry, especially since Mr. Barnhart's present work is such as to enable him to continue to increase his knowledge of both the fish and the fishery.

The effort to utilize kelp as a fertilizer is another industrial undertaking to which the Institution is contributing not a little through Mr. Crandall, who largely because of his long and intimate connection with the marine work of the Institution, has become one of the most active and effective of the special assistants of the Federal Government's Bureau of Soils in the study of the kelp beds and of the experiments toward using the kelp.

The splendid maps of the beds on the whole western coast of North America, recently published by the government, are based, so far as concerns the beds of California and Lower California Coast, on surveys and information furnished by Mr. Crandall. The symposium entitled "Potash from Kelp," issued early in 1915, as Report No. 100 of the United States Department of Agriculture, contains an important contribution by Mr. Crandall on the extent and location of the beds.

Through the co-operation of Dr. Frank K. Cameron, chemist of the Bureau of Soils, Mr. E. W. Scripps, and Mr. Crandall, an experiment on the extraction of salts, particularly of potassium salts from the kelp, was carried on at the Institution during the past winter.

Finally, from his keen interest in the whole kelp fertilizer problem and from his continued connection with the Bureau of Soils Mr. Crandall has been able to keep the Bureau well informed as to the various attempts that have been made for the manufacture and marketing of fertilizer.

The long delayed publication of field data, the labor of which has fallen so largely to Messrs. Michael and McEwen, has finally

been issued as "Hydrographic, Plankton, and Dredging Records of the Scripps Institution for Biological Research of the University of California, 1901 to 1912" (University of California Publications in Zoology, Vol. 15, No. 1, pp. 1–206).

Two or three of the marine biological investigations have been delayed pending a joint effort by Messrs. Michael and McEwen to devise a method of testing the trustworthiness of some of the conclusions tentatively arrived at. The task was undertaken in this way for the purpose of bringing to bear upon it the biological knowledge of Mr. Michael and the mathematical knowledge of Dr. McEwen. Stated in a nutshell, the effort has been to find a way of determining the probability that a *difference between two observed averages is significant;* and of determining the *probability that an observed average deviates from the true average by any given amount.* Both aims have been attained for certain types of problems, and are regarded as of importance because of the applicability of the methods to a considerable range of biological investigations, particularly those involving the relation of organisms to their environments. A joint paper on the study is nearly ready for publication.

By way of appliances to facilitate investigations in hydrography, Dr. McEwen has devised an instrument for recording the exact depth of closing of deep-sea apparatus which is closed after being sent down, and has prepared a set of charts and tables from the original data of all the hydrographic observations thus far made by the Institution.

In his oceanographic researches proper he has made progress in the task (mentioned in my last report) of formulating and testing a physical theory to account for the observed average relations between solar radiation, ocean temperatures, oceanic circulation, and wind velocities. He has studied evaporation and salinity in relation to this theory, and found them to harmonize with it.

He contributed a paper, "Oceanic Circulation and Temperature off the Pacific Coast," to the guide book for travelers in the west, entitled "Nature and Science on the Pacific Coast," and recently published by Paul Elder & Co., San Francisco.

As assistant to Professor Kofoid in his work on the Dinoflagellates, Miss Inez Smith spent several months at the Institution during the summer of 1914, one of the results of her work being the discovery that the "phosphorescence" of the sea which developed last year was due to a new organism, and not to Gonyaulax, the species which usually produces the "red water" and great displays of phosphorescence in this region. Not only is the organism itself new to science but the type of phosphorescence is also new, according to the investigators.

Professor Kofoid and Miss Smith have also found stages in the hitherto unknown life history of Gonyaulax which link that species with an organism previously supposed to be a peculiar kind of algae. They have made progress on a monograph of the genus Ceratium of the San Diego region, which has been in hand with Professor Kofoid for several years.

Mr. Michael has nearly completed the identification of the Chaetognatha of the Philippine Expedition of 1907–10, submitted to him by the United States National Museum. It remains to study the distribution and compare this with the distribution of the representatives of the group in the San Diego region; but already the fact comes to light that in general species common at San Diego are absent or are of rare occurrence in the Philippines, and vice versa.

Mr. Michael has made progress in confirming and elucidating the wholly unexpected and surprising facts discovered some three years ago, touching the vertical distribution of the sexual and asexual generations of *Salpa democratica*. But completion of this investigation has awaited the results of the joint study by himself and McEwen of statistical methods, referred to above.

In view of the circumstance that the question of the food and mode of feeding of the copepoda is one of special interest just at present because of its being involved in certain problems of both scientific and economic moment, and in view of the meager information possessed on the subject it seemed best that Dr. Esterly should devote most of his time at the Institution during the summer of 1914 to the study of the subject. The result was a large and interesting extension of our knowledge not only of

what these little crustaceans, which play so important a part in the economy of the sea eat, but also how they catch their prey.

Besides, Dr. Esterley has continued during the year, as his college duties would permit, the statistical studies on the vertical migrations of the copepods, handling the data according to the methods developed by Messrs. Michael and McEwen.

In addition to his work as librarian, Dr. Berry has taken in hand during the year, mostly as home work, yet under the auspices of the Institution, the completion of his study of the species and distribution of the chitons of the California coast. This work was begun some years ago, but was laid aside temporarily because of lack of time and certain instrumental facilities for prosecuting it.

Professor Daniel, who has been occupied for several years with the morphological study of several species of cartilagenous fishes from the California coast, carried on his work several months during the year at the American Museum of Natural History. The exceptional facilites afforded by the collections and libraries of that great institution should make Dr. Daniel's volume, now nearly ready for publication, more complete than it otherwise could have been.

Early in the year Dr. Sumner closed his studies on white mice by publishing (Journ. of Experimental Zoology, April, 1915) his final report on the subject. This investigation of several years' duration being out of the way, he is now devoting his entire time to the researches entered upon when he joined the Institution.

In addition to the stations in Berkeley and Victorville, San Bernardino County, mentioned in my last year's report, as places for collecting and observing the mice upon which the investigations are being prosecuted, two other stations have been established during the year. These are in Eureka, Humboldt County, and on the Institution grounds in San Diego County. It will be noticed that this distribution of stations includes a typical northern humid coast locality, a typical southern less humid locality, a typical intermediate coast locality, and a typical southern interior dry locality.

The northern coastal (Eureka) station, the southern coastal (La Jolla) station, and the inland southern (Victorville) station each has its quite distinct race or subspecies of the genus of mice, *Peromyscus,* being used. *P. maculatus rubidus* is the Eureka mouse; *P. maculatus gambeli* is the La Jolla animal, and *P. maculatus sonoriensis* is the one which lives at Victorville. The Berkeley subspecies is considered to be the same as that at La Jolla.

In November Dr. Sumner collected over one hundred individuals at Eureka and moved them finally to La Jolla. A hundred Victorville specimens were secured in April and taken to La Jolla, and as a lot of both Victorville and Berkeley specimens previously kept at Berkeley had been moved to La Jolla and one hundred and fifty La Jolla mice have been trapped there and placed in confinement at present some three hundred specimens of native stock, representing three subspecies and coming from widely separated localities, are in the Murarium. All are thriving and breeding well, although the efforts at crossing the different kinds have not yet gone far enough to enable us to guess how successful these experiments will be.

Something of the results of the work is already clearly indicated. The lighter colored semi-desert *P. m. sonoriensis,* born and reared in Berkeley or La Jolla, the native homes of *P. m. gambeli,* are typical *sonoriensis,* and not *gambeli.* Coast conditions do not change an inland into a coast species in two generations, at any rate. The characters of these minutely different kinds are "germinal" and not merely "somatic".

Confinement of these wild species, even under the favorable conditions provided for them, begins almost immediately, it would seem, to alter certain body proportions of the individual animals. This will be studied with great care to ascertain the extent of the change, and especially to see if it becomes hereditary.

The director's scientific work during the year has consisted in gathering, through collaboration with Dr. Myrtle Johnson, further data on the proportionality of parts in the growth of organisms; in making systematic observations daily throughout the year on the influence of environmental conditions on the

singing of the western meadow lark; and in carrying forward his critical studies of organization, or integration, in organisms generally.

Although this summary touches all the kinds of work now actually in hand at the Institution, a new line of investigation is under consideration with sufficient seriousness to warrant mention. It has long been a more or less definite idea of those immediately responsible for the Institution that some time aspects of human biology might be taken up. From a number of general considerations which need not be detailed here it seems highly desirable that certain sorts of quantitatively exact, systematic studies of the effect of environment upon the human species are urgently called for both from biological and sociological reasons. The quantitative studies being prosecuted by Messrs. Michael, Esterly and Sumner, on the influence of environment on organisms, and especially those by Messrs. McEwen and Michael on mathematical methods of dealing with statistics for such purposes, point clearly toward studies on man of the kind indicated as being needed at the present time. This also coincides with interests and studies that have long occupied the director. It is therefore a more or less definitely expressed purpose of the Local Board of Management to undertake something in this direction as soon as the Institution's financial condition shall warrant it.

Respectfully submitted,

WM. E. RITTER.
Director.