

UNIVERSITY OF CALIFORNIA
BERKELEY

SCRIPPS INSTITUTION FOR BIOLOGICAL
RESEARCH

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SCRIPPS INSTITUTION FOR BIOLOGICAL RESEARCH

LA JOLLA, July 1, 1922.

To the President of the University.

SIR: I beg to submit to you herewith the annual report of the Scripps Institution for Biological Research for the year ending June 30, 1922.

Physical Oceanography.—Although the problem of predicting winter rainfall in California, from observations on the condition of the ocean during the preceding summer and fall, is, as stated in previous reports, quite incidental to the regular oceanographic work of the Institution, it has now attracted so much attention as to justify giving it more prominence than usual in this year's report. As to greater or less precipitation the indications of the summer of 1921 were again borne out—as they had been for the previous four years. However, the excess was greater than was indicated, and this throws doubt to some extent on the significance of the correlations observed. On the other hand, Dr. G. F. McEwen, Oceanographer, is now able to show a possible physical explanation for the relations suggested by the statistical data which is soon to be published. The state of the problem and the importance of it, seem amply to warrant renewed effort for solution. One of the main desiderata to this end is a wider geographic range of field observations than it has yet been possible to make. The temperatures and water samples taken at Oceanside (by the San Diego Gas and Electric Company), Redondo (by the Southern California Edison Company), Hueneme (by the Institution), Santa Barbara (by the Southern California Edison Company), Point Arguello (by the Institution), Pacific Grove (by the Hopkins Marine Laboratory), and at Montara (by the Institution), are contributing importantly to this end. It now seems probable that temperatures from a few stations north of San Francisco Bay may be secured from lightships through the cooperation of the United States Light House Service.

Perhaps the most important thing in the oceanographic part of the Institution's programme to be noted for the last year is the clear progress that has been made in establishing work on the chemistry of the sea. Mr. Eric G. Moberg who, as a candidate for the doctor's degree, made a start in this direction last year, has this year been able to move forward very definitely in the particular problems set for himself. This

is especially true of his work on the acidity-alkalinity, or the "hydrogen ion concentration," of the water. Already definite indications of correlations between the conditions existing in this aspect of the sea and those being discovered by researches on the physics and the biology of the sea, make the outlook promising for continued effort in this field.

Much of Dr. McEwen's effort during the year has been devoted to the difficult mathematico-physical problem of interpreting the field data on oceanic temperature, salinity, and other physical and chemical phenomena. As an illustration, the question of the relation between sun-heating of water and its cooling by evaporation is being carefully studied. This problem is complicated for the ocean by the phenomenon technically known as "mixing motion," typical of large bodies of water. As a way of reducing the difficulties thus arising, extensive studies have been made on temperature and evaporation in certain lakes and reservoirs of Southern California in the belief that the simpler conditions presented by the small bodies would facilitate the mathematical treatment of the more complex data derived from the sea. As so frequently happens in scientific research, this stepping aside from the main line has proved to be by no means time and effort lost from the standpoint of the side work itself. The reservoir studies have been especially interesting in this way because of the importance of the evaporation of water empounded for irrigation, domestic use, electric power, etc. This phase of the investigation has been largely in the hands of Mr. N. W. Cummings who, as a candidate for the degree of Doctor of Philosophy, has for his thesis, now nearly completed, *Evaporation from Water Surfaces*.

Planktology.—Marine biology, or biological oceanography, is that division of natural science which aims to answer the questions: What living beings does the sea produce? In what quantities does it produce these? How are they distributed horizontally and vertically? Under what conditions are they produced? Which of them are or are likely to become economically useful to man? How may those, thus useful, be so used as to assure their maximum of usefulness for all time? It is certain that the investigations on the microscopic plants of the surface and close underlying waters (the phytoplankton) is very near, if not quite at the foundation of the whole business. This is the field of the activities of W. E. Allen, Associate Professor of Biology.

Although the major scientific values of the work so far done are also mainly preparatory in character, the actual accomplishments are somewhat more attractive in appearance. A few of the more conspicuous of these are here presented.

1. A satisfactory and highly practical method for securing surface collections of ocean pasturage material has been developed and has been in actual operation not only by members of the Institution staff but also by pier employees and the second officer of one of our coastwise passenger steamers.

2. A standardized method of handling material has been developed which will make it possible to put the routine work of various investigators on a comparable basis whenever means can be found for establishing coöperation. Interest in working up such coöperation has been expressed by workers in the Puget Sound and Hawaiian sections.

3. A policy of continuity of operation has been adopted which is of the utmost importance in the investigation of such phenomena as those of the ocean pasturage. The essential feature of this policy is the selection of the point most favorable for continuity and the use of it as a nucleus or center of investigation with which unavoidably discontinuous investigation may be profitably compared.

4. An approximate identification has been made of the important species of the pelagic ocean pasturage in the San Diego region.

5. A study of seasonal distribution of pelagic pasturage has been made from a series of collections taken at the Institution pier at intervals of twelve hours for one year. For this particular year maximum production occurred in May, sub-maximum in September, and minima in December, January, and August. This year of collections at twelve-hour intervals has particular scientific interest because no other series of such continuity has been described, because it has shown conclusively the great value of close continuity in seeking a basis for estimating production and because it shows the extraordinarily favorable characteristics of the San Diego region for such studies.

6. Strong indication has been found that one plant (*Nitzschia seriata*) tends to be dominant in the ocean pasturage for about half the year in this section.

7. Evidence has accumulated to show the error of the old assumption that plant life in the sea is evenly distributed. In fact quantitative geographical distribution of plants in the sea is probably just as extremely variable as is that on land.

8. Evidence has appeared which indicates that diatoms tend to displace dinoflagellates under favorable conditions and that dinoflagellates tend to displace diatoms in the same way.

9. There is reason to think that temperature, light, and an intricate complex of biological factors are all strongly operative in determining the rate of production of ocean pasturage in this region.

10. Studies thus far made indicate very clearly that the responses of ocean pasturage to changes in environment open up great possibilities for gaining better understanding of the detailed influence of various factors of marine environment and consequently for gaining better understanding of conditions of life in general.

Anything in the nature of forecast is rash or questionable at best. Still, much of the most significant and valuable of human achievement has been the result of hope when ground for forecast was lacking. There are one or two points which seem to be within the range of possibility.

1. We may be able to learn which plants have value in the food chains leading to production of commercial fishes, also which are indifferent and which are injurious (distasteful or poisonous, like loco weed on land). We may then learn how to tell, for a given season, when a pasturage is adequate to support the fish population of the area or when it is so deficient that fish food cannot develop and fishing might well proceed without restriction.

2. We may learn to use certain plants as indicators of fish production, i.e., if *Nitzschia seriata* is a favorite food of copepods of the kind which sardines like best we might find certain areas more favorable for sardines because this plant most frequently occurred there in sufficient numbers. Occasional surveys of an area with due regard to major currents and drift might enable selection to be more readily made of favorable areas.

3. We may find that after abundant production of an injurious plant in an area it is useless to seek certain fish there for some days or weeks afterwards unless a storm should clear the area.

The methods of procedure developed for the phytoplankton are being applied, as far as possible, to the smaller and more abundant animal plankton by Dr. C. O. Esterly, Zoologist, and Dr. Christine Essenberg, Zoologist and Librarian. But just as the difficulties of collecting the field data and studying them in the laboratory increases as we pass from the water itself to the simpler plant organisms, so the difficulties increase as we pass from the study of the plant life to that of the simpler animal life.

The last two years of Dr. Esterly's quantitative work on the copepods, the animal group which, from its abundance and constancy of occurrence, makes the most important animal element in the "ocean pasturage," is particularly indicative that the methods employed for the phytoplankton will yield results for the animal plankton also.

While, as heretofore, collections made from the Institution's pier have been the main source of plankton material, as heretofore also valuable additions have come from occasional collections elsewhere. Those made in connection with the water observations at Oceanside and Hueneme, and the six weeks' periods of systematic boat work during the summer of 1921 and 1922 have been most important.

Problems of the Pacific.—As noted in recent reports, members of the Institution's staff have taken an active part in the general efforts being made to extend our knowledge of marine animals of the Pacific area now economically important, a special point in these efforts being to prevent the extinction or great depletion of the animals by over-killing.

In addition to efforts in this behalf carried on through the Committee on Pacific Investigations of the National Research Council, an exclusively Pacific Coast committee (that on Conservation of Marine Life of the Pacific) has been formed during the year by the Pacific Division of the American Association for the Advancement of Science. This committee, in which several Institution men are active, is much more restricted and specific in its purposes than the National committee, with which, however, the all-western committee works in close coöperation.

As important specific problems being worked at by these committees may be mentioned that of securing additional scientific knowledge to form a basis for renewal of the Fur Seal Treaty which expires in 1926; that of studying and finding, if possible, a means of checking the great

mortality of the fur seal herd during its period of extensive oceanic migration; that of securing much needed scientific knowledge about the important commercial fishes and the northeastern Pacific; and that of studying, with a view to conserving, several species of animals inhabiting Mexico's Pacific waters. Mr. Crandall and Mr. Barnhart have been specially active for the Institution in this connection.

While the "Washington Conference," which dealt so largely with international problems of the Pacific, was in session the director syndicated, through Science Service and the Engineering Foundation, a short article on "Problems of Population in the Pacific Area." This attracted considerable public attention and it is hoped such attention may be still further aroused on this important matter.

Heredity and Environmental Influence.—The following summary of the work of Dr. F. B. Sumner, Associate Professor of Biology, may be taken as the results to date of the critical analysis of the relations which exist between the differentiating characteristics of several closely related sub-species of mice and the differences in physical environment of the wide geographic area over which the sub-species are distributed:

1. No change has yet been detected among the subspecies which have been introduced from other parts of the State, although one of these races has now been kept at La Jolla for seven years, and some ten or twelve generations have been reared.

2. Since there are, nevertheless, strong theoretical reasons, as well as some experimental evidence, for believing that the color differences between the various subspecies have resulted from the direct but gradual action of climatic conditions, a special experiment has been devised during the past year to test this question. Mice of several races are being subjected to a high temperature and an atmosphere from which the moisture is artificially abstracted. This experiment has not been continued long enough to make a forecast of results profitable.

3. The analysis has been continued of the data from both "pure" races and hybrids, with reference to the geographic distribution of characters, as contrasted with that of *subspecies*, and the behavior of these characters in heredity. It is found that in respect to the pigment of the skin and hair there seems to be a rather close correlation between the degree of pigmentation and the humidity of the atmosphere. In respect to other characters, e.g., length of tail and foot, there appears to be no constant correlation with climate. Nevertheless it is important that the relative size of these parts is not independent of position in space. The various local races (both of mammals and birds) form intergrading series, in respect to the size of various parts, though the direction of these gradients bears no constant relation to gradients of climate or other known environmental features.

4. From a consideration of much evidence, Dr. Sumner is far from convinced that the "mutation theory" accounts for the formation of these geographic races of mammals and birds, nor is he convinced that all of the differences concerned may be reduced to Mendelian unit factors.

5. A microscopic study of the hair is being undertaken by Mr. R. R. Heustis, assistant and graduate student in the Institution. Mr. Heustis finds it possible to express the general color differences between the

various races of mice in terms of varying proportions of different types of hair. He is seeking for possible indications of Mendelian inheritance among these minuter characters.

6. The albino and hairless mutants which have appeared among the mice under investigation have been still further studied to ascertain the behavior of these characters in heredity.

The research work proper of the Institution has again been greatly facilitated by special money gifts from Mr. E. W. Scripps, \$1500 having been contributed for the support of a fellow and assistants in physical oceanography and \$2100 for a fellow and assistant and field work in heredity and environmental influence. A stenographer's salary was also augmented in the sum of \$200 from the same source, making the total for the year \$3800.

Library and Publication.—The largest number of bound volumes of any single year have been added to the library during the year just passed, this number being 1050. Of these, 574 came as a gift of Mr. Charles Michael in memory of his son Ellis L. Michael, whose long service to the Institution and untimely death were recorded in my last report. The total volumes in the library is now 8638. Four hundred and sixty-three pamphlets were added, bringing the total to 7601.

As mentioned in my last two reports, the Institution is sharing with many other establishments for scientific research, difficulties about ways of publishing the results of its work. The question of what to do with the extensive "raw data," almost all in the form of statistical tables, has come to the front with special urgency during this year. This material is both voluminous and especially expensive to publish. These facts, coupled with the further fact that if published and then distributed through the usual avenues for distributing scientific publications, the material has a range of usefulness that is very limited even as compared with the ordinary publications in technical science, makes the question urgent of finding a more satisfactory method than that now in use of preserving the data and making them available to other workers. A few biologists hold the view that such data may be so handled in the first stages of their further study as to make their preservation in full unnecessary. But such a view rests partly on a misunderstanding of the true significance of statistical data; and we feel that a real step toward solving the problem has been taken by having reached something of an official decision that the "raw data" should be preserved *in toto*. The problem now is, consequently, that of finding a way of preserving them that shall be as satisfactory so far as concerns safety and availability as the ordinary way of publishing and shall effect a distinct saving of expense. The subject is being taken up by competent men and a solution is confidently expected. The activities of the supply department during the last year particularly indicate that the most promising outlook for further development here is the wholesale rather than the retail market

for such things as we have to sell. Of the \$1000 more or less that is to be accredited to this year's work of the department, \$700 have come from concerns in eastern cities which retail the specimens to schools, universities, etc.

Visiting Naturalists and Other Professional People.—The growing list of visitors of this class is demonstrating the attractiveness and the possibilities of the Institution in this way. Those who have been with us during the year are: Dr. Albert Mann, diatoms; Professor S. S. Maxwell, reflex action of elasmobranch fishes; Miss Hazel Field, lake plankton; Dr. J. B. Wright, use of library; Professor H. W. Norris, nervous system of elasmobranch fishes; Drs. H. S. Reed and H. H. Halma, mathematical problems in agriculture; Professor A. Richards, germ cell physiology; President W. E. Clark; Professor H. J. Snook, general marine zoology; Dr. Myrtle Johnson, general marine zoology; President C. A. Duniway; Professor Charles Zeleny; Dr. Marcus Hanna, paleontology of San Diego County; Mr. G. E. Verbe, paleontology; Mr. C. W. Rees, general marine zoology; Count Alfred Korzybski, logic and philosophy in relation to biology; Dean J. B. Johnston, brain of elasmobranch fishes; Professor H. E. Walter, general marine zoology; Dr. Bertil Hanstrom, neurology; Professor C. M. Child, metabolic gradients in *Corymorpha*; Professor S. J. Holmes, general problems in biology; Dr. Libbie H. Hyman, respiration in *Corymorpha*; Professor Harold Kylin, histology of sea weeds; Dr. Walter P. Taylor, biological survey, U. S. Department of Agriculture; Mr. Guy Flemming, naturalist of Torrey Pines Park; Mr. M. Girard, chemistry of sea water.

The Grounds and Buildings.—The unfinished and insufficiently cared-for condition of the Institution grounds became more than ever conspicuous and troublesome during the last winter owing to the excessive rainfall. Damage to the roads and fills necessitated an expenditure of about \$1000 to make them usable at all. The experiences of the last winter particularly emphasize very strongly the importance of completing the south end of the sea front retaining wall, and of a more adequate drainage of the grounds for flood water.

Respectfully submitted,
WM. E. RITTER,
Director.