

UNIVERSITY OF CALIFORNIA
BERKELEY

SCRIPPS INSTITUTION FOR BIOLOGICAL
RESEARCH

[Reprint from the Annual Report of the President of the University, 1912-13]

UNIVERSITY OF CALIFORNIA PRESS
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LA JOLLA, July 1, 1913.

To the President of the University.

SIR: My report for the year July 1, 1912, to June 30, 1913, is respectfully presented herewith.

Investigations Completed and in Progress.—In this report I distinguish, as usual, the continuous or programme investigations of the institution from the incidental investigations carried on at the institution.

(1) *Programme Work.* (a) *Biological.*—The year just passed has advanced the programme in several quite distinct ways. The axis of the programme I have frequently spoken of as being the problem whether or not the infinite hosts of animate creatures that dwell in the sea live their lives in an orderly way—whether law or anarchy prevails among them. In one connection I wrote: “To learn more than we know about the laws that prevail in the wealth of life of the great oceans seems to me an object of great importance for the highest welfare of mankind. So relatively slight is our knowledge in this domain . . . that all of us, professional biologists and the generally informed alike, look out upon the expanse of the sea with an impression concerning its inhabitants (so far as we think of them at all) that is very vague and therefore meaningless and uninteresting. We conceive this vast wealth of life *en masse*, as one may say; that is, our knowledge and thoughts about it are undifferentiated and chaotic. We take for granted in a hazy fashion that some sort of order prevails. Such knowledge has little power for good, either practical or theoretical. Knowledge as to what this order is must be explicit before it can be very significant and interesting. It

is just this kind of definite information that the San Diego Station is striving after."

No inconsiderable part of the year's progress has consisted in setting out sharply a number of questions as to how the "small fry" constituting the ocean's free-living population is related to its environment. Is it true, as a large and influential school of biologists have believed, that organisms are passive and plastic to the forces of their environment in much such way as a piece of red-hot iron is to the blacksmith's anvil and hammer? That such is not the case for some, at least, of the species being studied is indubitable according to the evidence obtained. Mr. Michael has shown by a comparison of the differences between the members of related species, with the differences of the environments of the same species, the determinations being rigidly quantitative for both organisms and environments, that no such correlation between the two sets of quantities exists as would be expected in accordance with the theory above indicated. The method of testing the anvil-and-hammer conception of organic kinds employed by us may be, and ought to be widely applied, as well to land plants and animals as to those of the sea; and it is for this reason that we regard the definition of the problem and the inauguration of a method of dealing with it as of almost as much importance as the results actually reached.

Another question brought to clearer focus by our work than ever before may be stated thus: Is it a general truth that natural organic species are as sharply differentiated from one another by their modes of life and activities as by their form and structure? Much evidence tending toward an affirmative answer to this has been accumulating in many quarters during recent years, and our investigations are adding weighty facts and inferences of like purport. "Each species", says Mr. Michael, referring to the chaetognaths, "occurring in the San Diego region has its own definite and specific manner of vertical distribution just as truly as it has its own specific morphological characteristics." And, with some differences, Dr. Esterly reaches a like conclusion concerning a radically different group of animals, the copepods.

Following close in the wake of the question last mentioned, that of the habits characteristic of individual organisms is brought into clear focus by our work. That all the individuals of a species differ from one another *structurally* to some extent has been a tenet of biology since Darwin recognized the fact and utilized it in his famous natural selection hypothesis. Now, so it seems, we must ask seriously and critically concerning their differences in *activity* also. Recent studies on "animal behavior" are engendering this necessity and our quantitative treatment of the movements and habits of organisms has a like bearing. When Michael and Esterly conclude that species are differentiated from one another in mode of life as well as in structure, they base this conclusion on the ascertained mean values of certain activities of great numbers of individuals. What of the performances of all the individuals which do *not* conform to this mean? We have gone no further with this question than to see that it must be asked, and that there are ways of approach to it full of promise for positive results. The subject would justify the expenditure of almost any amount of time and effort, for it is the biologist's gateway to the great problem of individuality. Biology's early, youthful motive is to find a single formula for all organic beings—to reduce them to a common denominator. This is good so far; so far, that is, as it corresponds with the nature of organisms. But it appears to be only half the story. Personality on the plane of human beings when understood through and through, always includes differences as well as similarities as between each man and every other man. Accepting difference as one of the essential criteria of human personality, must we not recognize that all organic beings whatever have something of personality? The evidence weighs heavily toward such a conception. To get still more evidence bearing on the question will be a prime object of future effort.

Another problem, minor in theoretical import as compared with those just mentioned, though of much local interest, has come specifically in sight during the last year, mainly from Dr Esterly's copepod work. Is the distribution of the minute pelagic organisms of this region determined to any extent by the dis-

tribution of ocean temperatures resulting from the "up-welling water" which is so important and peculiar a feature of this part of the Pacific Ocean?

The problems now in hand and thus formulated lay out very definitely, so far as aim is concerned, the programme work at sea for the immediate future. How far do the laws of distribution and activity found to hold in the groups studied, the Chaetognatha and the Copepoda, hold for other groups? In particular, how is it with groups still lower in the scale of life, on the one hand, and those higher in the scale, on the other? Dr. Esterly has already taken in hand the Ctenophera, a group of jellyfishes, to see how it is with these more lowly organisms; and the work of Dr. Kofoid and Mr. Barrows on the unicellular plants, the Peridinidae, will, it is hoped, yield illuminating results from this standpoint by the end of another year, though the minuteness of the latter organisms greatly increases the difficulties of research in several ways, both as regards collecting the specimens at sea and as to the quantitative treatment of them after they are in the laboratory.

As to animals higher in the scale than those already studied, Mr. Michael, with a little assistance from the director, has already well advanced the task of finding how one species of pelagic Tunicata behaves in relation to several of its environmental factors; and Dr. Esterly is now taking up the schizopod Crustacea, a group of animals far better equipped with eyes and swimming apparatus than any of the other groups so far under investigation.

During the year Mr. Michael has described a new member of the Chaetognatha or "bristle-jawed" worm, to which he has so long devoted himself. Few discoveries in biology are less significant than the discovery of a new species when such discovery stands all by itself. That it may, however, couple itself up with other knowledge in such a way as to make it genuinely interesting is well illustrated by this instance. After six years of the most painstaking collecting and examination of collections had elapsed, this new animal appeared all at once and in considerable numbers for a few days in October, 1911. Where did

they come from? How did they come? Did their coming depend chiefly on their own exertion or on currents or on other conditions of the sea? While in general there is evidence that the lives of all organisms are governed by law, what the law is, in so seemingly haphazard a case as this, is very difficult to find out.

In the sense of being administratively recognized and persistently followed up through a long period of time, the director's work on "The Organism as a Whole" must be counted as part of the Institution's programme. The aim of this undertaking is a clearer recognition than has hitherto been reached, of which many of the foremost biologists are sure exists, but concerning the nature and exact workings of which they recognize they are so much in the dark. The task involves the critical examination of a vast range of phenomena and literature, not only biological, as usually understood, but also chemico-physical and psychological. Stated in one way, the outcome foreshadowed is a clear recognition of the fundamentality and nature of *integratedness* as the counterpoise of *differentiatedness* in organic beings, the supreme expression of this integration of elements being that of what is called the physical, and what is called the spiritual, in human beings to make the individual *man*.

(b) *Oceanographic*.—As has been repeatedly stated, researches in this field are regarded as primarily in the interest of, and so subordinate to, the biological investigations. They are virtually investigations on the environment of the organisms. However, the results reached, as set forth in Dr. McEwen's last paper, published within the year, ("The Distribution of Oceanic Temperatures along the West Coast of North America deduced from Ekman's Theory of the Up-welling of Cold Water from the Adjacent Ocean Depths", *Internat Revue der gesam. Hydrobiol. u. Hydrograph.*), have a great scientific interest in themselves, and open the way to still others of equal scientific importance, and to possibilities of great practical moment. At last, after more than a half century of speculation about the temperature conditions of the Pacific off the California coast, in which the

the principle of unity
of the organism

Japan Current has played the leading rôle, we are getting clear insight into the situation; and it is not too much to claim that this Institution's work, in the hands of Dr. McEwen, has contributed more to this new light than any other single instrumentality.

By subjecting the hydrographic and meteorological observations previously collected, and those made by the Institution, to searching quantitative treatment in connection with a theory of oceanic circulation elaborated by the Swede, V. W. Ekman, the three factors—the direction and force of the wind, the rotation of the earth, and the presence and topography of a continental shore line—are proved to be by far the most important factors in producing the uniqueness of the oceanic temperatures of this region. Acting together, these cause the so-called “up-welling” of coastal waters, the low temperature of which, coming from the ocean's depth, appear to account entirely for the cool summer water and hence cool summer climate in California. One practical significance of this is, that, knowing the main factors in the problem of ocean temperatures in this region, and knowing further how the climate depends on the condition of the ocean, it may be possible by a study of the winds over the sea, and of the sea itself, to predict for some months ahead what in a general way the climate of the adjacent land will be. Undoubtedly much more study will be necessary to test the worth of this suggestion, but the obvious great value there would be in knowing beforehand that, for example, a dry winter is coming for California, would justify much effort to test the hypothesis.

To facilitate the future treatment of oceanographic phenomena of the region, Dr. McEwen has been occupied for some time with the search after physical formulae by the use of which the relatively few field observations that can be made at any one time shall give more information concerning the phenomena in question than the observations alone afford. This he hopes to accomplish by finding general statements as to the distance from the shore line to which the up-welling affects the surface of the sea, and the direction and velocity of the water; and further by determining formulae that will involve the dependence of

the temperature distribution of the water on the depths to which the heat of the sun penetrates the sea and is radiated from its surface at a given place.

For some months nearly the entire time of both Mr. Michael and Dr. McEwen has been occupied in the task of preparing for publication all the field data, both biological and oceanographic, thus far collected. This laborious and expensive piece of work has become indispensable for the further use of the data in the special researches based on them. So far as our own investigations are concerned, typewritten copies of the data might serve, and the expense of publication be thereby saved. However, investigators connected with other institutions and working on quite different problems from those now occupying us, are already asking for, and in the future will still more require, the use of the data. On this account largely we have decided, after much deliberation, that the whole thing should be published.

(2) *Non-programme Work*.—Of work under this head during the year, that by Dr. J. Frank Daniel and his student assistants on the cartilaginous fishes may be first mentioned. The aim of this is two-fold: In the first place, it is to produce what, in the end, will be an extensive monograph on the unique and hitherto little studied shark, *Heterodontus francisci*; and secondly, to make a comparative study of the anatomy of the elasmobranch fishes in general, much attention being given to the extensive literature of the subject. This summer's work will nearly or quite complete the task for several of the systems of organs of *Heterodontus*.

During the year I completed and published my long-delayed report on the collection of ascidians of the northeastern Pacific, belonging to the United States National Museum. Without in any wise minimizing the importance of studies in the classification of animals, I feel that I have done my share in this way, having devoted much time to such researches for twenty years, and so am privileged to lay them aside for some time at least.

The work prosecuted during the summers of 1911 and 1912 by Dr. Bennet M. Allen of the University of Wisconsin, on the natural history of the spiny lobster, under the joint auspices of

the California State Fish and Game Commission and the Scripps Institution, were discontinued with the termination of the season's work of 1912, the Commission not deeming it practicable to devote more of its funds to this purpose. Dr. Allen's efforts last year proved the impossibility of rearing these animals by the methods employed, namely, by confining the stripped eggs and the young in screen containers held by rafts anchored in the bay. The next attempt should be with the egg-bearing females themselves kept in the most effective aquaria that can be constructed.

Mr. Crandall continued his survey last summer of the kelp beds of the coast for the United States Department of Agriculture, extending the examination as far north as Puget Sound. Although the Department has made no provision for prosecuting the work further, Mr. Crandall and Mr. Wallace will carry on studies at the Institution's expense on the kelp bed at La Jolla with a view to learning the rate of growth and reproduction of the plants, and for determining what the beds amount to as a habitat for fishes and other animals.

The State Legislature passed a bill at its last session entrusting to this Institution the preparation of a report on the chance of protecting and still further developing various fishery industries of the coast; but since the bill, which carried with it an appropriation of \$5,000, failed to receive the Governor's approval, the work cannot be done in any such way as would have been possible had this money been made available.

Dr. M. M. Metcalf, Professor of Zoology at Oberlin College, is the only visiting investigator who has worked at the Institution during the year, he having devoted some time to a study of the pelagic Tunicata contained in the collections. With the increased laboratory work-room that will become available by the removal of the director's family to the residence soon to be erected for that purpose; and with the provision that has been made for domiciling naturalists near the laboratory, as well as for transportation, the facilities of the Institution may well be offered with more explicitness than heretofore to visitors.

Administration.—On July 1, 1912, the real regime of the University began in the management of the Scripps Institution for Biological Research. Although the formal transfer of the property from the Biological Association of San Diego to The Regents of the University had occurred some months earlier, the Comptroller of the University decided that it would be better to continue under the old order until the close of the fiscal year, July 1, 1912. Upon the same date also began the payment by Miss E. B. Scripps to The Regents of \$2,500 a month for two years or until the sum of \$60,000 should have been reached, this to be used solely for the physical development of the Institution.

In accordance with the terms of transfer a local Board of Directors was created to look after the details of management, their actions being at all times subject to the approval of The Regents of the University. Of this local Board the President of the University and the Director of the Institution are *ex officio* members, and Miss E. B. Scripps and Mr. E. W. Scripps are to be permanent members during their lifetime. The additional members were Dr. Fred Baker, president of the former Biological Association, and Mr. George A. Haines, who was elected secretary. Mr. Haines resigned later in the year owing to removal from San Diego, and Mr. W. C. Crandall was elected in his place. At the last meeting of the local Board it was voted that all permanent resident members of the staff shall be eligible to membership on the local Board, this action being for the purpose of making the Board more representative and more effective. Mr. W. C. Crandall, Mr. E. L. Michael, and Dr. G. F. McEwen were elected in accordance with this resolution.

One of the first steps in the University regime was that the Comptroller sent the University engineer, Mr. H. B. Foster, to the institution to survey the land and lay out roadways, building sites, etc., for the future improvements. An important feature in such improvements will be the construction of a sea-wall along the face of the cliffs in front of the present buildings to protect the cliffs from the encroachments of the sea. In connection with this will be a sedimentation tank which will be part of the salt-water pumping system soon to be installed.

Since the general business management would occupy the time of one man, the services of Mr. W. C. Crandall were secured on the first of February, 1913. Mr. Crandall had been connected with the station for several years, first as naturalist and then as master of the "Agassiz" during the vacation periods of the San Diego Normal School.

The first task undertaken by him was the erection of twelve cottages of various sizes to house the workers at the laboratory. The structures were ready for occupancy early in June. At the present writing nine are occupied, four by families, four by unmarried men, and one by persons not connected with the Institution, there being twenty-one persons thus added to the colony.

The increased activities of the Institution called urgently for a larger sum of money for running expenses; and since the State of California had been presented with an endowed property worth several hundred thousand dollars, it seemed natural to turn to the state for aid. To this end a legislative appropriation was asked and secured to the amount of \$15,000 for two years.

The local Board of Directors decided that this increase of \$7,500 per annum should be devoted to strengthening of the scientific staff and to additional work at sea by the "Agassiz." In addition to certain minor increases in the salaries of the present staff, it was voted to recommend to The Regents the appointment of one investigator to be of the rank of a professorship and two assistants. The first is yet to be selected. The two latter are Mr. W. S. Wallace, scientific assistant to the director, and Mr. A. S. Barrows, research fellow, as assistant to Professor Kofoid in his investigations on the Peridinidae. This last mentioned appointment establishes a precedent which will be given a trial for one year at least, i.e., that of a research fellowship of \$600, the holder being privileged to work for his doctor's degree.

On the first of January, 1913, Dr. S. S. Berry of Stanford University was appointed librarian. Certain business matters make it imperative for Dr. Berry to be out of the state for some months this summer and during his absence Mr. Edward P. Van Duzee, formerly librarian of the Grosvenor Library, Buffalo.

N. Y., will act as his substitute. In accordance with the policy adopted by the local board in the distribution of the \$60,000 for physical development, one-fourth of the amount is to be devoted to building up the library.

The position of aquarium attendant and collector has also been created, which position is yet to be filled.

In carrying out the arrangement that was made with the University four years ago, at the time the present director took up his residence at the station, he still continues to be a member of the teaching faculty of the University for one-fourth of each college year. This period of work in Berkeley has so far been the latter half of the second University semester. The engagement was carried out this year as usual.

For the year 1912-1913 the director served as president of the Biological Society of the Pacific, which held its annual meeting in Berkeley in April; and during the year was elected to membership in the American Academy of Arts and Sciences.

Respectfully submitted,

WM. E. RITTER,
Scientific Director.