

nomics and civics with some reference to the future life of the public school pupil as a citizen. Our teaching of hygiene should keep in view the same great end, and if this paper draws attention to the lamentable inadequacy of our present instruction in that subject to this purpose, our object will have been accomplished.

But much more is needed. We need a clear conception of the true place of physiology and hygiene, but we need also the proper teachers to realize that conception. If the subject is as important as we have represented, it should be taught by teachers specially trained. In the higher grades of our schools we often have special teachers of languages, of history and civics, of mathematics, of the natural sciences; but it is rare indeed to find physiology and hygiene in the hands of teachers who have had special training in these subjects. Too frequently they are imposed upon the least experienced member of the staff, whose connection with the school is too recent or whose tenure is too precarious to allow refusal. All this must be changed. The exact method of securing the trained instructor may often be left to local conditions. At times, medical examiners, the demands of whose practice are not distracting, and who are at the same time good teachers, may fill the position; at other times, teachers of the biological sciences should be encouraged to prepare themselves for the work.

A method which especially commends itself to us is to combine this work with that in physical training. The teachers of physical training, of all the instructing staff of the school, stand in closest relation to the work of preservation and promotion of sound health. At present their work is somewhat narrow and suffers from the lack of any direct explanation of the principles of physical training. It would broaden the work of these teachers and make their present efforts more effective,

if physiology and hygiene so obviously related to their other work were placed in their hands. True, it would require a broader preparation and an extension of the work of our normal schools of physical training in both time and scope; but this is really an argument in its favor. Normal schools of physical training ought to extend and enrich their courses, especially in view of the fact that so many of their graduates must occupy positions in the higher grades.

There is a widespread feeling that the present training in physiology and hygiene in the public schools is a failure. But signs are not lacking of a strong feeling among prominent educators that these subjects can and should rank in dignity and usefulness with languages, mathematics, physics, chemistry, biology, history and civics. Physiologists have long protested against the domination and excesses of 'temperance physiology.' Educators have complained of the bad pedagogical requirements often placed by law upon the teaching of the subject. We appeal to the members of the American Social Science Association to aid us in bringing about a reform, not as parties to either side of a dispute on questions of scientific fact about alcohol, nor from the standpoint of pedagogic theory and practice, but because the subject is one which profoundly affects social conditions and is closely related to a more intelligent and a more successful conduct of individual and social American life.

WILLIAM T. SEDGWICK,  
THEODORE HOUGH.

MASSACHUSETTS INSTITUTE  
OF TECHNOLOGY.

---

PRELIMINARY REPORT ON THE MARINE  
BIOLOGICAL SURVEY WORK CARRIED  
ON BY THE ZOOLOGICAL DEPART-  
MENT OF THE UNIVERSITY OF  
CALIFORNIA AT SAN DIEGO.

THE marine biological work of the Department of Zoology of the University of

California during the summer of 1901, with San Pedro, California, as a base of operations, was planned and carried out 'as though it were to be the beginning of a detailed biological survey of the coast of California.'\*

That season dredging and trawling were the chief work. A large number of dredging stations at San Pedro, around Santa Catalina Islands and at San Diego were occupied, charted and their bearings recorded. Many hauls were made, several at each station, as far as possible. All the material secured was either preserved or in case of species so abundant as to make their preservation seriously burdensome, was recorded, quantitatively as far as practicable.

Owing to lack of funds, nothing was done during the summer of 1902 toward the survey work beyond some shore collecting at San Pedro. During the present summer the survey idea has been again foremost. It seemed this year, the total of circumstances being taken into consideration, that it would be best to devote attention to the plankton chiefly. A sail vessel could be used for this kind of work more advantageously than for dredging and trawling, and would be much cheaper and consequently would make the limited funds available go considerably farther. Two good, intelligent fishermen would be able to do nearly all the collecting alone, thus permitting the naturalists to devote their whole time to studying the material as it should be brought in. Again almost nothing had hitherto been done on the plankton of the waters of this region.

The laboratory was moved this summer from San Pedro to San Diego, or, more exactly, to Coronado. Several considerations brought about this removal. The most potent was the fact that a number of

citizens of San Diego were desirous of having the work carried on there for a summer, at least, and were willing to furnish the funds to defray the expense of moving and of operating the station for six weeks during the summer and two weeks at the Christmas vacation, 1903-1904. Again, the zoologists of the university were glad of the opportunity to test more fully than had before been possible the fitness of the San Diego region as a location for a laboratory. Finally, the improvements of the harbor at San Pedro now being carried on by the national government, and the important commercial development in progress there, have made the building occupied as a laboratory inaccessible for this purpose, and have seriously, and, it is to be feared, permanently, impaired some of the most distinctive biological advantages of the location.

At Coronado ample quarters for a laboratory, well lighted and conveniently located, were generously given and partially fitted up by the Coronado Beach Company in their old boat house on Glorietta Bight. For a vessel the five- or six-ton schooner *Lura*, formerly a pilot boat of the port, was hired. This in charge of Mr. Manuel Cabral, an unusually intelligent and competent fisherman, with a helper was kept constantly at the collecting, almost though not quite exclusively, of plankton.

The nets used were of Nos. 000, 12 and 20 miller's bolting. No closing net was employed, but a series of nets placed at intervals on a rope and hauled vertically was the means used to differentiate the depths at which the macroplankton was taken. For the comparatively shallow depths, not exceeding two hundred fathoms, to which the operations were limited, this method gives very good results. This is particularly true when there is but little wind or drift so that several hauls can be quickly made in nearly the same place. For collecting

\* 'A Summer's Dredging on the Coast of Southern California,' SCIENCE, January 10, 1902, p. 55.

microplankton from different depths pumping was resorted to. For this a semi-rotary 'clock' force pump of one half inch intake and one half inch garden hose were used. This collecting was not extended below a little less than 100 fathoms. The volume of water that could be obtained by so small a pump and hose was too small to make the results wholly satisfactory. The trial convinced us, however, that the method is sound even for considerably greater depths than we were prepared to go, and that with a larger power pump and the right sort of a filter it would be of much importance. The most serious difficulty encountered during the summer was the lack of wind for propelling the schooner. Night collecting proved to be practically impossible most of the time on this account, and much of the time during the day the more sensitive organisms like some radiolarians, some medusæ, appendicularia, etc., were usually dead on reaching the laboratory when they were brought from a distance of six or eight miles.

The regular staff of the laboratory, *i. e.*, those engaged upon the survey work proper, with their tasks, were as follows: Wm. E. Ritter, Ph.D., professor of zoology, in charge, protochordata; C. A. Kofoid, Ph.D., assistant professor histology and embryology, protozoa; H. B. Torrey, Ph.D., instructor in zoology, cœlenterata; C. O. Esterly, A.B., assistant in zoology, copepoda; J. F. Bovard, B.S., assistant in zoology, protozoa, with Professor Kofoid; H. M. Evans, senior student in the university, hydrography and preparateur in zoology.

In addition the following persons used the laboratory for prosecuting their own special studies: Dr. A. Carlson, of the Leland Stanford Jr. University, investigations on the comparative physiology of the invertebrate heart; Mr. B. M. Davis, Los

Angeles Normal School, investigations on the flotation of pelagic animals; Miss Marion Hubbard, of Wellesley College and the University of California, general studies on tunicata and mollusca; and Miss Margaret Henderson, a student of the University of California, special studies on the cœlenterates with Dr. Torrey.

#### SOME RESULTS.

No part of the summer's work was done with greater regularity and interest than the hydrographic, though only the temperature and the specific gravity of the water were attempted. About 150 determinations of each of these were recorded. This number is, of course, too small, particularly when confined to so limited an area and so brief a time, to have more than local significance. Even so, however, a few facts worthy of noting were brought out. It was found that the specific gravity of San Diego bay water was distinctly higher during the period of observation than that of ocean water, and that near the head of the bay it was higher than in the middle portion. The averages are: Ocean water, 1.02455+; bay water, middle portion (at Coronado), 1.02546+; upper portion (off National City), 1.02626+.

Although these results are what would be expected in view of the fact that San Diego Bay is a land-locked, comparatively shallow body of water, they are still of interest particularly because it has been surmised that a large subterranean inflow of fresh water from the San Diego River enters the bay at its upper end. While these observations do not disprove the conjecture, they obviously do not support it. Furthermore, the difference between ocean water and bay water was somewhat greater, on the average, at low tide than at high, the average differences being for low water, .001003+, and for high, .00087.

Another interesting but puzzling fact was

the sudden drop in both temperature and specific gravity of ocean water on July 27. Up to this time the average surface temperature at Coronado pier, taken at ten o'clock in the morning, had been about 20° C. On that date at the same hour of the day it was 16.2° C. This low temperature continued about three days, when the previous conditions were gradually resumed. The specific gravity fell distinctly though slightly with the temperature. These unusual temperature and density conditions were not associated with any special increase or change in direction of the wind or fall in atmospheric temperature, neither could they be with certainty correlated with any known tide or current movements.

Professor Kofoid reports as follows on the work done by him and Mr. Bovard on the protozoa:

Attention was confined almost wholly to the forms taken in the silk net on or near the 'bank' off Pt. Loma, and to a few catches nearer shore and in the bay. The plankton is very rich in the well-known pelagic groups *Peridiniidæ*, *Tintinnidæ* and *Radiolaria*.

Of the *Peridiniidæ* 59 forms were found. The list includes a number of varieties known only from the Bay of Naples, from Marseilles, the Red Sea and the Gulf of Aden, and includes many if not all of the well-known forms from the Atlantic and Mediterranean. The entire list is reported for the first time from this coast and most of them for the first time from the Pacific Ocean.

Of the *Tintinnidæ* 30 forms were observed, including several of unusual interest and importance. All of the species are listed for the first time from the Pacific Ocean, and many of them were known heretofore only from the Mediterranean, the Red Sea and the Gulf of Siam. Many

Arctic and Atlantic species were also in the list.

The *Radiolaria*, though not abundant as to individuals, revealed a large number of species of which only a small part have as yet been carefully examined. Of the 33 studied a few are cosmopolites and most of them rare, known hitherto only from a single or at most a few specimens from *Challenger* collections in the tropical Atlantic and Pacific Oceans. One only was reported from the North Atlantic 57° N. latitude off Greenland, and others in hauls from great depths in mid Atlantic or Pacific, *e. g.*, in 2,250 fathoms or more.

Three pelagic Foraminifera which are cosmopolitan in the plankton occurred in the collections, and some bottom ooze cursorily examined appears to be rich in other forms which have not as yet been identified.

There were also four other forms belonging to other groups of protozoa, two ectoparasites on other pelagic organisms, one endoparasite and one flagellate free swimming in habit.

The affinities of the local protozoan fauna are to some extent with that of tropical waters, though some apparently northern forms appear in our lists. Apparently the protozoan fauna of the Bay of Naples, and perhaps that of the tropical Atlantic and Pacific, are to be found within a few hours' sail of San Diego.

Dr. Torrey's intimate knowledge of the actinozoa and hydroidea of the California coast enabled him to make the best of the little dredging and trawling and shore collecting done, and his preliminary report which follows, includes these as well as the pelagic groups:

The Cœlenterata are represented in the waters in the neighborhood of San Diego, Cal., by at least 86 species, more than half of which have not been found before in this region.

Among the medusæ, nineteen genera of ceraspedotes and one genus of acraspedotes have been taken, each represented by one species. Of these species, only four (*Aurelia labiata*, *Phialidium gregarium*, *Proboscidaactyla flavicirrata*, *Thaumantias cellularia*) have been reported previously from this coast; three (*Cladonema radiatum*, *Tiara pileata*, *Tiaropsis diademata*) are known in the eastern United States or in Europe; of the remaining thirteen, seven are in all probability new to science.

Six species of Siphonophora, representing as many genera, have been collected. Two are old species, world-wide in their distribution (*Sphæronectes köllikeri*, *Diphyes appendiculata*). The others have not been closely identified, owing largely to their fragmentary condition; two are physonects, two cystonects.

Four species of Ctenophora, each representing a genus, have been collected. Two of these are well known north of San Francisco (*Pleurobrachia bachii*, *Beroë cyathina*). The third (*Mertensia* sp.) closely resembles the *M. ovata* of the eastern coast. The fourth is a lobate, which has appeared only in immature stages and can not be placed accurately until the adult form is known.

These floating forms were obtained by the tow-net at the surface and in vertical hauls from depths varying from thirty to one hundred and sixty fathoms. Some of the species were taken in almost every haul at whatever depth (*Diphyes appendiculata*, *Sphæronectes köllikeri*, *Glossocodon* sp., *Obelia* sp., *Mertensia* sp.). Most of them are represented by less than six individuals, some by but a single specimen.

On the shores of San Diego Bay, Point Loma, Coronado and the Coronado Islands, and in hauls of the dredge at depths varying from three to fifty fathoms, off Point Loma and in the mouth of the bay, there

were obtained thirty species of hydroids representing fifteen genera, nine species of anemones representing six genera, two species of madrepore corals and five species of alcyonarian corals.

Of the thirty species of hydroids, at least four are new to science, eleven others have not been found here before, and two are new to the Pacific Coast. If to these thirty species there be added the fourteen previously reported but not obtained this season, the resulting total of forty-four will surpass the total known for any other region south of Puget Sound, and embraces representatives of nine of the eleven families known on the coast.

Of the nine anemones, all save one (*Sargartia* sp.) are found at San Pedro, two reaching beyond that point to the north, one to Puget Sound (*Epiactis prolifera*), the other to Santa Barbara (*Anthopleura californica*). All are peculiar to this coast.

None of the six corals are new species, but, so far as can be judged at present, are peculiar to the Pacific Coast.

Mr. Esterly summarizes the results of his study of the pelagic copepods as follows:

Twenty-seven species were recognized, of which twenty-two were accurately determined. These belonged to the following genera: *Acartia*, *Calanus*, *Euchirella*, *Heterochäta*, *Metridia*, *Oithona* and *Sapphirina*. Five of the twenty-seven species have not been reported previously outside the Mediterranean Sea. Four are new to North America.

The list of species obtained by the *Albatross* dredging on the west coast of South America and Mexico, and in the Gulf of California in 1891, contains forty-eight names. This number can now be increased by fourteen determined species, at least on the west coast of the Americas. Five of the species identified are common to this and the Woods Holl region on the Atlantic

coast. Considerable numbers of both males and females of a species undoubtedly new were found in San Diego Bay.

The tornaria described by me in 1893\* was taken this summer for the first time since the original discovery. Only a few specimens were secured at Santa Catalina, its first locality. This year it was abundant during the whole period of our work. Its habits and structural changes during metamorphosis were consequently studied to good advantage. Furthermore, Mr. Davis found it a particularly interesting subject for his studies on the flotation, specific gravity and modes of locomotion of pelagic animals.

Nearly all the specimens taken were from nets that had been down to from thirty-five to ninety fathoms. Almost none occurred in surface towings. In spite of rather extensive experiments by both Mr. Davis and myself to determine the influence of light on the larva's movements, conclusive results were not obtained.

This tornaria is certainly closely related to, if not identical with, the Bimini larva figured by Morgan,† pl. I., fig. 12. In addition to this tornaria an occasional specimen of another species undoubtedly new to science and quite distinct, was found. This form is especially characterized by the possession of as high as seven pairs of branchial pockets before there are other obvious signs of metamorphosis.

Of the pelagic tunicata, only the genus *Oikopleura* representing the Larvacea has yet been taken on the coast of California. Apparently two species of this genus occurred rather abundantly in the tow throughout the summer. The extreme sensitiveness of these animals to removal from

the sea itself is a striking phenomenon in the ecology of pelagic organisms and richly deserves investigation.

But a single species of *Doliolum* was taken, and that represented only by the 'nurse'; but this species is particularly interesting, it being clearly the peculiar form hitherto known only from the specimens taken by the *Challenger* and described by Herdman in his report on the pelagic tunicata of the expedition.

Of the seven or eight species of *Salpa* now known from the California coast only five were found during the summer; of these, however, one was taken for the first time, and is a new species. *S. runcinatafusiformis* was by far the most abundant species.

*Pyrosoma atlanticum* var. *tuberculosum* was taken in considerable numbers, and is the first record of a member of this genus on our coast so far as our collecting is concerned.

Owing to the little dredging and trawling and shore collecting that were done, only about fifteen species of sedentary ascidians were obtained. The great abundance of *Ciona intestinalis* on the floats and piles of the laboratory is worthy of mention as showing the ease with which this species may be obtained in unlimited quantity for experimental or morphological studies.

A wealth of life representing other subdivisions of the animal kingdom came to the laboratory, but, owing to a lack of workers, could only be admiringly looked at and put into preserving fluids to await attention in the future.

Mention should be made of the fact that the species of *Gonyaulax* which appeared in such enormous numbers in the summer of 1901,\* occurred at San Diego this year

\* 'On a New Balanoglossus Larva from the Coast of California, etc.,' *Zool. Anz.*, XVII. Jahrg., 1894, p. 24.

† 'The Development of Tornaria,' *Journ. of Morph.*, Vol. IX., p. 1.

\* H. B. Torrey, 'An Unusual Occurrence of Dinoflagelata on the California Coast,' *Amer. Naturalist*, Vol. 36, March, 1902. Also W. E. Ritter, 'A Summer's Dredging on the Coast of Southern California,' *SCIENCE*, January 10, 1902.

quite as abundantly as it did that year at San Pedro. During the last days of July the water of the ocean at Coronado extending from the shore out to a mile or more took on the rusty color, increasing at times and in places to almost that of old blood clot, with which we became so familiar at San Pedro two years ago. This year, however, we observed nothing of the fatality among other animals, as an accompaniment of the visitation, that occurred in 1901. It is not certain, however, that this latter phenomenon was absent, for we did not have the same opportunities for observation this year that we had before. This year we did no dredging in the affected region and consequently had no chance to see how the bottom organisms were affected. Furthermore, there was no high wind this year to drive the *Gonyaulax* on to the shore and to cast up the dead of other animals, had they existed.

As mentioned above, the same kind of work will be carried on again for two weeks during the Christmas recess of the university. This much we are now able to do toward realizing the plan of distributing the survey operations throughout the year.

It gives me genuine pleasure to conclude with an acknowledgment of our obligations to the citizens of San Diego for having made the work possible this year. The whole expense of moving the laboratory from San Pedro and of fitting up the new one at Coronado, and likewise all the expense of carrying on the work excepting for the equipment that was taken from the university, was provided by the citizens. A committee of the chamber of commerce of that city had the matter in charge, and such a duty was certainly never more efficiently discharged by any similar body of men.

WM. E. RITTER.

UNIVERSITY OF CALIFORNIA,  
August 14, 1903.

#### SCIENTIFIC BOOKS.

THE COLLECTED PAPERS OF ROWLAND AND FITZGERALD.

*The Physical Papers of Henry Augustus Rowland.* Collected for publication by a Committee of the Faculty of the University. Baltimore, The Johns Hopkins Press. 1902. 8vo. Pp. xi + 704.

*The Scientific Writings of the Late George Francis FitzGerald.* Collected and edited with a historical introduction by Joseph Larmor. Dublin University Press Series. Dublin, Hodges, Figgis & Co., Ltd.; London, Longmans, Green & Co. 1902. 8vo. Pp. lxiv + 576.

No more fitting memorials could have been produced in honor of the two distinguished physicists, whose untimely deaths occurred in the early months of 1901, than these admirable volumes issued by the Johns Hopkins Press and by the Dublin University Press respectively. The first duty of the living, therefore, is to acknowledge our deep indebtedness to Professor Ames and to Professor Larmor on whom the burden of the work fell in collecting and editing these widely scattered papers and in bringing them into readily accessible forms in the short space of two years. They have thus at once rendered homage to the heroes who have gone before and encouragement to the hosts who follow in the arduous march of physical science. The desirability of republication of the scattered papers of eminent men of science is now pretty generally recognized, and the prompt issue of the papers of Rowland and FitzGerald sets an example which should be widely followed.

The nearly simultaneous appearance of these two volumes tends to emphasize a remarkable similarity in the careers of Rowland and FitzGerald. Each was the son of a clergyman; each was a physicist by nature in spite of all educational influences that might have led his thoughts along other lines; each was in the van of the great progress in physical science of the last thirty years; each was a vigorous champion of the laboratory method in scientific studies; each advocated in the strongest terms the merits of pure re-