

THE BIOLOGICAL LABORATORIES OF THE PACIFIC COAST

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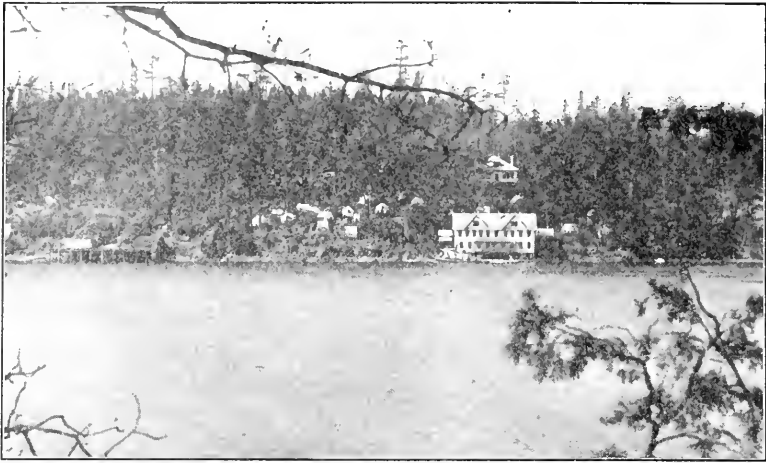
THE study of marine botany and zoology has gained a foothold on the Pacific coast of the United States in the brief period during which biology has been institutionally naturalized in this part of the world, that promises well for the future.

Seaside laboratories have been established at three main centers of population: at Puget Sound, in central California, and in southern California. At the extreme north the University of Washington, in cooperation with several other institutions, has a laboratory at Friday Harbor on San Juan Island. In central California the Timothy Hopkins Laboratory on Monterey Bay, belonging to the Leland Stanford Junior University, has now been in operation for twenty-three years; and near by is the Herzstein Laboratory owned by the University of California. On the coast of southern California are the Scripps Institution for Biological Research at La Jolla, near San Diego, securely founded because permanently endowed, and in the vicinity of Los Angeles laboratories at Venice and Laguna Beach are manfully striving toward permanency. The Scripps Institution is a research department of the University of California. The laboratory at Venice is being fostered by the University of Southern California and that at Laguna Beach by Pomona College.

With this bird's-eye view of what the country's long western sea frontage presents in the way of effort to turn to intellectual account the riches of life of this part of the Pacific ocean, we may proceed to a somewhat closer look at what is being done.

A student of marine life who has considered the geography of Puget Sound even from afar, does not need to be told that it is a great, richly stocked aquarium of both animals and plants. Almost completely land-locked though sufficiently open at both ends to enable the water to flow through it with each run of tides, beset with innumerable irregular islands, and rock-shored everywhere, a piece of the sea could hardly be more ideally circumstanced for all kinds of organisms adapted to such conditions. For several decades the prodigality of life in the Sound has aroused the enthusiasm of naturalists, resident and visiting.

Credit for the first efforts to create a laboratory for making use of this wealth of life is due to Professor Trevor Kincaid, of the University of Washington. After several years of preliminary collecting and reconnoitering by Professor Kincaid and his students, Friday Harbor was selected in 1903 as, on the whole, the most favorable place for a per-



PUGET SOUND MARINE STATION, at Friday Harbor, San Juan Island, Washington.

manent laboratory. This salmon-cannery hamlet of a few hundred people situated on the eastern side of the large, partly agricultural San Juan island, is distant from Seattle about four or five hours' run for the small steamers which constitute the transportation system of the islands of the Sound. That the natural conditions of this location are good for the kind of work which the laboratory aims to do, there can be no doubt. The distance from the mainland ports is something of an inconvenience, but the isolation would seem to be a perpetual security against contamination of the water by a large city and much shipping; and this is a consideration of great importance for such a laboratory.

For a number of years the station went through the experience familiar to such undertakings, that of playing cuckoo so far as housing is concerned. In this instance the alien home was an abandoned salmon cannery.

But the persistence and enthusiasm of Professor Kincaid and his colleagues finally bore fruit to the extent of a four-acre piece of land, the gift of Captain Newhall, of Friday Harbor, as a permanent site; a new laboratory building about seventy-five by thirty feet in floor area, two stories high; a mess house about forty feet square; and forty-five platform tents for living quarters. The buildings were provided by the University of Washington on money appropriated by the state legislature. The laboratory proper situated at the very water's edge, indeed, partly over the water on piles, is at the foot of a beautiful wooded bank that reaches up one hundred feet or more at an angle of full forty-five degrees from the back door of the building. The first floor of the laboratory is mostly one large room in which are the salt-water aquaria and facilities for experimental work of various sorts. On the second floor are nine private workrooms and a large room thirty

feet by thirty feet which is used for various laboratory and other purposes. Besides the work space in the laboratory building a laboratory for botanical study has been fitted up in the basement of the commons building.

The station owns a fleet of a dozen row boats, but as yet no power boat, dependence been placed so far on hired boats for the heavier bottom collecting.

This station stands alone among its kind on the Pacific coast in aiming to be intercollegiate in constitution and maintenance. While, as already indicated, the "plant" has been furnished by the state, and is owned by the university; and while the state is at present supplying nearly all the maintenance funds, about \$3,000 a year, a system of co-operating institutions is nevertheless being worked out. At present the Universities of Kansas and Oregon and the Washington State Normal School at Billingham are, I believe, the only institutions in the partnership, but the plan is being earnestly pushed and other schools and colleges, notably Reed College of Portland, Oregon, seem likely to enter.

So far the laboratory has not aimed at much beyond formal instruction and general information-getting on the part of those who assemble there; and sessions have been restricted to a few weeks in the summer. The session of 1913 saw an attendance of about one hundred teachers and students, these being drawn from a wide area of the northwestern United States. This considerable number may be taken to indicate the reality of the demand for opportunity for this kind of study in this region. No doubt this demand will increase and will soon expand to include advanced specialized studies and genuine investigation as well as elementary instruction and general information. Since the beginning of the session of 1914 Professor T. C. Frye, of the department of botany of the University of Washington, has been director of the station, Professor Kincaid having turned his interest and efforts in other directions.

Traveling down the coast from Puget Sound to central California, one finds the Timothy Hopkins laboratory at Pacific Grove on Monterey Bay belonging to the Leland Stanford Junior University. This is the pioneer among the marine laboratories on the Pacific coast, its life being practically coexistent with that of the university of which it is a part. It began its work in 1892, only about a year after the university opened its doors. It is also the most commodiously housed of the western stations, and, in keeping with its greater age and size, has furnished facilities to more biologists than any of the other Pacific coast laboratories.

About eighty students can be accommodated in the station's two buildings. There are four general laboratories, one lecture room, and

seventeen private laboratories for investigators. The buildings, of wood, are both two stories high, well lighted and amply supplied with running water, both salt and fresh. According to the directors, about seventy-five investigators have made use of the laboratory since its foundation and something like six hundred and fifty students of various grades have received instruction. Regular class instruction is given each summer by university professors from the departments of zoology, botany and physiology. Although the buildings are not formally open during the rest of the year, investigators are usually able by special arrangement to get the use of the laboratories at almost any time.

The laboratory was a gift of Timothy Hopkins, of Menlo Park, Calif., but is dependent on the university for maintenance funds, library, and equipment. Students who receive class instruction pay fees, the money derived from this source being applied to the running expenses of the institution.

Professors C. H. Gilbert and O. P. Jenkins, of the departments of zoology and physiology, respectively, have been from the beginning joint directors of the laboratory, but the courses of instruction have been mostly given in later years by the younger men of the university, Professors Harold Heath, F. M. McFarland and W. B. Price having been especially faithful and efficient in this capacity.

Pacific Grove is an exceedingly advantageous location for a marine station, particularly one with the aims which the Hopkins laboratory set for itself; namely, those of providing facilities for investigations on littoral animals and plants and those inhabiting the bottom in relatively shallow waters; and of giving instruction to elementary students.

So far as the writer's somewhat extensive observations on the Pacific littoral of North America has gone, no other point on the whole coast, with the possible exception of Yakutat Bay in southeastern Alaska, has a rocky shore fauna and flora of greater luxuriance, whether as to individuals or species, than has the southern shore of Monterey Bay. This richness of life, taken along with the accessibility of the locality from a populous center, and the all-year-round congeniality of the climate, has made the Hopkins laboratory an important factor in the promotion of biological science in this part of the country. It is greatly to be hoped that at no distant day the laboratory will become possessed of sufficient funds to enable it to be fully prepared to receive investigators and students at any time of the year, and not be obliged to restrict its activities so largely to the summer months.

The Herzstein laboratory, also at Pacific Grove, is quite different in aim and scope of activities from the Hopkins. It was a gift to the department of physiology of the University of California by Dr. Morris Herzstein, of San Francisco, the primary purpose of which was to provide a sea-side working place where Professor Jacques Loeb could prosecute certain of his investigations.

In keeping with the relatively simple technic of the studies which have made this biologist famous, the Herzstein laboratory is small and inexpensive. It is a plain, one-story wooden building, about forty-five feet square, divided into three fairly good-sized rooms, two small store rooms and a dark room. It is provided with an alternating electric current, and running fresh water, but not with gas or salt water. The small quantities of sea water needed are brought to the laboratory from the nearby sea by hand. A good supply of glassware for experimentation on simple animals is always on hand.

As already indicated, the laboratory is operated in close connection, so far as research is concerned, with the department of physiology at Berkeley. No provision is made or is hardly possible for formal instruction or for any considerable number of investigators, or for much range of investigation.

At present Professor S. S. Maxwell, as head of the department of physiology, also has charge of the laboratory. Professor Loeb's use of it has not ceased, although he has severed his connection with the University of California. He has spent considerable time at Pacific Grove during the last two years.

Going on down the coast to southern California, the undertakings at Venice and Laguna Beach must first be noticed in following the geographical order of treatment. Although, as intimated in the opening paragraph, these have not attained a strong and permanent existence, they have been useful as adjuncts to the teaching facilities of the colleges to which they belong, the University of Southern California, and Pomona College. The Venice Station possesses a power launch of sufficient size and equipment to make possible a good amount of collecting at sea. The director of the station is Albert B. Ulrey, professor of zoology in the University of Southern California.

The suggestion may be ventured here that the California coast south of Point Conception ought to have one good teaching sea-side laboratory which should have the support of all the schools and colleges in the south. We biologists of the southwest must, I think, allow that we are aspiring less wisely than are our colleagues of the northwest in the very important matter of promoting sea-side studies by young men and women.

The Scripps Institution for Biological Research being situated at the extreme southern end of the Pacific coast line of the United States must accept last place in this survey.

A somewhat full account of this station was published by the writer in 1912,¹ and the accessibility of this makes an extended statement here superfluous.

¹ "The Marine Biological Station of San Diego, Its History, Present Conditions, Achievements and Aims," Univ. of Calif. Publ. in Zool., Vol. 9, No. 4, March 9, 1912, pp. 137-248.

Though privately founded and for some time without organic connection with any other institution, its property and endowment were deeded to the regents of the University of California in 1911, thus making it a department of the university.

The main elements in its physical being are 177 acres of land with a half mile of ocean front in the city of San Diego about two miles north of the suburb of La Jolla; a fireproof reinforced concrete laboratory building 47 by 74 feet, two stories high; a 20,000 gallon concrete tank for sea water with tank house; thirteen cottage residences, one of which is a commodious two-story structure; one carefully planned and well-built animal house for experimental breeding; and an eighteen-ton motor boat, the *Alexander Agassiz*, equipped for biologic and oceanographic work at sea.

The laboratory contains twelve individual research rooms, six of which are furnished with aquaria constructed of concrete, iron and plate glass. There is also a general aquarium room with concrete tanks and glass aquaria.

A room 40 by 32 feet on the second floor contains a well-displayed collection of the marine life of the San Diego region. On the first floor in a combined collection and reagent room are arranged several thousand bottles of research collections, chiefly of pelagic organisms.

The library, consisting of about 3,500 bound volumes and a much larger number of pamphlets, occupies three rooms on the second floor, one of which serves as a journal and reading room. The books are fully classified, catalogued and arranged, and as the number is increasing rapidly the library is becoming a fairly good one for the kinds of investigation prosecuted by the institution. The university library at Berkeley still has to be called on, however, for many works, particularly when studies which fall outside the program of the institution are being carried on.

At present the institution has an annual income of about \$20,000, \$10,500 of which come from the Scripps endowment, \$7,500 from the state of California, and the balance from miscellaneous sources, chiefly rentals.

The staff consists of four resident investigators, three of whom are biologists and one an oceanographer; a business manager who acts also as master of the *Agassiz*; a scientific secretary who serves likewise as assistant librarian; an engineer and keeper for the *Agassiz*; and a helper for the buildings and grounds. In addition, there is a non-resident contingent of the research staff consisting at present of four biologists. These are able by reason of their vocations to be in La Jolla only at irregular intervals and for short periods, but are regularly engaged upon the institution's program. They receive fixed compensations for their work.

The brief statement to be here made about the policy of this institution will be facilitated and possibly rendered more interesting by putting it in the form of a trenchant comparison between the two exclusively research stations of the Pacific coast; the Herzstein laboratory at Pacific Grove and the Scripps Institution.

For full two thousand years there have been among the inquiring two conceptions or faiths about the nature of the world, particularly the living part of it, that stand over against each other with a sharpness and apparently irreconcilable antagonism which, seen in their fullness, are highly poetic as well as profoundly scientific. These two conceptions flow from the university experience of the unity, on the one hand, and the diversity, on the other, of nature. Because of the first some men have conceived that at its core nature is One and Simple; and with an irresistible faith they have sought to penetrate to the single essence or substance held by this philosopher to be Spirit, by that Matter, the grasping of which should constitute the discovery of the great mystery of existence.

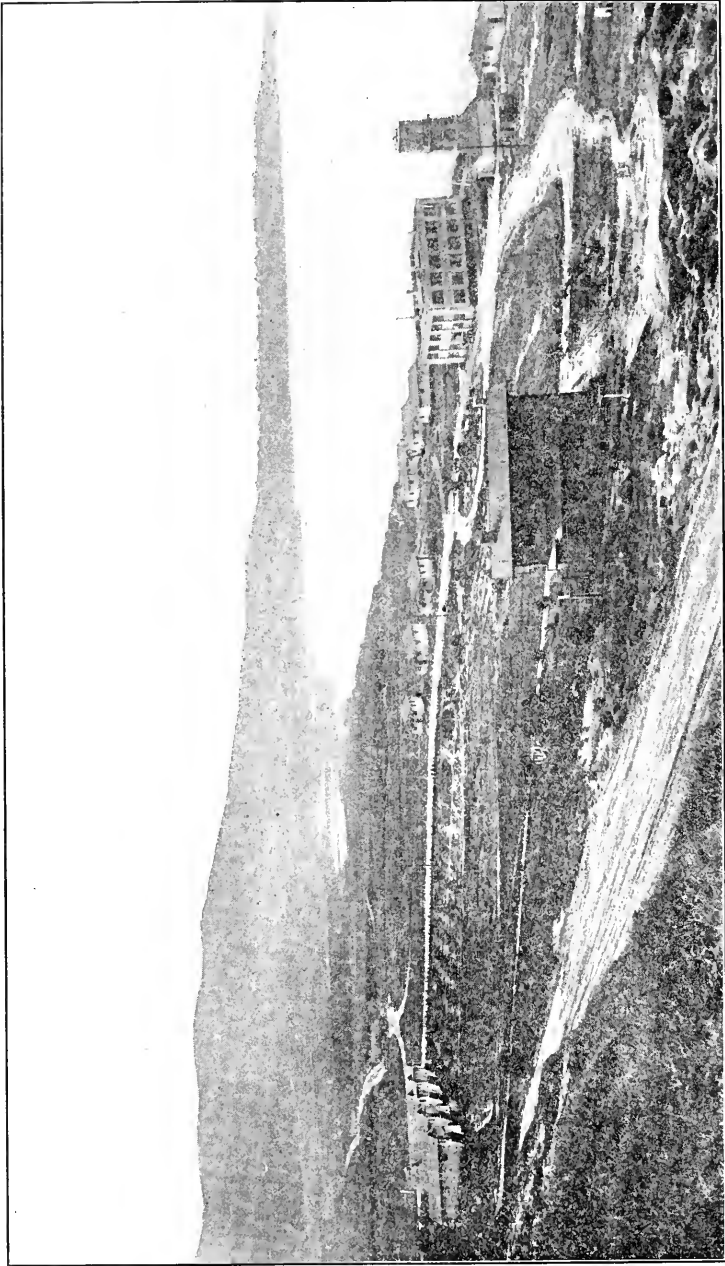
This kind of faith has found no finer expression in the modern era of all-pervading scientific analysis than in Tennyson's

Flower in the errannied wall,
I pluck you out of the errannies;—
Hold you here, root and all, in my hand,
Little flower—but if I could understand
What you are, root and all, and all in all
I should know what God and man is.

The distinguished scientist whose investigations the Herzstein laboratory was built primarily to further would probably agree that were his ultimate biological ideas and aims to be expressed in the poet's way, these lines would need as little alteration as any that could be found. He might wish to have the first line so altered as to give the flower's place to the sea urchin: and would probably want "God" replaced by "Mechanism" or some term which disguises its anthropomorphism as effectually. But the great basal idea ". . . if I could understand What you are . . . all in all, I should know what God and man is," would presumably need no alteration.

And why should not devout chemico-physical biologist and devout theist alike have each his unflinching faith in substance. One or at most very few. All-pervasive. All-potent. Eternal? For has not each in his own sphere and his own way discovered to the deepest depths of his nature a few mighty realities underneath the vast, bewildering maze of phenomena?

No one can look upon the simple laboratory under the pine trees at Pacific Grove and contemplate the idea for which it stands without seeing true grandeur in its simplicity.



THE SCRIPPS INSTITUTION FOR BIOLOGICAL RESEARCH, AT LA JOLLA, CALIFORNIA; LOOKING SOUTHWEST ACROSS LONG BEACH TO LA JOLLA.

But is the oneness of the world with its demonstrably underlying few substances and forces, whether these be held to be material or spiritual, more real than the diversity of it? Surely it is not so far as the every-day lives of every-day people are concerned. And the view that science is common sense refined and systematized withstands all objection. The fisherman's Albacore endures whatever test of reality may be applied to the biologist's sea urchin eggs or anything contained in them. It is impossible to define any given specimen of living substance so as to ascribe to it ultimateness without ascribing ultimateness to the living animal itself to which the specimen pertains if the same rules of defining be adhered to throughout. But if every part of the living world is as real and as ultimate as any other part, it is futile to expect to fully understand some portions of it by knowing other portions of it. The theory that any amount of understanding, even complete understanding, of a flower or a sea urchin would give complete understanding of man, to say nothing of God, is contrary to the fundamental nature of things and of knowledge. Nor, speaking chemico-physically, can any amount of understanding of the substances of which an organism is composed give complete understanding of the organism itself.

Vastly contributory to the understanding of organic beings as are chemico-physical investigations upon them, indeed impossible though it is to gain exhaustive knowledge of them in any aspect of their lives without such investigations, every truly vital chemico-physical problem of organisms is two phased: how do the chemico-physical attributes of the constituent substances act upon and so explain the organisms; and what particular structures and activities are the chemical substances caused to manifest by being constituents of and used by the particular organisms?

And so it is revealed that the familiar dictum "all life is one" must not be understood to mean that living nature has *only one life*; but rather that there is some thing *in common* among all the myriad things that live, namely, the half dozen, less or more, chemical simples now known to compose a living being. The diversities of living nature are, consequently, as "ultimate problems" as are its uniformities; and the biological institution which should set for its goal final solution of the problems of the organic world would be vast and complex and costly beyond any thing yet created or likely to be.

The administrative body of a research foundation in biology which should so understand biology would always have before it this compound question: what particular subject or group of related subjects at this particular time, in this particular locality, and under existing limitations of resources would best be investigated?

The Scripps Institution conceives its purposes in this way, at least while its present director stands as spokesman of its purposes. Just

now its small resources are being devoted to certain aspects of the mode of life of organisms in nature; to the nature and relationships of natural races; and to the influence of natural environments upon organisms, particularly as to the heritability of such influences. No other subjects are, in the belief of the management, of greater moment to present-day biology, and various circumstances make their study by the institution peculiarly practicable. But the managing board have no delusions as to the uniquely "burning" character of the questions under investigation, or as to its having reached the threshold of the Ultimate Mystery of Life and Death. Its profound belief in the importance of biologic truth to the welfare of humankind is of such sort that it knows that many other problems being studied by many other men and other institutions are no less vital than those engaging its efforts; and that problems of to-morrow, next year, next decade, next century, while different from those of to-day, will be no less numerous and no less insistent than those of to-day. It holds every item of positive knowledge of the living world essential to the scientific interpretation of that world; that such interpretation alone can beget a right attitude toward that world; and that the high level of man's development which we call civilization is wholly dependent upon a right attitude on the part of the largest number possible of the community toward all things that live.