

The Role of T. Wayland Vaughan in American Oceanography

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1 Introduction

A request to study reef corals in Florida turned T. Wayland Vaughan into an oceanographer.

The Florida program, under the auspices of the U. S. Geological Survey and the Carnegie Institution of Washington from 1908 to 1915, gave Vaughan what he called "a splendid opportunity to study certain problems in marine sediments." Chemical analyses of the sediments and of seawater and investigations into the role of bacteria in the precipitation of calcium carbonate were carried out, as well as Vaughan's detailed studies of coral reefs and the ecology and physiology of coral organisms. He later said (Vaughan 1929a) that the establishment of the Committee on Sedimentation in the Division of Geology and Geography of the National Research Council was a direct outcome of the extensive Florida project. This committee was chaired by Vaughan from 1919 to 1923; among its achievements was publishing W. H. Twenhofel's "Treatise on Sedimentation."

On the opposite coast of the United States in 1922 William E. Ritter, the founding director of Scripps Institution for Biological Research, was facing retirement. He observed (Ritter 1922):

A rather wide circle of scientific men in America are now convinced that the Institution we have developed on the coast of Southern California ought to be treated as a nucleus for an oceanographic institution worthy of the magnitude of oceanographic problems of the largest ocean now on earth and one of the richest countries on earth.

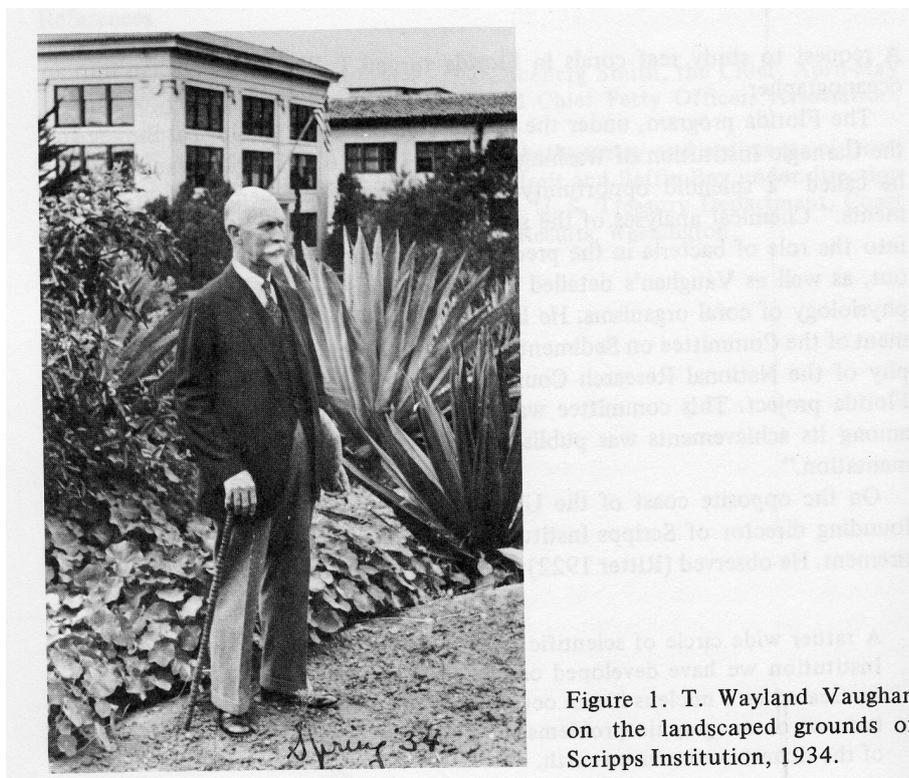


Figure 1. T. Wayland Vaughan on the landscaped grounds of Scripps Institution, 1934.

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In that circle was T. Wayland Vaughan (Fig. 1), who served with Ritter on the Committee on Pacific Investigations of the National Research Council. That committee, among other achievements, established the first Pan-Pacific Scientific Congress (later called Pacific Science Congresses). Ritter urged University of California authorities that Vaughan become his replacement at Scripps Institution, and that the scope of the institution should become wholly oceanographic. Among Vaughan's conditions of acceptance were that he be allowed to carry out certain of his own oceanographic studies, that investigations at Scripps be extended to include chemistry, bacteriology, and marine sediments, that "efforts be made to work in coordination with other interested individuals," and.

Vaughan also advanced the Scripps Institution of Oceanography to the foremost rank and simultaneously helped to create a national program in oceanography. His approach was to expand the scope of oceanographic researches at Scripps, to work in cooperation with many sea-going agencies, and to participate in ocean-oriented committees.

2 Vaughan's Program at Scripps Institution

In 1924 the staff of Scripps Institution consisted of the director, two associate professors, an assistant professor, a postdoctoral researcher, an aquarium-museum curator, three students, two laboratory assistants, a business manager (who soon resigned), a superintendent of buildings and grounds, and a secretary who was also the librarian. Associate professor George F. McEwen was a physicist; the rest of the academic staff were biologists. To Vaughan, a geologist, it did seem that turning the biological station into an oceanographic institution would take a long time. Scripps had even sold its only research vessel, *Alexander Agassiz*, seven years earlier. However, appreciable basic marine biological research essential to the broader concept of oceanography had been initiated by Ritter.

Vaughan promptly started his search for additions to the small staff in the fields that he felt were necessary to broaden the oceanographic studies. He queried colleagues for suggestions, and he moved slowly so as not to disrupt the sensitivities of the "biological colony," most of whom lived on campus.

Finding a chemist was easy, as Erik G. Moberg was then a graduate student at Scripps, already carrying out a program in marine chemistry. He was continued on the staff when he received his Ph.D., as Vaughan thought highly of him from their first meeting. This resolved a debate that Vaughan was having with himself: whether to select as new staff members "men who had already achieved high reputations," or "young men who are already interested in investigations planned for the Scripps Institution and who have shown promise" (Vaughan 1923c). He adopted the latter course. Some of those promising young men have shown great endurance: physiologist Denis L. Fox and microbiologist Claude E. ZoBell joined the staff in 1931, and invertebrate zoologist Martin W. Johnson in 1934. They are now professors emeriti at Scripps, but still active.

The meteorological studies of George F. McEwen appealed keenly to Vaughan, and this program was soon expanded. As a member of the National Research Council's Division of Geology and Geography, Vaughan had been much impressed in 1922 with McEwen's proposal: "Suggested Schedule of Oceanographic Research in the North Pacific, with Special Reference to the Problem of the Relation between Ocean Temperatures and Precipitation in Western North America." At Vaughan's urging that year, the National Research Council's Committee on Pacific Investigations promptly arranged that temperature records from all lightships on the Pacific coast be sent to McEwen.

In the fall of 1924, not long after Vaughan had become director of Scripps, a representative of Southern California Edison Company proposed cooperation

with the Institution in the hope of acquiring improved rainfall forecasts. That inquiry led to conversations with officials of other utility companies, who responded with contributions to the "Special Meteorological Fund" at Scripps. Eventually 14 companies participated, throughout California, and the fund increased to \$15,000 annually. It paid the salaries of several assistants, and allowed for the purchase of considerable equipment (such as "Burroughs adding and subtracting machines"). Data on sea-surface temperatures were acquired from shore stations from La Jolla to the Columbia River, from thermograph records taken by commercial steamships, from Navy ships and from Coast and Geodetic Survey ships. McEwen issued rainfall forecasts annually to the participating companies, and to farm advisory services and newspapers. His forecasts were based chiefly on sea-surface temperatures, and he estimated them to be 70 to 80% correct. The support from utility companies was brought to an end in 1931 by the depression, but McEwen's program continued with other support until the beginning of World War II.

The means of acquiring data for McEwen's work was characteristic of Vaughan. Cooperation with other agencies was necessary and desirable, especially as his institution was scarcely able to gather oceanographic data alone. In 1925 Vaughan did acquire a "boat"—a 64-foot purse seiner for sale following customs violation. This was the *Scripps* (Fig. 2; not the schooner *E. W. Scripps* given to the institution in 1937). Vaughan optimistically estimated that on it trips could be made to several hundred miles offshore and "certainly from Panama to British Columbia." Not so. The *Scripps* was, however, used frequently from Point Conception to the Coronado Islands and out to Cortez Bank. It was Vaughan's avowed inten-



Figure 2. The boat *Scripps* acquired for the institution in 1925 by Vaughan.

tion to have "virtually all the students working at the Scripps Institution spend a certain amount of time on the Institution's boat" (Vaughan 1928c). The "virtually" did not exclude women, who did go to sea on *the Scripps*.

Vaughan's philosophy on oceanic expeditions was summed up in a letter to Ellen B. Scripps' agent, J. C. Harper (Vaughan 1925a):

. . . within a few years the Institution should undertake extensive expeditions so as to supplement the oceanographic data and collections which are now coming to the Institution from a number of different sources. The expense of such an expedition may be roughly placed at \$50,000. Since field work is intended to obtain both data and materials for study, interpretation, and publication, expeditions should not be undertaken more frequently than will permit the adequate working up in the laboratory and office of the data and materials collected and preparation of reports on the results. From past experience expeditions should be undertaken about once in four years.

But material for oceanographic study could come from many other sources. As early as the fall of 1924 Vaughan (1924c) reported to University President W. W. Campbell these cooperative efforts: The U. S. Coast and Geodetic Survey steamships *Guide* and *Pioneer* were supplying Scripps with water, plankton, and bottom samples throughout the year; the Survey had installed a tide gauge on the Scripps pier; the Carnegie Institution was about to install a seismograph on the campus; the U. S. Geological Survey was making chemical analyses of bottom muds for Scripps; the U. S. Bureau of Soils was carrying out mechanical analyses of those muds; the U. S. National Museum had donated foraminifera specimens; the Bureau of Lighthouses and Hopkins Marine laboratory were collecting water samples and plankton samples from two of its expeditions in conjunction with the U. S. Navy; and Vaughan was about to negotiate cooperative work with Navy himself.

By the next year he had the U. S. Battle Fleet gathering hourly temperature records and some water samples for Scripps from its exercises from California to Hawaii and Australia. By 1927 Navy ships were providing similar data from off western South America, and, through the arrangements of U. S. Naval Intelligence, so were ships of the Peruvian Navy. Also in 1927 three steamship companies began sending sea-surface temperature records from along their routes across the Pacific. All these agencies continued such collections for the Institution for many years, using thermometers and bottles routinely provided to them by Scripps. Soon institution staff members began riding ships of the Navy, the Coast and Geodetic Survey, and the California Fish and Game Commission to gather data directly.

The cooperation was not one-sided. Officers of the Coast and Geodetic Survey felt that they were receiving equal value for their efforts, in the salinity determinations carried out for them by Scripps, which were used "in the determination of the rate of propagation of sound waves through the water and in the standardizing of the sonic method of the determination of depth" (Vaughan 1924a). Vaughan acknowledged the Coast Survey's cordial thanks in 1928, and

simultaneously asked it to survey the Scripps Submarine Canyon for him, which it did from the Institution's boat.

Vaughan's primary advantage during his Scripps years was his wide circle of acquaintances in Washington. Commissioner of Lighthouses George R. Putnam was an old acquaintance; E. Lester Jones of the Coast and Geodetic Survey was very much interested in oceanographic observations. Vaughan retained his contacts with the U. S. Geological Survey and the U. S. National Museum. He was a member of the National Academy of Sciences from 1921, and he regularly attended its spring meeting in Washington, at which he arranged conferences with other ocean-interested scientists.

"Besides looking after the general affairs of the Institution and doing what I can to stimulate oceanographic investigations in the Pacific, I must do some research work myself wrote Vaughan (1927c). He continued at Scripps his researches on corals and the larger foraminifera, on which his fundamental studies are considered major contributions in taxonomy and stratigraphy.

His new special interest was in marine sediments—"my beloved bottom muds," he once called them (Vaughan 1924b). "What I am trying to do," he wrote to Captain W. E. Parker of the Coast and Geodetic Survey, "is to build up a sufficient collection of marine bottom deposits to make possible the mapping of the deposits on the bottom of the Pacific Ocean off the west coast of America from Alaska to the Canal Zone" (Vaughan 1927b). In all modesty he intended to share this project with W. H. Twenhofel, who was to receive all samples from north of Puget Sound. On one occasion Vaughan reported with great pleasure to the University President that the U. S. National Museum had donated to Scripps two vials of radiolarian ooze—had in fact "generously divided" its small collection thus, and so had made the Institution's "representation of modern deep sea deposits complete except for one kind which I hope later may be added" (Vaughan 1925b). By 1934 he noted with pride that the Institution had "over one thousand bottom samples from the Pacific Ocean" (Vaughan 1934).

The most extensive oceanographic exploration planned under Vaughan's direction was to have been on the *Carnegie* following the completion of that ship's work for the Carnegie Institution of Washington. Erik Moberg worked out, with Captain James P. Ault, a detailed 18-month program on a course throughout the eastern Pacific, after Moberg had sailed on the *Carnegie* during August and September of 1929. This program was dashed by the tragic loss of that ship and her captain in Apia, Western Samoa in November, 1929. Scripps Institution received seawater samples and marine bottom samples from the *Carnegie* and some of the ship's collecting equipment. A nominal plan was begun for using the tiny *Scripps* to explore the vast Pacific Ocean, but the idea was soon abandoned.

As the depression deepened, the Institution's finances were affected, and Vaughan was unable to carry out several of his hopes. He had wanted to increase the annual income of the Institution to \$100,000 (from the \$45,000 when he arrived), and he did raise it to approximately \$85,000 by 1936. He came close to getting a new ship from Robert P. Scripps, but that was not carried out until 1937. Vaughan hoped to build a "moderate-sized permanent

aquarium" and an oceanographic museum; that building was finally completed in 1950, and was appropriately named for T. Wayland Vaughan. Another of Vaughan's goals was a national journal of oceanography, but that too came later. In the meantime he was able to encourage the use of the already established *Bulletin* of the Scripps Institution for publications by staff and visiting investigators.

3 Vaughan's Programs beyond the Institution

The oceanographic committee of accomplishment in the 1920s and 1930s was the Committee on Oceanography of the National Academy of Sciences, which served from 1927 to 1938 under the chairmanship of Frank R. Lillie. Minutes of the meetings indicate that negotiations had begun between Lillie and Wickliffe Rose of the (Rockefeller-sponsored) General Education Board prior to the establishment of the committee and specifically for founding an oceanographic institution on the east coast.

Vaughan was an active member of this committee, for both altruistic and selfish reasons. He favored an east-coast "competitor," and assured University President W. W. Campbell that "it would be ten years or even more before the institution on the Atlantic could catch up to where the Scripps Institution now is" (Vaughan 1929b).

His altruistic aim, often recognizable in the wording of the committee's minutes, was to create a national program in oceanography, to overcome what he and others felt was "the relative backwardness of the United States in the study of oceanography" (National Academy of Sciences 1938).

If an institution of the kind indicated can be started [wrote Vaughan (1927d) to Lillie] I think that it will then become practicable to bring into more or less concerted efforts the activities of the different marine stations and of a number of the governmental organizations, such as the Navy, Coast and Geodetic Survey, Bureau of Lighthouses, Bureau of Fisheries, and International Ice Patrol.

One effort of the committee, Vaughan felt, should be

to get support for the keeping of marine laboratories open for research purposes during the entire year, and to endeavor to have the scope of the marine laboratories extended beyond the biological field and take into consideration numerous problems of physical oceanography and of the chemical properties of sea-water (Vaughan 1927a).

To biologist Henry B. Bigelow, Vaughan (1928b) commented:

I am inclined to the opinion that one of the handicaps from which oceanography has suffered is that it has been considered too much either from the

standpoint of biology or fisheries. [Harald U.] Sverdrup . . . expressed an opinion virtually the same as this.

An early action of the committee was to appoint Henry B. Bigelow secretary, for the purpose of preparing a report on the status of American oceanography. Bigelow's report, "Oceanography: Its Scope, Problems, and Economic Importance," was published by the committee in 1931, and Bigelow soon was appointed a full member of the committee.

As it became obvious that, through the action of the Committee of Oceanography, the Rockefeller Foundation would provide one million dollars to found Woods Hole Oceanographic Institution, Vaughan (1929c) commented to Lillie:

I certainly hope that the Pacific side of the country is not going to be left out of the running. As you know I wish the Institution with which I am connected strengthened and I think that additional consideration should be given both to the Pacific Grove group and those at the University of Washington.

The Atlantic side received the lion's share of the Rockefeller contributions: the endowment of Woods Hole Oceanographic Institution, and £50,000 to the Bermuda Biological Station. On the Pacific side the University of Washington received "a liberal contribution" for a laboratory building and a research boat, which established the Oceanographic laboratories at that university and Scripps Institution of Oceanography received \$40,000 toward its second laboratory building, Ritter Hall.

The committee then turned to Vaughan for another summary report, on the status of international oceanography. At its expense Vaughan took a round-the-world tour of Oceanographic agencies from September 1 of 1931 to April 1 of 1932, and in 1937 the committee published "International Aspects of Oceanography" by Thomas Wayland Vaughan and others. The committee then recommended its own dissolution. (Other committees on oceanography of the National Academy of Sciences existed prior to and following this one.)

Vaughan was well qualified for undertaking the international study, for he had been participating in those circles since 1920. He was a delegate to the first six Pacific Science Congresses. The second was in Australia in 1923, before he assumed the director's post at Scripps, and after it he wrote to George F. McEwen (Vaughan 1923b):

While in Australia I succeeded in having first the Section of Geography and Oceanography and then the general Congress pass a resolution looking toward a cooperative study of the surface temperatures, salinities, hydrogen ion concentration, and currents of the Pacific, particularly of the northern Pacific . . . I did this largely for the purpose of bringing out and strengthening the investigations you have been making in physical oceanography and the relation of oceanic conditions to continental meteorology.

At the third Congress (Japan, 1926) was established the International Committee on the Oceanography of the Pacific, of which Vaughan served as chairman for ten years. This committee, according to Thompson (1958, p. 404), "not only enormously stimulated oceanographic research in the Pacific, but it became a medium whereby the different oceanographic organizations of the Pacific Basin could coordinate their efforts." As organizing chairman Vaughan devoted considerable correspondence to lining up committee members from the many countries bordering or colonizing in the Pacific.

Deciding whether to attend the fourth Congress in Java in 1929 put him into a quandary. In present days of jet-set scientists, one must be reminded that in 1929 a minimum of three *months* was required to make the round trip from California to Indonesia. Vaughan wondered whether he should be absent from his campus that long, and, as he observed to University President Campbell (Vaughan 1928a): "My personal scientific research work has been seriously interrupted because of the time that I have devoted to attempts to promote and organize oceanographic research." He was soon persuaded to attend, however, by his appointments as a delegate from the University of California, the Carnegie Institution of Washington, the American Association for the Advancement of Science, and the National Academy of Sciences. The Committee on Oceanography of the National Academy contributed to his expenses, and urged him to visit oceanographic agencies throughout the Indo-Pacific region. Vaughan set aside his own researches and enjoyed the four-month trip.

In fact, he obviously enjoyed his expanding acquaintance with oceanographers in other countries. Among his personal interests were Oriental art and gardening, subjects that he often discussed with colleagues whom he had met through oceanography. Some of the plants that he set out during his extensive planting program on the Scripps campus came from seeds sent by those colleagues.

4 The Results of Vaughan's Efforts

There were setbacks to Vaughan's hopes while he was director of Scripps Institution, mostly because of the depression. Also, during the latter half of 1934 Vaughan underwent a slow recovery from pulmonary tuberculosis. But there were many bright moments: his pride in McEwen's meteorological program, the cordial cooperation that he found in many oceanic agencies, the new laboratory building, the much improved landscaping on the formerly bleak campus, and the caliber of the institution's students.

Vaughan devoted considerable time to the handful of students then at Scripps, in their acceptance and in their preparation for a career in oceanography. Those students were truly research assistants in his mind. Vaughan took a particular interest in one recommended to him in 1931 by George D. Louderback to work on the marine bottom samples collected by the *Carnegie*. The student prepared the long report (somewhat late), and then Vaughan got into a sharp exchange

with the dean of graduate studies at Berkeley over the student having written a "thesis" before having been accepted for candidacy. So now, those of you who are acquainted with Vaughan's favored student—keynote speaker Roger Revelle—will not be surprised to find that even as a student Roger sometimes carried out big projects in reverse order, and not quite according to University of California procedure!

T. Wayland Vaughan retired from Scripps Institution satisfied that he had advanced American Oceanography, immediately after turning over the reins to his hand-picked successor, Harald U. Sverdrup, in the summer of 1936, Vaughan attended a meeting of the International Union of Geodesy and Geophysics in Edinburgh, as did several of the Scripps staff. He reported to Sverdrup (Sverdrup 1936):

There were more papers on the Pacific than on any other ocean . . . The Scripps Institution received many compliments. I was gratified to get an ovation when T. G. Thompson mentioned that I had attempted in developing oceanographic research in the Pacific. After Revelle had presented the last of the papers contributed by Scripps, the Institution was accorded a vote of thanks. Helland-Hansen repeatedly said to me that what has been done at the Scripps was 'most impressive.'

Under T. Wayland Vaughan's direction, Scripps Institution of Oceanography became oceanographic and internationally known.

Acknowledgments

Vaughan's correspondence is in the Archives of Scripps Institution of Oceanography, now under my care, so I owe a debt to earlier history-minded Scripps people who saved the material. The National Academy of Sciences courteously provided copies of minutes of the Committee on Oceanography. I thank Roger Revelle and Martin W. Johnson for reviewing the manuscript. Mrs. Caroline Vaughan Fortune gave the photo of her father to the Scripps Archives. The research was supported in part by a gift in memory of Margaret Scripps Hawkins, here gratefully acknowledged.

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