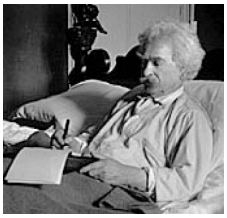
Chapter 3. The First Fifty Years of Marine Research at UH: 1907 to 1957

(http://modis.gsfc.nasa.gov)

"Hawaii is the loveliest fleet of islands anchored in any ocean"

Mark Twain
(1835-1910)



3.1. Hawaii's Natural Laboratory

According to a 16 February 1986 *The Honolulu Advertiser* article by Kay Lynch on the history of higher education in Hawaii, several schools were established after the missionaries arrived in 1820, including Lahainaluna on Maui in 1831 and Punahou School on Oahu in 1841; the latter was founded as Oahu College. At that time, Oahu College sponsored a two-year, pre-baccalaureate degree program that fed island graduates to various mainland institutions, though it never reached the level of higher learning that was originally envisioned.

In 1862, the Morrill Land Grant Act was signed into law by US President Abraham Lincoln. This act permitted states to apply for federal land grants, the proceeds of which could be used to support education. The land grant act facilitated the establishment of universities and colleges throughout the country, including the creation, in 1907, of a land grant college of agriculture and mechanic arts in the Territory of Hawaii. Because of the territorial status of Hawaii, UH never received a grant of land such as that provided for similar colleges in the United States under the original Morrill act, but it was still considered to be a federal land grant college and enjoyed the benefits of the second Morrill Act of 1890, the Nelson Amendment of 1907, and all subsequent legislation.

According to *The Honolulu Advertiser* reporter Robert Hollis, there was serious discussion at the meeting of the 1st territorial legislature in 1901 about where to site the first land grant college in the territory. Big Island legislators wanted to establish the "Territorial University at North Kona." Another proposal had the college in Lahaina, Maui, and still other legislators wanted the first college in their own home district. Again, according to Hollis, it was Wallace Rider Farrington, then editor of the *Honolulu Evening Bulletin* (and later, chair of the UH-BOR and territorial governor), who pulled the disparate proposals together and produced the plan for the creation of the College of Agriculture and Mechanical Arts in Hawaii, which gave the BOR the authority to select the site; the bill was unanimously passed by the legislature and signed into law on 27

March 1907 by territorial governor George Carter. The BOR selected lower Manoa as the location for the new college, but set up temporarily in the old William Maertens house at Young and Victoria streets, near what is now Thomas Square. Classes commenced on 14 September 1908. A plaque at the entrance to the old Linekona School (now the Academy of Arts) at 111 Victoria Street marks the original site of the college (Figure 3.1).

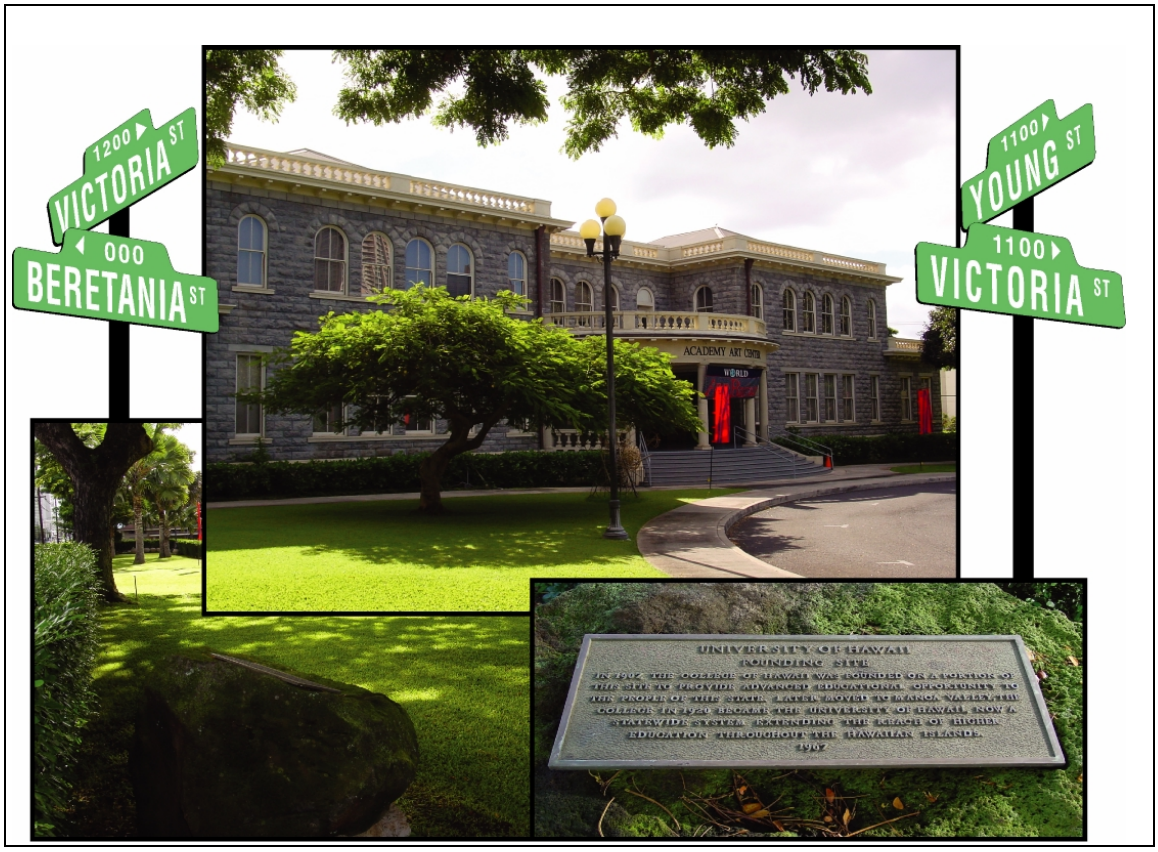


Figure 3.1: Plaque marking the site of the "new" College of Hawaii that opened for business on 14 September 1908. (Photos by D. Karl; collage design by N. Hulbirt).

In 1911 the name changed to the College of Hawaii and in 1912 the college moved to Manoa Valley and was eventually housed in Main Hall (note: Main Hall became Hawaii Hall in 1922). In 1919 the territorial legislature passed an act that transformed the College of Hawaii into the University of Hawaii with the addition of the College of Arts and Sciences, and on 30 April 1919 Governor C. J. McCarthy added his approval to this change in status and stature, to take effect 1 July 1920. William Kwai Fong Yap spearheaded the campaign to transform the College of Hawaii into the University of Hawaii and for that reason is sometimes credited as "the father of UH" – others believe that designation should go to Farrington for his efforts to create the college in the first place. The campus took its present name, University of Hawaii at Manoa, in 1972 to distinguish it from other units in the growing state-wide university system. An excellent historical account of the first thirty years of UH (1907-1937), written by William George, is available in Hamilton Library (*The University of Hawaii: A Short History*, 1938).

From its beginning, UH has always had an academic interest in the sea. In August 1908, John Washington Gilmore was appointed the inaugural president of the new college. "Our teaching should be in accordance with our environment," said Gilmore; there should be a logical focus on agriculture and marine sciences. According to the *College Records* No. 6, February 1911 (note: In accordance with Act 24 – 1907 – that established the College of Hawaii, the Board of Regents was required to file periodic reports with the Legislature on matters related to a variety of academic affairs. These reports became known as the "College Records" beginning with No. 1 in 1908 and ending with No. 20 in 1920 when the College of Hawaii became the University of Hawaii. After that time, these same materials were contained in the "University Records" series and eventually in the University catalog which is still published today.), there was a formal proposal by College of Hawaii President Gilmore to establish a Marine Biological Laboratory as a branch of the Department of Zoology as early as 1910. It was stated that, "It is quite probable that if the college could make a beginning in this work, aid might be secured from the US Fish Commission." This vision was implemented a few years later. The establishment of marine research laboratories at pier 6 in Honolulu harbor in 1917 and in Waikiki in 1919 provided the facilities necessary to build new ocean-related programs (see section 3.6). The second College of Hawaii president, Arthur Dean, served from 1914-1927 and continued Gilmore's vision of Hawaii's potential as an out-of-doors natural laboratory with a focus on marine sciences, especially marine zoology.

The original seal of the College of Hawaii depicted a Pacific Ocean map showing Hawaii's central location and a view, through a ship's porthole, of neo-classical columns (Hawaii Hall?), Diamond Head, and the open ocean beyond (Figure 3.2). This nautical scene emphasized the connections between the new college and the potential role of the sea in future academic programs. Hawaii's strategic mid-Pacific location with easy access to the deep sea provided many unique educational and research opportunities. Just as in the retail sales industry, the three most important considerations for success are location, location, location! With the formation of the College of Arts and Sciences in 1919, the territorial legislature and academic administrators were actively promoting programs that focused on marine sciences as a wise use of Hawaii's largest untapped natural resource.

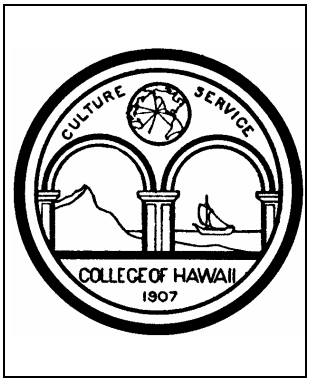


Figure 3.2: Original seal of the College of Hawaii, circa 1911. (from UH archives)

3.2. First US Interagency Conference on Oceanography: July 1924

"We made from water every living thing"

Koran

In 1923, Assistant Secretary of the Navy, Theodore Roosevelt, Jr., commissioned the US Navy's Experimental and Research Laboratory (predecessor to the Naval Research Laboratory). Later in 1924, Roosevelt invited the heads of various government agencies as well as the Carnegie Institution, the American Geophysical Union, and the National Research Council – National Academy of Sciences (see *Box 3.1*) to an oceanography planning meeting in Washington, D.C. on 1 July 1924; this event would become the "First US Interagency Conference on Oceanography."

Box 3.1: **National Academy of Sciences, National Academy of Engineering, and National Research Council**

The National Academy of Sciences (NAS) is a private, non-profit society of distinguished scholars who are engaged in research. According to their charter, the NAS serves "to investigate, examine, experiment, and report upon any subject of science or art" whenever called on by a department of the federal government.

From information provided on their website (http://www7.nationalacademies.org/archives/nasfounding.html), the idea that the US should have a national organization devoted to the promotion of science and technology began as early as 1743 when Benjamin Franklin founded the American Philosophical Society; 37 years later, the American Academy of Arts and Sciences was founded. Naturalist Louis Agassiz (see *Box 3.2*) was one of the leading proponents for the creation of the NAS, and he worked closely with US Senator from Massachusetts Henry Wilson to draft the legislation that was eventually passed on 3 March 1863. The act was signed into law by President Abraham Lincoln.

The academy is self-perpetuating; elected membership to the NAS is one of our nation's highest scientific honors. Today there are 1964 elected members and 327 foreign (non-American) associates representing a broad spectrum of scientific disciplines, from environmental sciences and ecology to geophysics. Currently, only two UH at Manoa faculty, emeritus astronomer George Herbig and emeritus cell biology professor Hampton Carson, are members of the NAS; reproductive biology professor Ryuzo Yanagimachi is a foreign associate of the NAS.

The National Research Council (NRC) was established by the NAS in 1916 (note: The NRC was established permanently by an executive order of President Woodrow Wilson in 1918) to engage the broader scientific and technical communities, beyond the NAS members, in science policy issues. Over the years, the NRC has become the operating agency for the NAS, facilitating information gathering and dissemination. The NRC has several independent boards, each of which deals with a specific discipline or specialty. For the field of oceanography much of the work is conducted by the present Ocean Studies

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Box 3.1: **National Academy of Sciences, National Academy of Engineering, and National Research Council (continued)**

Board and the Polar Research Board. Over the years, many UH at Manoa faculty have served on NRC boards and assisted the NAS in other ways.

In 1919, the NRC founded the American Geophysical Union (AGU) as one of its activities. According to an article on the "organization and aims of the American Geophysical Union (AGU)" by Louis Bauer (1923, *EOS* 4: 7-18), when AGU was founded in 1919, the term "mareology" was used to describe studies of the ocean (mare is the Latin word for "sea"). William Bowie was appointed the first chair of AGU in 1920. Later, in 1972, AGU became an independent organization. Today AGU is the largest international Earth and marine science organization in the world with over 40,000 members, including many UH faculty, several of whom are fellows of the AGU. George Woollard, the founding director of the Hawaii Institute of Geophysics (HIG), served a term as AGU president (see *Box 4.1*).

In 1964, the National Academy of Engineering (NAE) was established to acknowledge leadership in engineering sciences. The NAE operates under the same congressional act as the NAS. Currently the NAE consists of more than 2,000 peer-elected members and foreign associates. Former UH President Fujio Matsuda (see *Box 6.8*), former UH Dean of Marine Programs John P. Craven (see section 6.1), and two current UH engineers, Jaw-Kai Wang and Wai-Fah Chen, are NAE members.

The conferees recommended that an interdisciplinary expedition, termed the Maury Research Expedition (in honor of Lieutenant Matthew Fontaine Maury, a pioneer in naval oceanography) be planned and implemented. Henry Bryant Bigelow, the person who would later become a key figure in future planning efforts (see section 3.3), represented the US Bureau of Fisheries at the conference. Despite all good intentions, this planned oceanographic expedition got caught up in the politics and the scandals of the day; the Secretary of the Navy Edwin Denby and Roosevelt were both forced to resign in 1924 (Nelson 1980). Curtis Wilber, Denby's successor as secretary, favored naval air programs so the planned Maury sea-based program failed due to lack of appropriation and other support.

3.3. The US National Academy of Sciences Committee on Oceanography: 1927-1937

On 27 April 1927, the NAS (see *Box 3.1*) acted on the following resolution: "That the president of the academy be requested to appoint a committee on oceanography from the sections of the academy concerned, to consider the share of the USA in a worldwide program of oceanographic research, and report to the academy." Academy member Frank R. Lillie, then director of the Marine Biological Laboratory at Woods Hole (see *Box 3.2*), had requested the establishment of this new committee. With this request and subsequent committee action, Lillie had planted a major seed for oceanography. The Committee on Oceanography was established under the NAS Division of Biology and Agriculture, once again emphasizing the role of biological sciences in the emergence of the new discipline of oceanography. Thus began a benchmark event in the history of marine sciences in our nation.

Box 3.2: **Marine Biological Laboratory at Woods Hole: 1888-present**

Swiss-born naturalist, Louis Agassiz, one of the incorporators of the US National Academy of Sciences, established the Anderson School of Natural History on Penikese Island (near Woods Hole) in 1873. At that time, Agassiz was the director of the Museum of Comparative Zoology at Harvard University, an academic unit that he had created. In 1863, Agassiz became a founding member of the US-NAS (see *Box 3.1*). A few years later, in 1888, the Marine Biological Laboratory was founded at Woods Hole as an extension of the Anderson school. Although Louis Agassiz had passed away in 1873, his son Alexander Agassiz continued the tradition that his father had begun. A recently published book, *Agassiz's Legacy* by Elizabeth Higgins Gladfelter (2002) chronicles the work and the views of several Agassiz heirs.

In 1891, Frank R. Lillie – a marine zoologist from the University of Chicago – attended a summer course at the Marine Biological Laboratory; he would later serve as Director, then President, of the Marine Biological Laboratory and as President of the NAS from 1935-1939. One of the oldest laboratory buildings at the Marine Biological Laboratory, which houses the world-famous library, is named in Lillie's honor.

According to an article written by *Cape Cod Times* staff writer Paul Peters (http://www. capecodonline.com/ year2000/lillie06.htm), Lillie was much more than a brilliant scientist – he was a man with a clear vision for the future and well connected with the people and foundations with the money to make it happen. For this and other reasons, there was great interest at that time in the eventual recommendations of this high profile NAS Committee on Oceanography.

The academy president, Albert Michelson, accordingly appointed NAS members William Bowie (geodesist with the US Coast and Geodetic Survey), Ed Conklin (professor of biology at Princeton University), Benjamin Duggar (professor of physiology and economic botany at University of Wisconsin), John Merriam (president of the Carnegie Institution of Washington), and T. Wayland Vaughan (director of the Scripps Institution of Oceanography) to the committee; Lillie was appointed committee chair, and Henry Bryant Bigelow – the curator of oceanography in the Museum of Comparative Zoology at Harvard University – was engaged as secretary.

(note: According to the archives of Scripps Institution of Oceanography, Director Ritter's first choice for the new director of the Marine Biological Laboratory of San Diego was Bigelow, but he declined the position in 1922. A year later Vaughan accepted the position, and on 19 October 1925 Vaughan received notice from the UC Board of Regents that the name would be changed from Scripps Institution of Biological Research to Scripps Institution of Oceanography. Both Vaughan and the founding Scripps director, William Ritter, had trained at Harvard under the leadership of Alexander Agassiz, the son of Louis. This may explain the fact that two research vessels at Scripps were so named. The original R/V *Alexander Agassiz* was in service from 1907-1917, and the second from 1961-1976. It was then, and to some extent still is, a very small community of scholars in the field of oceanography.)

In 1931, after his election to the NAS, Bigelow was appointed a full member of the committee; Arthur Day (a geophysicist), another newly elected member of the academy, was later added to the committee. In July 1935, Frank Lillie became the president of the NAS and Bigelow succeeded him as chair of the influential NAS Committee on Oceanography. (note: A second NAS Committee on Oceanography, dubbed NASCO,

was formed in 1957; see section 5.1. These two separate committees had similar missions, namely to assess the status of the field of oceanography in the nation.)

The work of the NAS Committee on Oceanography was published in an academy report in November 1929, in a 263-page monograph, *Oceanography: Its Scope, Problems, and Economic Importance*, written by Bigelow and published by Houghton Mifflin Company in 1931, and in a 225-page monograph, *International Aspects of Oceanography: Oceanographic Data and Provisions for Oceanographic Research*, written by Vaughan and others and published by the NAS in 1937 (Figure 3.3). The former was the "official committee report" while the two latter "reports" were comprehensive assessments of the extant knowledge of the sea that were commissioned, partly, as a result of the 1929 Lillie Committee Report. These two monographs served as the background for the classic work *The Oceans: Their Physics, Chemistry, and General Biology* by Sverdrup, Johnson, and Fleming that appeared later in 1942 (Figure 3.3).

An extended excerpt of the 1929 Lillie Committee Report was also published in *Science* (vol. 71: 84-89) in 1930 as an article titled, "A developing view-point in Oceanography" by Henry Bryant Bigelow. According to Bigelow, the NAS committee concluded that "the establishment on our Atlantic coast of a new organization dedicated to the encouragement and prosecution of oceanographic investigation is the greatest need at the present time both from the point of view of American oceanography and also for adequate participation of this country in a study necessarily international."

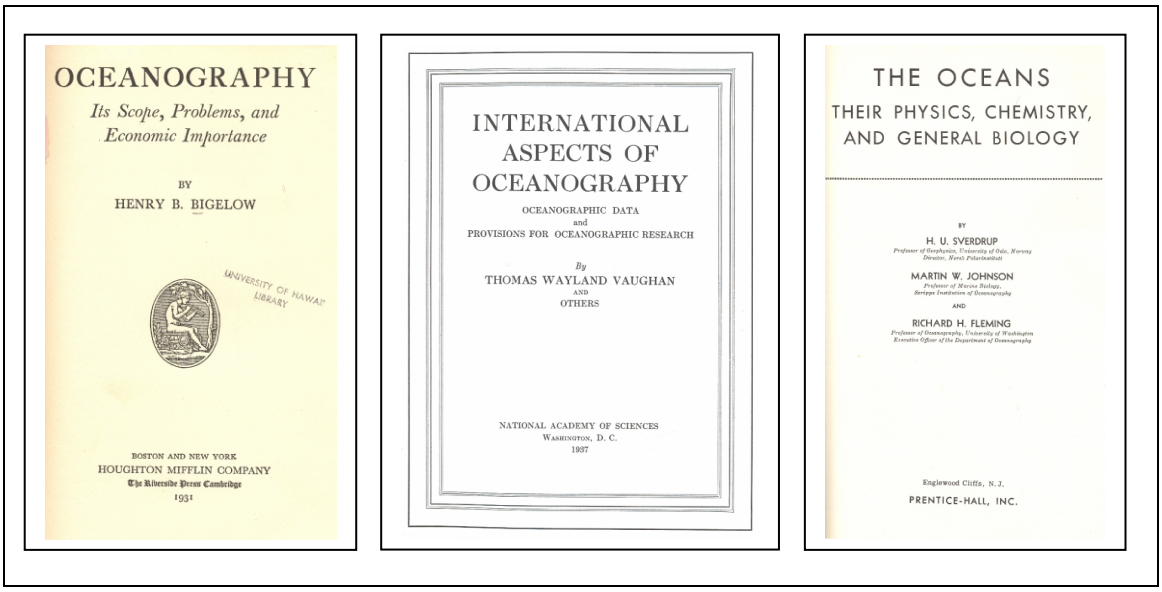

Figure 3.3: Collection of ocean classics: The Bigelow (1931) and Vaughan et al. (1937) monographs (shown above left and center) were products of the NAS Committee on Oceanography. These works led to the publication, in 1942, of the monumental work of Sverdrup, Johnson and Fleming, *The Oceans: Their Physics, Chemistry and General Biology*.

In an authoritative account of "Education in oceanography: History, purpose, and prognosis" that was prepared for the NAS-NRC's (see *Box 3.1*) *Fifty Years of Ocean*

Discovery published in 2000, Arthur Nowell of the University of Washington concluded that the 1929 Lillie Committee Report should be considered the true beginning of academic oceanography in the US. At the time this blue-ribbon committee was established, the only formal PhD-granting educational program in oceanography was at the newly founded Scripps Institution of Oceanography (note: Technically, the degree awarded was a PhD in zoology at UC at Berkeley for research conducted in marine biology at Scripps). According to Nowell, one of the main conclusions of the 1929 Lillie Report regarding the relatively new field of oceanography was, "The graduate student, sufficiently devoted to the subject and fitted for advanced instruction or research finds far fewer avenues than the importance of this field of science demands." The report went on to conclude that the human resource issue is the greatest handicap for progress, not ships, laboratories, or even money. Nowell lamented that despite this important conclusion from this very high profile NAS committee, there is little evidence that the report had any immediate influence on education *per se*; however, the impact of the Lillie report on research in the new field of oceanography was quite profound.

Foremost among the many lasting achievements of the NAS Committee on Oceanography was the establishment, in 1931, of the Woods Hole Oceanographic Institution (WHOI), an expansion of the research capacity at the Bermuda Biological Station for Research, and expansion of research laboratories at both the University of Washington and Scripps Institution of Oceanography. All of these enhancements were supported by gifts from the Rockefeller Foundation. The funding provided to establish WHOI was $2.5 M, including the resources necessary to construct a seagoing laboratory.

Henry Bigelow, chair of the NAS Committee on Oceanography, was appointed the inaugural director of WHOI (see *Box 3.3*), and a 12-member board – including 6 persons from the NAS Committee on Oceanography – was established to oversee the institution's direction and progress. Included as a member of the WHOI board was T. Wayland Vaughan, then director of the Scripps Institution of Oceanography; Frank Lillie, then president of the NAS, was appointed president of the board. So, in effect, WHOI was directed, at least initially, by the 1927 NAS Committee on Oceanography.

These connections between the Rockefeller Foundation, Frank Lillie, the NAS, and WHOI, however, ran much deeper than what might be perceived from the committee's fine achievements. As it is now well known, Lillie – who had been elected to the NAS in 1915 for his pioneering work in developmental biology – had worked closely with Wickliffe Rose, then president of the General Education Board of the Rockefeller philanthropies prior to the formation of the NAS Committee on Oceanography (Burstyn 1980). There was at that time a great interest on the board to assist fishery science in the US. Lunching at the Quadrangle Club of the University of Chicago – where Lillie was a professor – in October 1925, the two men discussed the field of oceanography and the possibility of establishing a new oceanographic institution on the east coast of the US, possibly at Woods Hole. The two met again in October 1927 to discuss these matters and agreed to consider other locations in the context of the "committee" but that "Woods Hole seemed the likeliest to be chosen" (Burstyn 1980). Furthermore, according to Roger Revelle (1980), the creation of the NAS committee was Lillie's idea. It was a

device to give "respectability and credibility to his proposed creation of a new institution, and he served as chairman of the committee. Its report was a fine example of the effectiveness of the 'old boy network' in science. Predictably enough, the report recommended establishment of a major institution on the east coast of the US…" Revelle goes on to state that "After an ostensibly objective examination of all possible sites for the new institution, no one was surprised when the committee settled on Woods Hole as the best location."

***Box 3.3*: Henry Bryant Bigelow**

Henry Bigelow, a biological oceanographer and key member (and subsequently chair) of the 1927 NAS Committee on Oceanography, was appointed inaugural director of the Woods Hole Oceanographic Institution in 1931. He served in that post until December 1939 when he retired, but continued as president of the trustees until August 1950 when he was made chairman of the board. In 1955, the scientific journal *Deep-Sea Research* published an entire volume of papers on a broad range of topics dedicated to Bigelow by his former students and associates on the occasion of the 25th anniversary of the founding of the Woods Hole Oceanographic Institution. In 1966 he was the first recipient of the Henry Bryant Bigelow Medal for Oceanography, that was established in his honor by the trustees of the institution. Following his death in 1967, the Henry Bryant Bigelow issue of *Oceanus* appeared (vol. 14, no. 2, July 1968) as yet another tribute to his leadership over the years; "To our great grief, we lost our founder chairman in the 88th year of his life." This volume contained numerous articles by leading authorities in oceanography and a few of his many friends and colleagues. The Bigelow building at Woods Hole and the Bigelow Laboratory for Ocean Sciences – a marine research institution founded at West Boothbay Harbor, Maine in 1974 – both stand as part of his enormous legacy.

In a 14 March 1930 article in *Science* (vol. 71: 277-278), Bigelow announced to the scientific world the incorporation of WHOI, a new establishment for the study of the sea. The article reported that the choice of Woods Hole was, in part, a result of the close proximity of two world-class research institutions, the National Marine Fisheries Laboratory and the Marine Biological Laboratory. The non-profit, independent organization would, according to Director Bigelow, have informal associations with other educational and research institutions.

From the beginning, there were strong academic connections between WHOI and both Harvard and Yale Universities. Bigelow, the founding director of WHOI, had a staff appointment in Harvard's Department of Oceanography at the Museum of Comparative Zoology, and Columbus Iselin II, WHOI's second director, was the assistant curator of the museum; Alfred Redfield – the Woods Hole "ratio" man – also held a professorship at Harvard. The connection to Yale University was through the Peabody Museum and, later, the Bingham Oceanographic Foundation. Albert E. Parr, a research associate in oceanography at WHOI, was also the curator of the Bingham Oceanographic Collection at Yale. WHOI has also had a long-standing collaboration with the Massachusetts Institute of Technology (MIT), and in 1968 the two institutions created a

joint PhD program in oceanography. H. Burr Steinbach, the founding dean of the joint program, had several key connections to the development of marine programs at UH. These are discussed subsequently.

The 1930 *Science* article also announced that the new institution "expects to own and operate a seagoing ship, of moderate size, with convenient living quarters, capable of extended voyages and equipped to carry on investigations at all depths in various fields of sea science. This is desirable because no other American marine laboratory independent of governmental control is at present in condition to do this." In the summer of 1931, the steel-hulled, ketch-rigged vessel *Atlantis* was launched from the Burmeister & Wain yard in Copenhagen, Denmark (see *Box 3.4*). This would provide access to the high seas, a prerequisite for research in oceanography.

(note: From 1907-1917, the predecessor of Scripps Institution of Oceanography operated the 85-foot ketch rigged vessel *Alexander Agassiz* that was built for the Marine Biological Association with funds provided by Ellen B. Scripps; but from 1917 until 1937, when they acquired the 100-foot auxiliary schooner *E. W. Scripps*, they had no open ocean-capable research vessel. In a 1934 letter to then UC President Gordon Sproul, T. Wayland Vaughan – then director of Scripps – stated: "The principal deficiency of the institution as regards its progress is its lack of a vessel which can make rather long, continued voyages on the high seas." There was then, and still is now, no substitute for a capable research vessel. Also, the Carnegie Institution of Washington operated the research vessel *Carnegie* from 1909 until 1927, when it was destroyed by fire in Apia, Samoa.)

Box 3.4*: R/V *Atlantis

"They that go down to the sea in ships,
that do business in great waters;
These see the works of the Lord
and his wonders in the deep."
The Holy Bible
Psalms 107:23-24

The research vessel *Atlantis*, a 142-foot steel-hulled ketch built by Burmeister & Wain in Denmark for $147,000, entered service in 1931 as the first deep-water research vessel of the newly created Woods Hole Oceanographic Institution. (note: In mythology Atlantis was a legendary island in the Atlantic Ocean west of Gibraltar that is said by Plato to have sunk beneath the sea during an earthquake.) The R/V *Atlantis* would eventually serve the US science community for 35 years, and after that was repainted and re-christened *El Austral* ("The Southerner") when it began a second career in support of marine research in Argentina.

The R/V *Atlantis* was not the first US oceanographic vessel, nor the largest in her time, but its long and faithful service around the globe over many years placed it into a separate category among research ships in the fleet; the fact that WHOI's logo proudly displays the *Atlantis* will serve as a constant reminder of its fine service. In the book *On Almost Any Wind*, Susan Schlee chronicles the saga of R/V *Atlantis* from keel laying in 1930 to southern hemisphere retirement. In 1963 the new 210-foot R/V *Atlantis II* replaced the more graceful, but much less capable, sailing vessel.

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***Box 3.4*: R/V *Atlantis* (continued)**

There is one very significant connection between the R/V *Atlantis* and UH marine programs – in the person of Alfred Woodcock. Prior to joining UH as an adjunct research meteorologist in HIG in 1963, Woodcock had at least two, and perhaps more, successful careers in marine sciences. According to Susan Schlee's account of the maiden voyage of the R/V *Atlantis*, Al had been hired by master Columbus Iselin as an ordinary seaman at $45 per month. Woodcock had a high school diploma and one week at an agriculture college; those who knew him later in life would find this lack of formal education hard to believe.

Captain Iselin, the master of the *Atlantis* at that time and, later in life, the second director of WHOI, recognized that Woodcock was much more than a sailor and encouraged him to collect data on sea conditions and weather, which Al did with exacting detail. In his unpublished autobiography, Gordon Riley – then a marine science professor at Yale University – proclaimed that Al Woodcock was "one of the keenest observers I have ever known, and full of curiosity about anything he didn't quite understand." Roger Revelle described Woodcock as someone who "possessed imagination and a seeing eye – who was willing and able to work long and hard, and who loved the sea."

Over the next decade, Woodcock – serving in the capacity of science technician aboard the *Atlantis* – would make comprehensive observations of the behaviors of seabirds and marine mammals and of the distributions of *Sargassum* and other marine life. For example, in a now classic 1940 *Journal of Marine Research* article, Woodcock described two different types of soaring in herring gulls at sea, determined largely by wind speed with the switch at approximately 7 m per sec; above wind speeds of 13 m per sec gulls did not soar. He also conducted some of the first field tests of the bathythermograph (BT) in 1939. He published many of these data in scientific papers, and these research efforts established him as one of the leading authorities of oceanic processes.

By 1936, Woodcock had spent more time aboard the R/V *Atlantis* than any other scientist. This was no minor physical achievement, as conditions aboard the R/V *Atlantis* were not always favorable. According to Gordon Riley, again in his unpublished autobiography, "the *Atlantis* was built with a curved and bulging bow, designed to give the bow a good lift over oncoming seas. This it did but it also made her relatively ineffective making headway against a heavy sea. She plunged into the wave with a fast deceleration like an express elevator coming to a stop, lifted her bow high, and slid over with a disconcerting corkscrew wiggle of her stern." He went on to say, "…then there was the roll…"

Another vivid account of life aboard the R/V *Atlantis* during one especially rough cruise was provided by Charles Renn: "Everybody was seasick, it was gray, miserable and pure diesel exhaust – the *Atlantis* at her worst in the worst water in the world – the Gulf of Maine." During that cruise Henry Bigelow, the director of WHOI and expedition leader, took one look at a very seasick Selman Waksman – marine microbiologist and 1952 recipient of the Nobel Prize in Medicine for his research on antibiotics – and proclaimed, "all food would be wasted on him." Such was life aboard the R/V *Atlantis*.

Al Woodcock outside his office in the new HIG building circa 1970. Note that Holmes Hall was "under construction" in background at this time (from SOEST archives)

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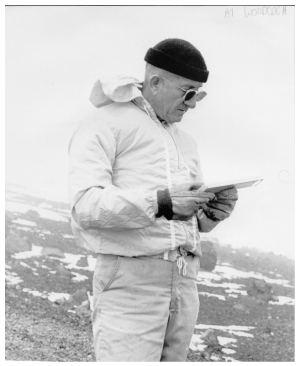
Box 3.4*: R/V *Atlantis (continued)

According to an authoritative account titled "The Life and Science of Alfred H. Woodcock" written by Duncan Blanchard and published in the *Bulletin of the American Meteorology Society* in 1984 (vol. 65:457-463), Woodcock moved to Hawaii in 1963 partly to be where "simple natural experiments in rain-making are an almost daily occurrence." It was during his informal affiliation with HIG that Al would make his most significant and lasting scientific contributions – namely the study of sea salt particles and their role in the formation of rain. He also conducted research on air-sea exchange processes and the role of bubble collapse, buoyancy mechanisms in marine plants, and the physical processes in high alpine lakes (note: Al was an expert on Lake Waiau located near the summit of Mauna Kea. He visited this field site more than 350 times during his career at UH.).

In January 1995 Al received a special award (see below) from the American Meteorological Society for his career achievements in marine and atmospheric research. Today, approaching the century mark (Al was born on 7 September 1905), Al resides in Oakland, California.





The various faces of Alfred Woodcock. Shown at left with Mike Landry and Tom Schroeder with his American Meteorological Society special award; at center in his office in the Marine Sciences Building; and at right, working at Lake Waiau near the summit of Mauna Kea. (from SOEST archives)

A final point made by Bigelow in his 1930 *Science* article, "A developing view-point in oceanography" was a call to arms for interdisciplinary research in marine sciences. After providing several pages of explicit links between biological, chemical, physical, and geological processes in the sea, Bigelow concludes by stating, "There is, I think, no need to quote more examples to show that the different disciplines of oceanography inevitably interlock, or to prove the intellectual necessity of not only recognizing but indeed acting upon this unit, if we hope ever to gain a thorough understanding of the sea and its inhabitants. Any attempt (conscious or unconscious) to hold them apart can result only in frustrating this high aim and in setting us backward to the stage of simply gathering and accumulating facts in unrelated categories." He reiterated these key points at the end of his 1931 book *Oceanography: Its Scope, Problems, and Economic Importance*, "There is, we think, no need of further argument to prove that these several disciplines do inevitably interlock, or to point the intellectual necessity not only of recognizing, but of acting upon this unity, if we hope ever to gain any sound understanding of the sea, or of the lives of its inhabitants."

Thus began a new chapter in marine sciences, one that would focus on a transdisciplinary approach and one that would eventually develop specific academic curricula to train a new generation of scientists.

3.4. A New Emphasis on Basic Research at UH, Including Marine Sciences

"Try to learn something about everything and everything about something"

T. H. Huxley

The Master of Science (MS) degree was created at UH in 1914, and by the end of 1933, 122 MS degrees had been granted. Most of these were in the fields of entomology and agriculture, reflecting the original land grant focus of the UH curriculum. In 1930, Hans Pettersson, son of famous Swedish chemist Otto Pettersson, became the first oceanographer in Sweden. During the 1947-1948 circumnavigational cruise of the Swedish research vessel *Albatross* (not to be confused with the US fishery vessel of the same name; see *Box 3.8*) he conducted research in Hawaiian waters and the vessel had a port call in Honolulu. Pettersson would visit Honolulu a few decades later as a visiting professor of geophysics at UH. His influence on the emergence of UH marine programs was substantial.

Post-World War II growth at UH included several new academic programs and significant capital improvement projects for basic research, including a new chemistry building. Unfortunately, events surrounding the planned dedication of this new research facility became mired in the national level politics over the rise of communism and led to the UH "red scare affair" of 1951 (see *Box 3.5*).

Box 3.5: **The Linus Carl Pauling "Red Scare" Affair: 1951**

A major setback for UH as an institution of higher education came in March 1951 just as the newly constructed chemistry building was about to be dedicated (Figure 3.4). This modern, well-equipped $1.3 M building would represent a commitment to research in the basic sciences at UH and for that reason the administration and the faculty wanted the dedication ceremony to be a meaningful, historic event. With a $1,000 grant from the Hawaiian Pineapple Company to sponsor this affair, the UH-BOR, on the recommendation of UH President Gregg M. Sinclair, extended an invitation to Linus C. Pauling, Chair of the Chemistry and Chemical Engineering Division of the California Institute of Technology and one of the leading chemists in the world at that time (note: Pauling would go on to receive the 1954 Nobel Prize in Chemistry for his research on the structure of molecules and crystals and the 1962 Nobel Prize for Peace for his efforts in the global non-proliferation of nuclear weapons. Pauling is the only person ever to receive two unshared Nobel Prizes.)

continued

Box 3.5: **The Linus Carl Pauling "Red Scare" Affair: 1951 (*continued*)**

Pauling's name had been suggested by Leonora N. Bilger, then chair of the UH chemistry department. The entire university community was thrilled by the possibility of having someone of Pauling's stature to help move our basic science programs forward. Everything seemed set for a memorable and enjoyable dedication ceremony. However, a few days later, on 13 March 1951, Sinclair withdrew the UH invitation stating that the planned early April dedication ceremony would be "indefinitely postponed."

It soon became evident that the real reason was that the UH officials had just learned that Pauling was apparently listed in the 1947 report of the California legislative un-American activities committee as a member of various groups labeled subversive and communistic by that committee. In a subsequent statement to *Ka Leo*, the UH student newspaper, Sinclair denied that the postponement of dedication ceremonies had anything to do with Pauling's past or present political affiliations – but others were not convinced. The *Ka Leo* urged the UH administration not to cancel the invitation, citing Pauling's numerous honors, awards, and scientific achievements.

After considering the matter at their meeting on 23 March 1951, the UH-BOR voted unanimously to officially withdraw their invitation to Pauling citing his "activities and affiliations with subversive and un-American organizations." His "subversive" activities apparently included a bold, brave mission to inform the public of the potential consequences of nuclear war. Pauling's 13 February 1950 speech at New York City's Carnegie Hall was subsequently published as a brochure entitled *The Ultimate Decision*. Largely for his anti-war, anti-weapons stance Pauling was considered un-American and a person with communist sympathy.

In response to the UH-BOR action Pauling said, "The regents of the University of Hawaii did not inform me that any charges had been made…" and "I am very surprised that the regents of a university would put a man on trial and publicly announce his conviction without having told him of the charges or given him an opportunity to refute them." In a written response to UH dated 30 March 1951, Pauling demanded that the BOR renew their original invitation so that damage already done to this reputation could be minimized. He characterized the behaviors of UH President Sinclair and the BOR as "highly unjust and unethical." Surely this was the low point in the otherwise proud history of the university.

The Pauling affair continued to fester even after the BOR refused to reconsider their decision. Several years later, in February 1954, Pauling concluded that UH would "rank among the lowest of state universities" when statehood comes. As reported in *The Honolulu Advertiser* on 5 February 1954, Pauling claimed that UH has a shortage of "outstanding professors and it lacks vigorous, imaginative leadership and support from the community." President Sinclair issued this statement in reply: "The Regents and the administration of the university have long been conscious of the opportunity of the University of Hawaii to become an outstanding institution of learning. So we agree with much that Dr. Pauling has said as to the need for more money for outstanding scholars and improvement of facilities. We have also felt that the teaching load was too heavy if we were to expect much creative research and publication from our faculty members." Board Chair Philip E. Spalding said that the territorial status of Hawaii had made it more difficult to get federal grants and felt that statehood, once approved, would likely improve the situation overall. Another board member, Hung Wai Ching, put a more positive spin on Pauling's criticism of UH and used it as a call to arms for the business community and the legislature to support higher education in the territory.

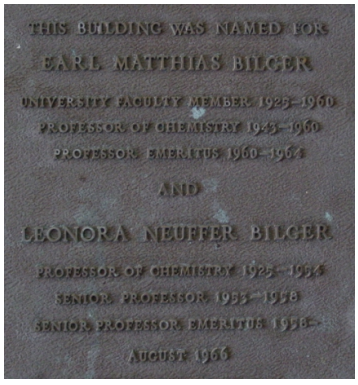
continued

Box 3.5: **The Linus Carl Pauling "Red Scare" Affair: 1951 (*continued*)**

Then in the fall of 1954 it was announced that Linus Pauling would receive the Nobel Prize in Chemistry for his pioneering research on the nature of chemical bonds. This announcement featured prominently in the Honolulu newspapers, as it should have, along with summary accounts of our previous unfair treatment of one of the nation's greatest scientists.

Finally, on Tuesday, 13 January 1959, nearly 8 years after Pauling had originally been invited to UH to dedicate the new chemistry building, it was officially named in honor of Leonora Neuffer Bilger (Figure 3.5). Leonora, who had suggested Pauling as the keynote speaker for the planned building dedication in 1951, had recently retired from UH after 32 years of service, 11 of them as chair of the Department of Chemistry. She had also served as Dean of Women at UH and in 1953 was the recipient of the Francis P. Garvan award as the nation's outstanding female chemist.

According to Victor Kobayashi's book *Building a Rainbow*, naming the chemistry building after Bilger was a controversial decision, in part because then President Lawrence Snyder "pushed the resolution through the UH-BOR without any faculty consultation." In August 1966 a plaque was placed on Bilger Hall indicating that the building was named in honor of Earl Matthias Bilger, a UH faculty member (1925-1960), professor of chemistry (1943-1960), and professor emeritus (1960-1964) and Leonora Neuffer Bilger. The information on this plaque contradicts news accounts from the 1959 dedication. It is not known to the author whether Bilger Hall was subsequently re-dedicated to honor both Earl and Leonora (effectively Bilgers Hall), however, it seems almost certain that the building would not have been named – even partly – in Earl Bilger's honor in 1959 because he was an active UH faculty member at that time.



Nearly three decades after Pauling was initially invited to help dedicate a new UH science building, he was brought back as the keynote speaker at the dedication of the Cancer Research Center of Hawaii on 26 March 1979; his presentation was on "Cancer and Vitamin C."

Later, in January 1982, when the two-time Nobel laureate was invited to address the American Civil Liberties Union at their annual dinner in Honolulu, Pauling spoke about his life-long work in science and his untiring efforts on behalf of civil rights and human rights. In a *The Honolulu Advertiser* interview published on 28 January 1982, the 80-year old Pauling said he "holds no bitterness towards Hawaii or the University." The small number of people at fault, including President Sinclair and the UH-BOR, were the only ones to blame for this major blemish on this institution.

Pauling died in 1994, at the age of 93.

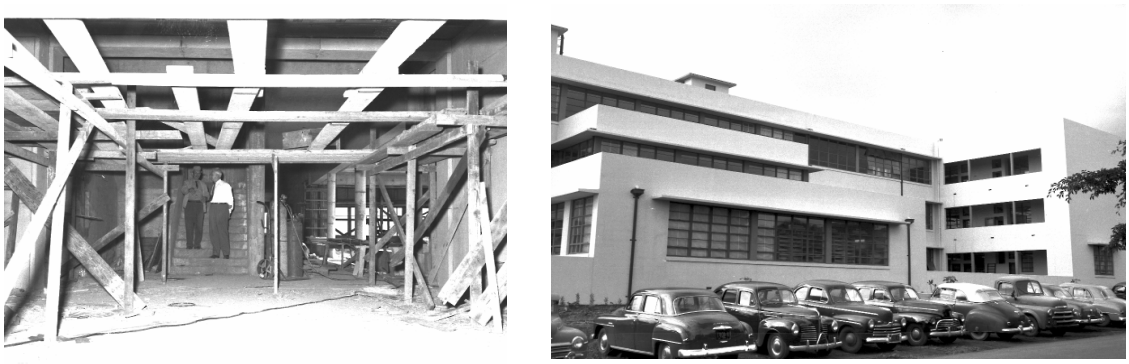


Figure 3.4: The new chemistry building (later named Bilger Hall) at the time of its construction circa 1951. (from UH at Manoa Masao Miyamoto collection; negatives A50-00003, A51-00010)

Figure 3.5: Leonora Neuffer Bilger speaking with UH officials just after the ceremony in 1959 naming the "new" chemistry building in her honor. (from UH at Manoa Masao Miyamoto collection; negative A59-00003).

UH President Gregg Sinclair presided over this unprecedented growth in the capacity for science and technology. According to newspaper reports, Sinclair wanted UH to be "not a big University, but a significant one."

In July 1946, the UH-BOR approved plans for an expedition to Yap to conduct the first marine research investigation of this region. Five UH scientists, including recently hired marine ecologist Robert W. Hiatt, would spend six weeks in the field collecting

specimens and conducting experiments; Hiatt planned to use the recently developed Self Contained Underwater Breathing Apparatus (SCUBA) in his research.

Among the many visiting leaders, educators, and scientists who helped to shape and promote marine sciences during the formative period of development, none had the lasting impact of David Starr Jordan (see *Box 3.6*). During a visit to UH in 1922, Jordan – a world-class marine scientist, educator, and founding president of Stanford University – recognized UH for its potential role as an academic leader in marine sciences. To symbolize this potential for leadership and growth, he planted an India rubber tree (*Ficus elastica*) on the UH campus which today bears his name (Figure 3.6). At a UH memorial service following Jordan's death in 1931, UH President Gregg M. Sinclair stated "I think he (Dr. Jordan) would be thrilled by the work on volcanology, meteorology, and oceanography and with the possibility of the formation of a geophysics institute." Sinclair was referring to the Hawaii Institute of Geophysics that would emerge as an academic research entity nearly one decade later. Much later, in 1966, the US Bureau of Commercial Fisheries commissioned a new fisheries research vessel, *David Starr Jordan*, in his honor (Figure 3.6). This vessel is home-ported in San Diego and still in service today (http://www.moc.noaa.gov/ds/).

Box 3.6: **David Starr Jordan: Founder of Modern Ichthyology**

David Starr Jordan graduated from Cornell University in 1872 and thereafter accepted a professorship in natural sciences at Lombard University – an institution under the direction of the universalist church – located in Galeburg, Illinois. If he had remained in that position for very long, marine sciences as a discipline may not have evolved as quickly or as completely as it did – no one will know for sure. Suffice it to say that Jordan was fortunate to have been invited by Louis Agassiz to participate in the first "Anderson summer school of natural history" on the island of Penikese in June 1873. He was one of 50 students who would spend a summer with "the master" (see *Box 3.2*). Unfortunately, the first year class was the last; Agassiz died in December 1873 and, with his passing, the Anderson school closed in 1874.

As for Jordan, he was forced to leave Lombard in 1873; his performance was deemed "inadequate." However, he would go on to become a leading authority in marine science (the study of fish was his specialty), and one of our nation's most distinguished academic administrators. He also had a major influence on the development of marine sciences at the University of Hawaii. In 1873, Jordan moved to Appleton College in Wisconsin where he taught for a year. He then taught high school in Indianapolis where, in his spare time, he received a MD degree from Indiana Medical College. In 1879 he moved to Bloomington, Indiana to begin a new job as professor at Indiana University. On 1 January 1885, at the age of 34, Jordan became president of Indiana University – a position he held until 1891. While he was at Indiana University, Jordan helped train the next generation of marine scientists, including Charles H. Gilbert who received the first PhD degree granted by that institution. Gilbert – or at least his namesake, the research vessel *Charles H. Gilbert* – would also have an important connection to the emergent marine

continued

Box 3.6: **David Starr Jordan: Founder of Modern Ichthyology (continued)**

programs at UH (see *Box 3.9*). Jordan Hall, the biological sciences building at Indiana University, stands today as part of his enormous legacy.

Jordan left Indiana following a visit by Leland Stanford – railroad baron, former governor of California, and then US senator from California. Stanford convinced Jordan to move to California to become the founding president of Leland Stanford Jr. University, named in honor of Stanford's son who had contracted typhoid fever in Italy in 1884 and died two months before his sixteenth birthday. Jordan was only 40 years old when he began his successful, 22 year reign as Stanford's inaugural president. Among other major accomplishments, Jordan fostered marine sciences through the formation, in 1892, of Hopkins Marine Station in Pacific Grove.

Jordan made several visits to Hawaii, in part to advise UH administrators on potential areas of excellence for the university to pursue. He planted the seeds for the emergence of marine expeditionary research and, in this regard, UH marine scientists have roots that lead back to Louis Agassiz. The Thomas Hamilton library at UH has a signed and dated copy of Jordan's two-volume autobiography, *The Days of a Man* that was published in 1922. The books were originally given to Alexander Hume Ford (in September 1925), one of Waikiki's original beach boys and expert surfer (see Figure 3.7). It is possible that Ford may have given Jordan some personal surfing lessons during his visit to the islands.

(note: According to an authoritative account of the history of surfing, "From Polynesia, with love" by Ben Marcus (http://www.surfingforlife.com/history2.html) Alexander Hume Ford is also credited with introducing the sport of surfing to literary giant Jack London on Waikiki Beach in 1907. Later that year, London wrote "A Royal Sport: Surfing in Waikiki" which appeared in the October 1907 edition of *The Lady's Home Companion*. This helped to promote the sport and later, on 1 May 1908, to the founding of the Hawaiian Outrigger Canoe Club largely through the efforts of Ford and the generosity of the trustees of the Queen Emma Estate. When London returned to Waikiki in 1915, the Outrigger Canoe Club had 1200 members and a long waiting list!)

In addition to his pioneering research in marine biology and ichthyology and his skillful administration of two of America's great universities, Jordan was also a noted peace activist – writing several books on the subject (*The Blood of the Nation*, *War and Waste*, and *Ways of Lasting Peace*); he also served as the president of the World Peace Foundation from 1910 to 1914. Jordan campaigned vigorously against US involvement in World War I. He also served as an expert witness at the Scopes trial in Tennessee.

Jordan retired from his post at Stanford in 1916 and died in 1931. In 1986, Cornell University, Indiana University, and Stanford University jointly established the David Starr Jordan Prize for "innovative contributions to the study of evolution, ecology, population or organismal biology." International in scope, the prize is awarded every three years to recognize young (under 40 years) scientists whose research is likely to redirect their respective fields. Several California schools, including the David Starr Jordan high school in Long Beach and the David Starr Jordan middle school in Burbank are named in his honor. Finally, in 1925 the Sierra Club named a mountain in northern California after Jordan; Mount Jordan (13,320 feet) stands as a permanent reminder of his academic and scientific achievements.

Reproductions of the medal awarded to the recipient of the prestigious David Starr Jordan Prize.

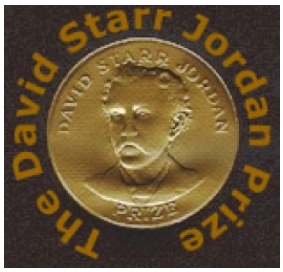
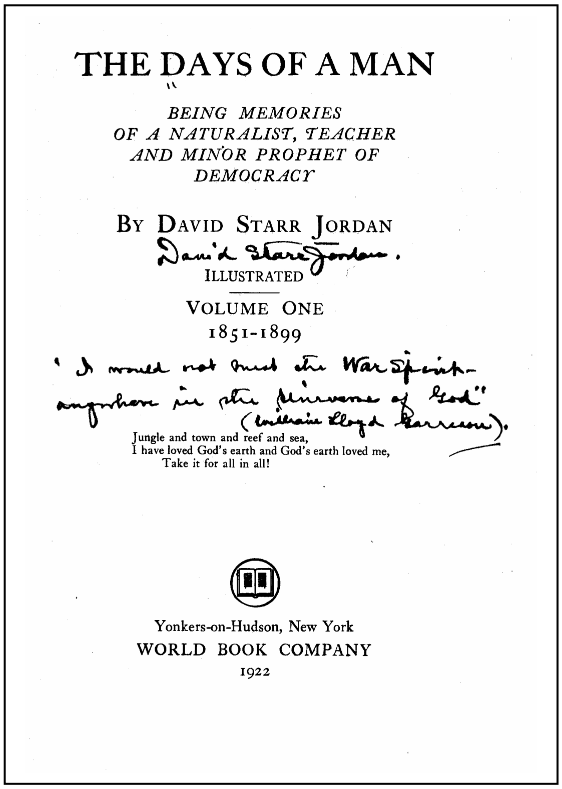


Figure 3.6: David Starr Jordan's legacy at UH was enormous. Shown here is his portrait, circa 1900, the David Starr Jordan tree on the UH campus (in background) planted by him in 1922 located just mauka of what is now Sinclair Library, with memorial plaque (upper right), and the fisheries research vessel *David Starr Jordan* (inset) that was commissioned in 1966 by what was then the US Bureau of Commercial Fisheries. (Photos by D. Karl; collage design by N. Hulbirt)

In 1947, as part of the 40th anniversary of the founding of UH, the Hawaii chapter of Sigma Xi – the national honorary scientific society – was founded. This marked the beginning of an increased awareness of, and emphasis on, the study of natural sciences at UH. At the beginning of academic year 1947-48, the only PhD degree program at UH was in the field of tropical agriculture. However, UH President Gregg M. Sinclair had ambitious plans for the growth of research at the university.

In 1948 the UH Graduate Division was created to promote and facilitate the expanding graduate programs, including marine sciences. (note: In 1950 it was renamed the Graduate School, and in 1965 the name reverted back to Graduate Division.) A Graduate Council was also established to develop and guide policies; inaugural members included Leonora Bilger (Chemistry), Harold St. John (Botany), and Robert Hiatt (Zoology). As emphasized in the inaugural Graduate Division catalog, "The location of

the islands offers students of marine biology a natural laboratory for the study of marine life in the tropics."


THE DAYS OF A MAN

BEING MEMORIES OF A NATURALIST, TEACHER AND MINOR PROPHET OF DEMOCRACY

BY DAVID STARR JORDAN

David Starr Jordan.

ILLUSTRATED

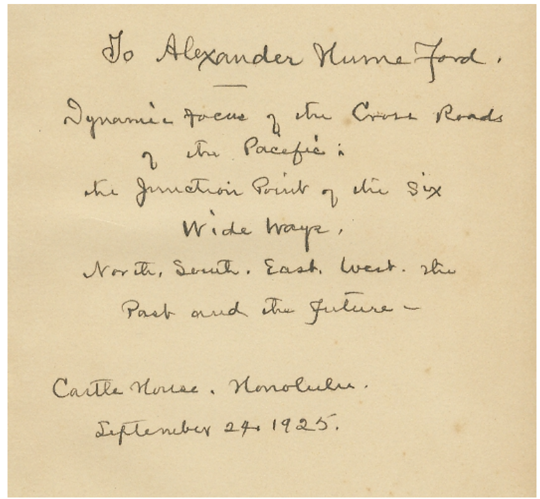
VOLUME ONE

1851-1899

"I would not trust the War Spirit anywhere in the Universe of God" (William Lloyd Garrison).

Jungle and town and reef and sea,
I have loved God's earth and God's earth loved me,
Take it for all in all!

Yonkers-on-Hudson, New York
WORLD BOOK COMPANY
1922


To Alexander Hume Ford.

Dynamic focus of the Cross Roads of the Pacific:
the Junction Point of the Six Wide Ways,
North, South, East, West, the Past and the Future —

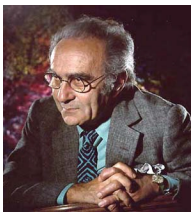
Castle House, Honolulu.
September 24, 1925.

Figure 3.7: Signed copy of the cover page of volume I of the two volume treatise, *The Days of a Man*, David Starr Jordan's autobiography. Shown at right is the inscription, by Jordan, to Alexander Hume Ford in the archive copy of Jordan's autobiography at the UH at Manoa's Hamilton Library.

By this time, Robert Hiatt had already begun to provide the much needed leadership in his capacity as "senior" professor of marine zoology. According to the 1949 faculty handbook, a senior professor had duties and responsibilities that were essentially the same as those of a professor. The title, however, was "reserved for that select group of distinguished visiting professors or local professors of outstanding ability who have achieved recognition as authorities in their field of specialization and whose services enhance the prestige of the university." This was also a vehicle to provide extra compensation when appropriate. For example, in 1949 the base salary plus bonus for a "typical" senior professor was $7356 per annum compared to $5556 for a professor. UH professors L. Bilger, K. Watanabe, and W. J. Holmes – as in Bilger Hall, Watanabe Hall, and Holmes Hall – among others were also senior professors at this time. In the 1964 UH handbook for faculty and staff it states that appointment to rank of senior professor or senior researcher "were made in the past by special action of the BOR on recommendation by the president but that new appointments to this rank are no longer made." The reason for discontinuing this practice was not mentioned in the handbook.

Robert Hiatt would go on to have a profound impact on UH marine programs and would figure prominently in the creation of several key education and research units; he clearly deserves the title of "Father of UH Marine Sciences" (see *Box 3.7*).

Box 3.7: **Robert W. Hiatt: The Father of UH Marine Sciences**



"A genius is a man who has two great ideas"
Jacob Bronowski
The Ascent of Man

Robert W. Hiatt was born on 23 December 1913 in San Jose, CA, one of 7 children. According to information contained in a University of Alaska press release following his death in 1997, Robert was the only one of his siblings to attend college. He went on to receive a PhD in marine zoology in 1941 from the University of California at Berkeley. He joined UH in 1943 and served for 26 years in various influential capacities ranging from professor to acting president.

In his dual capacity as dean of the graduate school and director of research (1955-1963) and later vice president for academic affairs (1963-1968), Hiatt was deliberate and articulate in his support of marine sciences as a new and important field of study. Hiatt was also a strong advocate for basic marine (and related) research.; he argued forcibly that while expensive, it will eventually pay its own way. Research, he argued, was the basic foundation on which great universities are built (Figure 3.8).

His efforts led to the creation of oceanography as a graduate field of study in 1962 and eventually to the Department of Oceanography two years later. He also founded and directed the Hawaii Marine Laboratory (HML, later renamed Hawaii Institute of Marine Biology – HIMB) and the Enewetak Marine Biological Laboratory (EMBL), created the Hawaii Institute of Geophysics (HIG) and the Pacific Biomedical Research Center (PBRC), and served as the inaugural executive director of the Research Corporation of the University of Hawaii (RCUH) which he created during his term as vice president and, later, acting president of UH.

The aggregate impact of these new marine education and research units is unprecedented in the nearly 100-yr history of this academic institution. Who was Robert Hiatt? What motivated him to these great academic achievements? Who was on his "marine dream team" and who, if anyone, stood in his way? Why is there no Hiatt Hall on the UH campus to recognize his leadership and accomplishments in a discipline so important to the state and the nation?

Robert and Mrs. Hiatt at his UH retirement luncheon in April 1969 (from UH at Manoa Masao Miyamoto collection; negative C69-00055)

continued

Box 3.7: **Robert W. Hiatt: The Father of UH Marine Sciences (*continued*)**

After leaving Hawaii, Hiatt served as consular officer and secretary at the US Embassy in Tokyo (1970-1973) and in 1973 he became the 5th president of the University of Alaska, a post he held until 1977. Among other accomplishments, Hiatt created the Rural Education Affairs division to extend post-secondary education into less populated regions of Alaska for the first time.

Robert Hiatt died on 6 September 1997 at the age of 83. On 9 February 1998, a memorial service was held at Kaneohe Yacht Club and later his ashes were scattered in the waters near the Hawaii Institute of Marine Biology – one of the many marine academic and research centers that he had established during his tenure at UH.

In his "end of the year" report for 1950, UH President Gregg M. Sinclair reviewed progress on two significant marine related projects. He stated that UH now holds a lease to part of Coconut Island where a laboratory has been established and the university's research vessel *Salpa* (I) collects marine samples and data (see section 3.6). Second, the US Fish and Wildlife Service recently completed a building on 2.8 acres of land made available to the federal government by UH. Already at that time the US Fish and Wildlife Service scientists were operating three oceangoing vessels to gather data and it was expected that a new graduate training program aimed at common interests would be created at UH (see *Boxes 3.8 and 3.9*).

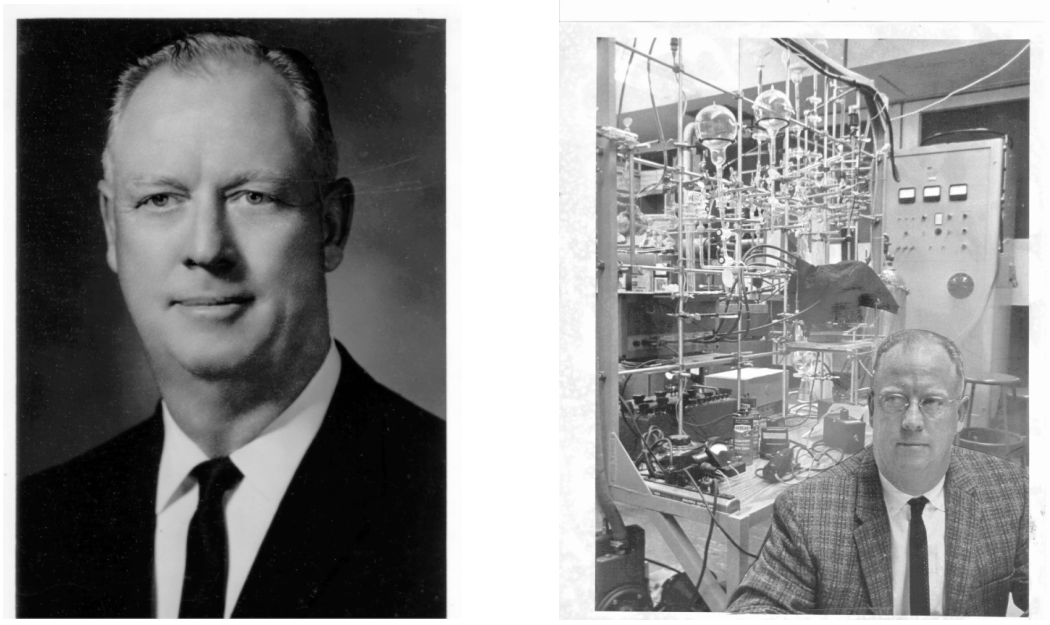


Figure 3.8: Robert Hiatt – a leading figure in the emergence of the marine sciences programs at UH at Manoa – sitting for a portrait circa 1967 (left) and in his laboratory circa 1963 (right). Hiatt's leadership resulted in the formation of the Hawaii Marine Laboratory, the Hawaii Institute of Geophysics, the Department of Oceanography, and the Research Corporation of the UH, among other programs. (reproduced with permission from *The Honolulu Advertiser*)

Box 3.8: **Fisheries Research in Hawaii: POFI-BCF-NMFS**

In 1871, Spencer F. Baird – a pioneer in marine natural history – helped convince congress to establish the US Fish Commission; he was named its first commissioner. He selected the village of Woods Hole as the site to establish the first laboratory.

Baird was also able to raise funds to construct the first ship built for "oceanographic research," the steel-hulled 234-foot steamer *Albatross*. The *Albatross* conducted research off Hawaii in 1902 under the direction of oceanographer David Starr Jordan. Jordan would eventually figure prominently in the development of UH marine science programs (see *Box 3.6*).

Until 1903 the organization, known then as the US Commission of Fish and Fisheries, was independent but for the past century it has been a part of the Department of Commerce. The agency conducts research related to the life histories, physiology, breeding, and ecology of commercially important fish, including shellfish, and conducts stock assessments. In 1904, Alexander Agassiz (son of Louis Agassiz) then president of Calumet and Hecla Copper Mines, personally financed the refitting of the 234-foot fisheries vessel *Albatross*.

This federally sponsored research on marine fisheries expanded over the next half-century and regional laboratories emerged at strategic sites along both American coasts and in the territory of Hawaii. The Honolulu branch, the US Pacific Oceanic Fisheries Investigation (POFI), was established in 1949 to conduct biological and physical oceanographic research in the Pacific Ocean. This unit was the predecessor to the Fish and Wildlife Service's Bureau of Commercial Fisheries (BCF) and, after NOAA was created in the early 1970s, to the National Marine Fisheries Service (NMFS).

Over the years much of the research at the fisheries laboratory has focused on tunas and billfishes, bottom fishes, lobster, deep-sea shrimp, sea turtles, and the Hawaiian monk seal. Since the formation of the Department of Oceanography, and even before then, there has been close collaboration between scientists working in the fisheries lab and those working in various academic departments at UH. The first chair of the UH Department of Oceanography, and several of the inaugural faculty had roots in fisheries oceanography (see section 4.5).

By the mid-1950s, several UH-based marine scientists, most notably Maxwell Doty of the Department of Botany, were routinely conducting open ocean sampling and measurement programs aboard research vessels operated out of Honolulu. Doty had received his PhD degree from Stanford University in 1945, then taught at the Marine Biological Laboratory at Woods Hole before joining the UH Faculty in 1950. He was among the first true biological oceanographers at UH. The *Hugh M. Smith* and *Charles*

H. Gilbert, two vessels owned and operated by the US Fish and Wildlife Service and home-ported at Pearl Harbor (*Box 3.9*; Figures 3.9 and 3.10), were significant assets in Doty's field campaigns. Much of his fieldwork was centered on measurements of marine productivity, specifically the use of the recently discovered radioisotopic tracer – ^{14}C – as a tool for assessing rates of primary production in seawater. This new technique provided an alternative to the less sensitive, and therefore less reliable, light-dark oxygen technique that had been developed in the 1920s. Doty's research at UH was supported for many years by the US Atomic Energy Commission (see section 3.5).

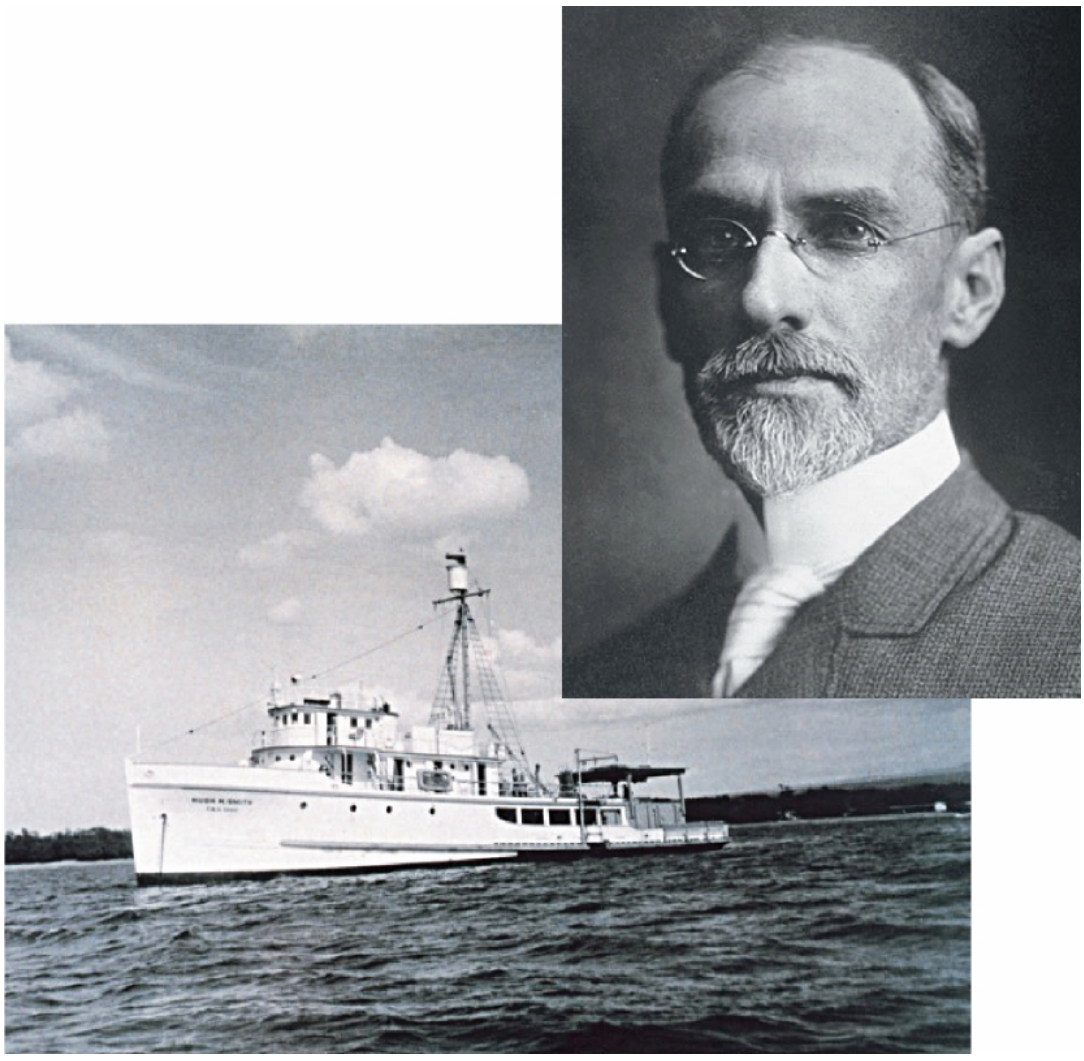


Figure 3.9: The fisheries research vessel *Hugh M. Smith* and portrait of its namesake. (from NOAA Photo Library: http://www.photolib.noaa.gov/ships/shind9.htm; collage design by N. Hulbirt)

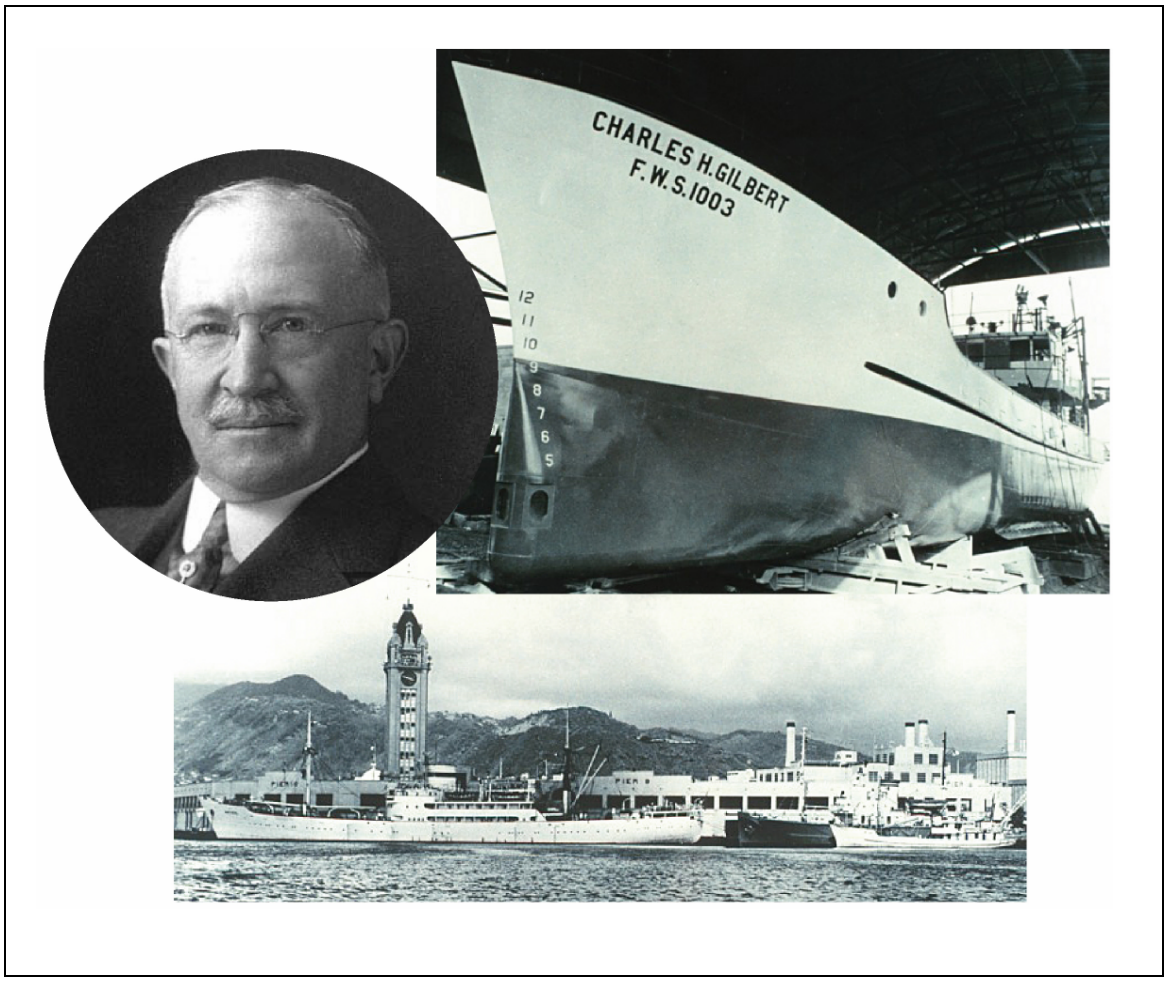


Figure 3.10: The fisheries research vessel *Charles H. Gilbert* and portrait of its namesake. (from NOAA Photo Library: http://www.photolib.noaa.gov/ships/shind9.htm; collage design by N. Hulbirt)

Doty's field and laboratory research on primary production was a logical and important extension of the POFI's research on fish and zooplankton, so this federal-UH collaboration was mutually beneficial. Other coastal ocean research programs conducted by Doty and his UH colleagues were underway in regions throughout the Pacific from Kaneohe Bay on Oahu, to San Miguel Bay in the Philippines, to Enewetak atoll lagoon. In one year alone (1 October 1956 to 30 September 1957) Doty, or members of his team, were at sea 148 days in the Pacific Ocean, much of this time in the western Pacific.

By 1951, Hiatt had become chairman of the Department of Zoology and in that leadership capacity he promoted the development of an expanded curriculum in biological oceanography, including the following formal courses: Methods of Fishery Investigation (Zool 287), Oceanography (Zool 290), Marine Ecology (Zool 282), Seminar in Marine Zoology (Zool 312), Seminar in Fisheries Biology (Zool 313), Seminar in Marine Biology (Zool 314), Marine Invertebrates (Zool 320), and Fisheries Management (Zool 388). Hiatt taught the marine ecology class, Albert Tester and Vernon Brock the fisheries biology courses, and Albert H. ("Hank") Banner taught

oceanography. Albert Tester, a fisheries biologist with world-class expertise in the study of tunas and sharks, had joined the UH department of zoology in 1948. Brock would go on to become the inaugural chair of the department of oceanography (see section 4.6 and *Box 4.6*) and Banner would later serve as director of the Hawaii Marine Laboratory (see section 4.11). This outstanding core of marine scientists was the seed for bigger and better things yet to come. New course listings in marine sciences across the natural sciences departments, including graduate courses, continued to be added to the curriculum as UH hired additional faculty to fill the expanding ocean science research mission. Oceanographic Chemistry (Chem 580), Oceanography (Zool 536), Biological Production of the Sea (Bot 586), Marine Geology (Geol 470), Geology of Deep Ocean Basins (Geol 672), and Near Shore Marine Processes (Geol 671) were among several new courses in marine sciences.

Box 3.9: **The Fisheries Vessels *Hugh M. Smith* and *Charles H. Gilbert***

The fisheries research vessel *Hugh M. Smith* was named in honor of Hugh McCormick Smith (1865-1941) who began working as a fisheries biologist with the US Fish Commission in 1886 and spent the next 40 years in government service; he served as director of the US Bureau of Fisheries from 1913-1922 (Figure 3.9). Smith also had an MD degree and taught medicine at Georgetown University until 1905 before turning his undivided attention to fisheries research. The R/V *Hugh M. Smith* was used extensively for open ocean research by UH marine scientists, especially during the period prior to the arrival of the R/V *Mahi* (see section 13.3).

The fisheries research vessel *Charles H. Gilbert* (Figure 3.10) was named in honor of Charles Henry Gilbert (1859-1928), the naturalist in charge of the 1906 North Pacific expedition of the R/V *Albatross*. According to the authoritative website of "The Gilbert Ichthyological Society" (http://artedi.fish.washington.edu/GIS), Gilbert attended high school in Indianapolis where he was greatly influenced by his high school teacher David Starr Jordan (see *Box 3.6*). Later, Gilbert earned the first ever PhD from Indiana University in 1883; his mentor was none other than David Starr Jordan! At the time he received his PhD degree at the age of 24, Gilbert already had published 80 scientific papers. After Jordan moved to Stanford University in 1890 to become the founding president of that institution, Gilbert was one of his first faculty appointments; he remained at Stanford for 37 years where he became a leading authority in Pacific marine fishes. The US Bureau of Commercial Fisheries vessel *Charles H. Gilbert* was commissioned in 1952. In 1991 a new biological sciences building at Stanford was named in his honor.

In 1953, the first two "marine science" PhD degrees were awarded, both in marine zoology; these were only the 6th and 7th PhD degrees in the history of UH (note: The first two PhD degrees at UH were awarded in 1933 and 1934 in entomology and the next three, awarded in 1938, 1949, and 1951, were all in agriculture). At that time in the history of UH, PhD programs existed only in selected basic sciences, soil science, and marine zoology.

In 1953, Hans Pettersson – then president of the United Nations Joint Commission on Oceanography and Marine Biology, and professor of oceanography at the University of Göteborg in Sweden – visited the territory of Hawaii on his return from the 8th Pacific Science Congress in Manila, the Philippines. Pettersson considered Honolulu to be the logical location for an international deep-sea research center and was surprised and disappointed to learn that more had not been accomplished in the field of oceanography from a Honolulu base. He had led the *Albatross* expedition (1947-48) during which he

and his colleagues came halfway around the world to study the deep ocean on Hawaii's doorstep. (note: This is the same name, but not the same vessel, as the fisheries steamer *Albatross*; see *Box 3.8.*)

In his discussions with UH administrators, Pettersson emphasized the unique potential at UH for the creation of a major center for oceanographic studies. He also emphasized that UH had a good start, "Dr. Robert W. Hiatt is an excellent oceanographer and the laboratory on Coconut Island is an excellent beginning" – but more could be achieved. "You have the location, a progressive University, and capable men. You need money and ships. You have, as it were, the bowl of porridge before you, but no spoon." The international marine sciences community was watching UH with great interest, and hope, for future development in marine science.

Two years later, in 1955, Pettersson was appointed to the UH faculty for a 6-month term as professor of geophysics. UH President Paul S. Bachman told the BOR that Dr. Pettersson would be instrumental in the effort to gain US congressional approval of a grant for the establishment of a new geophysics institute in the territory of Hawaii (see section 3.8). Pettersson also initiated new courses in physical oceanography. That same year, Colin Ramage was appointed associate meteorologist at UH. Professor Ramage would later become a leader in the emergence of tropical marine meteorology as a key research focus in HIG and within the graduate program in meteorology.

3.5. New Opportunities for Federal Support of Marine Sciences: NIH, ONR, AEC, and NSF

The Rockefeller Foundation, established in 1913, was one of a very few private sponsors of marine research prior to World War II. In particular, the Marine Biological Laboratory at Woods Hole and Hopkins Marine Laboratory at Stanford University received significant Rockefeller Foundation grant support for their work in marine biology; Woods Hole Oceanographic Institution began in 1931 with a generous $2.5 M grant from the Rockefeller Foundation (see section 3.3).

In 1942, during World War II, Harley M. Kilgore, then a US senator from West Virginia, proposed the creation of a new federal agency that he suggested should be called "The National Science Foundation." His intent, according to J. Merton England's *A Patron for Pure Science: The National Science Foundation's Formative Years 1945-1957*, was "to draft science and technology into wartime public service" and to provide research funding for basic scientific research during and after the transition from war to peace.

In response to this proposal, President Franklin D. Roosevelt turned to Vannevar Bush – then director of the Office of Scientific Research and Development (OSRD) – who effectively served as the president's wartime science advisor. According to England's account of this event, Roosevelt wrote a letter to Bush asking: (1) How can scientific knowledge developed during the war be released to the world quickly?, (2) How can a program of medical research be organized to continue the attack on disease?,

(3) How can the government assist research by public and private organizations, and (4) Can a program be suggested to develop the scientific talent of American youth to ensure high-quality research in the future? This presidential request "for a report on this matter" was dated 17 November 1944 – approximately 5 months before Roosevelt's death.

Vannevar Bush delivered the final report, titled *Science – The Endless Frontier*, to then President Harry S. Truman in July 1945, just prior to the Japanese surrender that ended World War II. This treatise articulated the need for federal support of basic research in natural sciences and medicine, as well as the creation of a new federal agency – the National Research Foundation. On 19 July 1945, Wilbur Mills – then US representative from Arkansas – and Warren Magnuson – then US senator from Washington state – simultaneously introduced bills into both houses of congress to openly debate the creation of the National Research Foundation. Four days later, Senator Kilgore re-introduced his own bill to establish the National Science Foundation. Though similar in name, the two proposed organizations differed significantly in organization, control, and patent policy. These different visions divided scientists and politicians alike, and ultimately delayed the creation of the National Science Foundation (NSF) for several years.

In his authoritative account of the politics and the financing of science in the US, *Science, Money, and Politics*, Daniel Greenberg dispels what he believes is the myth that Bush's original treatise, *Science – The Endless Frontier*, was the cornerstone of the present day NSF. While Bush did prepare the influential presidential report that led to the creation of NSF, the original view of the agency was substantially different from the one that was ultimately approved by congress. At one point during the extended debate there was an amendment introduced to the senate bill that would ensure an explicit geographic distribution of research funds – the "pork barrel" amendment, as it was called – as opposed to a provision for funding the most competitive research projects. Fortunately, the pork-barrel amendment was defeated by a vote of 39 to 24. Later in 1947, a compromise bill finally made its way to the president's desk only to receive a veto! Finally, on 10 May 1950, President Truman signed the act that created NSF as an independent agency of the federal government specifically to support basic research. Any scientist who has received NSF funds should read J. Merton England's captivating account of the politics surrounding the foundation's creation.

While congress was debating the creation of NSF, President Truman approved a bill in August 1946 that established the ONR within the US Navy. ONR provided support for both basic and applied research. In July 1946, congress approved legislation to establish the Atomic Energy Commission (AEC) which also had a research funding mandate. AEC's mission was much more restrictive, namely the production and use of nuclear energy. Much of the early marine research at UH was supported by AEC, including the use of radioisotopes in ecological research at sea and for laboratory-based research at the Hawaii Marine Laboratory (later Hawaii Institute of Marine Biology; see section 3.6) on Coconut Island. In 1953, the AEC established a field laboratory at Enewetak and in 1954 the lab was transferred to UH authority (see section 3.7). The National Institutes of Health (NIH) was the third federal agency that was created for the funding of basic

research. The Public Health Act of 1944 authorized the then existing NIH, founded in 1930, to award research grants to university scientists. Much of the laboratory and field research in selected areas of marine biology was, and still is, supported by NIH.

The first Director of NSF was Alan T. Waterman, who had previously served as chief scientist at ONR. According to Waterman, the goals of the newly created NSF were simple – "to develop a hard core of first-rate research by competent investigators." The primary criterion for NSF funding would be scientific merit. Initially NSF was provided a budget of $3.5 M to accomplish its vital national mission. NSF budgets remained relatively small until the Soviet Union successfully launched *Sputnik*, an artificial satellite, in October 1957. After that show of science and technology superiority, the NSF budget grew from $16 M in FY 1956 to $133 M in FY 1959. Today the agency sustains a larger than $5 B per annum research enterprise. An excellent account of the NSF's key role in ocean sciences has recently appeared in a National Research Council book entitled *Fifty Years of Ocean Discovery*; the chapters by Mike Reeve, Sandra Toye and Feenan Jennings are especially noteworthy and informative.

NSF was then, and still is today, organized into separate directorates, divisions, and programs. The initial NSF Act of 1950 created four major divisions: medical research, math/physics/engineering sciences (MPES), biological sciences, and science personnel and education. In 1953, the Division of Biological and Medical Sciences (BMS) was formed upon merger of the Division of Biological Sciences and the Division of Medical Research, and at the same time an earth sciences program was established in MPES. The former supported research in biological oceanography and marine biology and the latter supported research in geological, geophysical, and geochemical research – both terrestrial and marine. The BMS assistant director in 1953 was H. Burr Steinbach who later was appointed assistant director of NSF. Steinbach was a distinguished marine scientist from the University of Chicago who would later, in 1968, go on to serve as the inaugural dean of the WHOI-MIT joint graduate program in oceanography. He also played a significant role in UH's involvement in marine research at Enewetak atoll (see section 3.7), and in Hawaii's Oceanic Foundation (see *Box 5.1*).

According to Toby Appel's fascinating account of NSF's history in his book *Shaping Biology*, BMS created an *ad hoc* committee on biological oceanography in 1960 that was chaired by Dixy Lee Ray, then associate professor of zoology at the University of Washington. (note: Dixy Lee Ray would go on to become the chair of the AEC and, later, the governor of the state of Washington.) The committee report, published in August 1961, led to increased awareness and funding for marine biology / biological oceanography, and in 1968 a separate biological oceanography program was established in the BMS directorate.

Also within BMS, a biological facilities program was established in 1959. This unit would eventually facilitate marine expeditionary research, including support for the construction of the R/V *Eastward* (Duke University) and the R/V *Alpha Helix* (Scripps), as well as the conversions of the motor sailer *Te Vega* (Hopkins Marine Station) and the former presidential yacht USS *Williamsburg* later rechristened the R/V *Anton Brunn* – in

honor of the famous Danish oceanographer. The R/V *Anton Brunn* was owned by NSF but was later chartered to Woods Hole to support biological investigations during the International Indian Ocean Expedition in the early 1960s. So for many years and to many people – at least for those associated with the BMS division at NSF and marine researchers at many universities – "oceanography" was synonymous with biological oceanography.

In March 1967 a new oceanography program was established within the MPES Division of Environmental Sciences with separate offices for physical oceanography, submarine geology and geophysics, and oceanographic facilities. However, as Sandra Toye remarks in her excellent account of the administrative history of NSF in *Fifty Years of Ocean Discovery*, "NSF's early and enduring decision to organize research support by discipline was, for many years, a source of difficulty for oceanography…Profoundly interdisciplinary, it (oceanography) would not find a unified home in the NSF research support portfolio until 1970…" This came about through a major reorganization of NSF, one that transferred the biological oceanography program from BMS to the Ocean Science Research Section (OSRS) of the Division of Environmental Sciences under a new assistant director for research. Finally, after twenty years of NSF existence, there was a single consolidated program for the multidisciplinary study of the oceans. This facilitated the planning and execution of the International Decade of Ocean Exploration program (see *Box 5.3*) which began in 1970 under the assistant director for national and international programs.

Also in 1970, at the height of the Vietnam War, the Mansfield amendment to the defense appropriation act was passed by congress. This legislation forbade the defense department, including ONR, from supporting research that was not relevant to its primary mission – i.e., national defense. Thus began the shift of emphasis in many disciplines, including marine sciences and especially physical oceanography, from ONR to NSF sponsorship.

In July 1974, the marine chemistry program was established within the OSRS and a few years later, in 1977, there was another reorganization at NSF to create the directorate for Astronomical, Atmospheric, Earth and Ocean Sciences (AAEO) which included a Division of Ocean Sciences. Finally, in 1998, the Directorate for Geosciences, the current home for ocean sciences, was established at NSF.

Since its inception, NSF has awarded investigator-initiated grants to individuals or research teams as their core mission. Many UH marine scientists have received NSF project grants over the years. In addition, NSF funds have also provided specialized instruments and analytical facilities, and laboratory buildings as detailed in subsequent sections of this book. NSF funding has also largely supported the operation of the national fleet of research vessels (see *Box 5.2*).

3.6. The Waikiki Aquarium (1904), Cooke Memorial Marine Laboratory (1920), Hawaii Marine Laboratory (1951), and Hawaii Institute of Marine Biology (1965): The Evolution of UH's Marine Biology Field Stations

We need men who can dream of things that never were"
John F. Kennedy
(1917-1963)

According to a historical account by Leslie Matsuura in *Building a Rainbow*, the original Honolulu Aquarium opened to the public on 19 March 1904 as a private project under James B. Castle, Charles M. Cooke, and Lorrin A. Thurston, then directors of the Honolulu Rapid Transit Authority. The main purpose of the new aquarium was to attract the public to Kapiolani Park, the end of the transit line. Named in honor of Queen Kapiolani, the consort of King Kalakaua and the grand-daughter of the last independent King of Kauai, Kapiolani Park was the center of leisure activity at that time including a horse track, polo fields, a bandstand, ponds and gardens, a public bath house in addition to the new aquarium.

The aquarium was initially constructed on the seaward edge of Kapiolani Park close to the present Queen's Surf pavilion (Figure 3.11). Frederick Potter, a clerk for the Honolulu Rapid Transit Authority, served as the aquarium's first director from 1904-1940; the second director, Spencer Tinker served from 1940-1972, followed by Leighton Taylor, and Bruce Carlson (note: Following Carlson's resignation in May 2002, Cynthia Hunter was appointed acting director. On February 2004, the UH-BOR confirmed Andrew Rossiter – then deputy chief of the aquarium at Lake Biwa Museum in Japan – as the new director. Tinker and Taylor were also faculty members in the department of zoology, so – at least in the past few decades – there was a strong connection to UH. The present aquarium, also part of UH, was completed in January 1955, on the Diamond Head side of the old site (Figure 3.12). Since that time, plans for expansion and relocation of the aquarium have periodically emerged (see *Box 3.10*).

At the time of its creation, the Honolulu Aquarium had no basic research mission. According to E. Alison Kay's authoritative account of the history of biological sciences at UH that was published in *Malamalama: A History of the University of Hawaii* (Kamins and Potter 1998), William T. Brigham – the first director of the Bishop Museum – and William Alanson Bryan – professor of zoology at the College of Hawaii – were the founding fathers of UH biological sciences. Bryan proposed "a scientific institution for the study of oceanography with a headquarters in Honolulu."

Figure 3.11: Images of the Honolulu Aquarium / Waikiki Aquarium in what is now called Kapiolani Park (named after the Queen whose statue is shown here at right center) – then (circa 1910, lower left; from *Kapiolani Park, a history* by Robert R. Weyeneth, 2002) and today (top). The line of palm trees shown at center – easily recognized today – formed the entrance corridor of the original aquarium shown at lower left. The current Waikiki Aquarium building, completed in 1955 (see Figure 3.12) is Diamond Head of the original location. The recently restored streetcar shelter (bottom right) marked the "end of the line" for electric streetcar #78 circa 1905 (shown at bottom left; collection of Paul Ward). (photos, except as noted above, by D. Karl; collage design by N. Hulbirt)

Figure 3.12: Ceremonies marking the dedication of the "new" Waikiki Aquarium building in January 1955. Dignitaries at bottom include Spencer Tinker (left) – then director of the aquarium – and UH President Sinclair (second from left). (from UH at Manoa Masao Miyamoto collection; negative package A55-00001)

***Box 3.10*: A "New" Waikiki Aquarium**

Approximately every half-decade, or so it seems, at least for 25 years, a new plan is presented for an upgrade and expansion of the Waikiki Aquarium. Usually the primary focus is on public displays and tourist dollars, with a casual mention of marine research. Since the Hawaii Marine Laboratory (predecessor to the Hawaii Institute of Marine Biology) and the Pacific Biomedical Research Center were formed to focus on marine research, the mission of the UH-operated Honolulu/Waikiki Aquarium has been on education and public outreach.

On 21 November 1988 it was reported in the *Honolulu Star-Bulletin* that Charles Helsley, then interim dean of SOEST, predicted that within 10 years the Waikiki Aquarium will have a new facility combined with a new UH fisheries research institute as the centerpiece for the planned 120-acre waterfront development located between the entrance to Honolulu harbor and Kewalo Basin – if he had his way. Unfortunately, this vision was unable to override the city's plans for the Kaka'ako Waterfront Park built on the same former landfill. One more aquarium expansion plan foiled!

Then on 14 November 2002 the headlines of *The Honolulu Advertiser* read: "Aquarium plan emerges." The Andrew Gomes article revealed a new $200-250 M facility to be located on a 10.4-acre Kaka'ako waterfront property near the existing Kewalo Basin marine laboratory. According to the article,

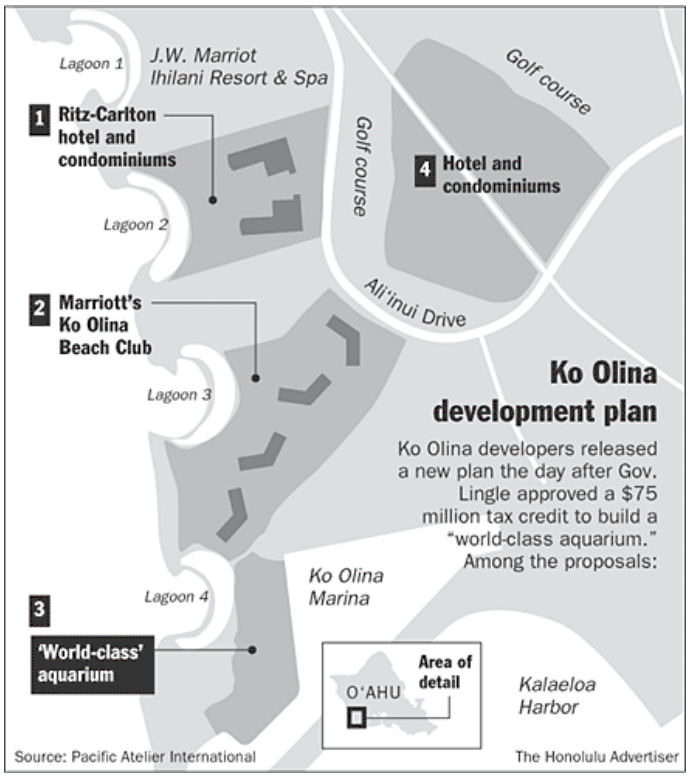
An architect's rendering of the proposed Kaka'ako aquarium that would be located on a 10.3-acre site at Point Panic near the entrance to Kewalo Basin (from Honolulu Star-Bulletin *[http://starbulletin.com/2003/03/06/business/story1.html], story by Russ Lynch, drawing by Esherick, Homsey, Dodge and Davis)*

continued

***Box 3.10*: A "New" Waikiki Aquarium (continued)**

this new facility would provide UH with an "expanded marine mammal lab and create marine research facilities for the university and other users." Funding would have to come from private sources including equity investors, venture capitalists, and gifts. This plan could develop into a world-class center, or it might take a place on the shelf with several other failed plans for the renovation and expansion of the aquarium facilities – we shall see!

In May 2003, the state legislature approved a $75 M tax credit for construction of an aquarium in the resort community of Ko Olina. This development will be part of a $500-700 M construction project that will also include a hotel, two condominiums, a commercial village with retail shops and restaurants, and – of course – a golf course or two. It is uncertain if or how this "world class aquarium" will intersect with marine science programs at UH.



Map showing the location of the proposed Ko Olina "world-class" aquarium and other planned developments (from The Honolulu Advertiser *[http://the.honoluluadvertiser.com/article/2003/Jun/02/bz/bz03a.html] article by A. Gomes, drawing by Pacific Alelier International)*

According to the *College Records*, No. 8, 1911-1912, there was already a formal course in oceanography nearly 50 years before the field of study would emerge (see section 4.5). The course description was: lectures, observations, laboratory, and library assignment. A general survey of the ocean as a great natural realm, with a view to bringing out its bearing on the facts underlying such subjects as geology, botany, zoology, evolution, distribution, climatology, etc. Some knowledge of physics, chemistry, zoology, and botany is desirable. 1st semester, 3 credits. Professor Bryan, instructor. In *College Records* No. 13, 1915, a textbook – Murray and Hjort's *The Depths of the Ocean* – was added as required reading for this course.

According to *College Records* No. 9, 1913, there was a well articulated need for "A Marine Biological Laboratory for Hawaii" based on a paper by zoology professor Allan Herbert. The plan called for a seashore laboratory at Waikiki, in the park adjacent to the aquarium. A seaside lab, when available, the report stated, "would give the college access to the fascinating world that lies hidden in the ocean." Then in *College Records* No. 16, the College of Hawaii Report of BOR to Legislature for 1917, it was announced that "The most noteworthy advance made during the past two years in the development of the department of zoology has been the securing of temporary quarters on pier 6 for the equipment of a small laboratory on Honolulu harbor." This provided easy access to the sea for students and staff alike. However, it was emphasized that, "this in no way lessens the demand for the establishment of a properly located and thoroughly equipped marine biological laboratory." Again, Professor Bryan was at the helm of this major step forward for the emergent field of marine biology.

Finally, in 1919 (*College Records* No. 18), marine research facilities began to materialize. It was announced that "the Honolulu Aquarium stands on government land the lease of which will expire on 3 June 1919. The land will then pass into the Waikiki park system. The aquarium, however, has possibilities far beyond its use as a show place, excellent as that is. As a beginning for a marine biological station it opens up the opportunity of carrying on scientific investigations and instruction of the very highest value." This report, submitted by Arthur L. Dean – then president of the College of Hawaii – further stated that by change in existing laws it would be possible to turn over the two existing lots at Waikiki where the aquarium now stands to the BOR of the College of Hawaii to establish a marine research laboratory in connection to the aquarium. The plan would also "put at least two men at work on investigations, one a trained biologist, the other a man with experience in fish hatchery work." The Territorial Legislature of 1919 placed the Honolulu Aquarium under the care of the College of Hawaii. The Charles M. Cooke Estate generously provided $10 K for the construction of a laboratory for marine zoology in conjunction with the aquarium. This facility, the Charles M. Cooke Memorial Marine Laboratory, was ready for use in summer 1920.

That same year, 1919, the Legislature enacted a bill to create – in 1920 – the University of Hawaii. According to *College Records* No. 20, 1920-1921, the faculty was expanded to include Charles H. Edmondson (MS, University of Iowa, 1904; PhD, University of Iowa, 1906) as professor of zoology. (note: Mr. William Bryan who had handled work in marine zoology and had worked tirelessly to establish new programs in marine biology, left in summer of 1919. An arrangement was entered into with the Bishop Museum whereby the new professor of zoology, Charles Edmondson, would be on the staff of the museum as well as the university.)

Professor Edmondson had previously worked at Carnegie Institution's Tortugas Laboratory (see *Box 3.11*), one of our nation's oldest marine research facilities. As already mentioned, this new faculty position was funded jointly by the Bernice P. Bishop Museum and UH, so Edmondson spent part of his time at each institution. He also became the founding director of the newly acquired Cooke Memorial Marine Laboratory, which was administratively separate from the Honolulu Aquarium. According to a

biography of Edmondson written by Hank Banner, the "Beach Lab," as it was called in those days, was to become an active center for diverse marine research activities over the next few decades. Edmondson served as director until 1943 when he retired. He sustained an active research program until 1961 when, at the age of 85, he was forced into full retirement by failing health. Edmondson Hall, the present home to the Department of Zoology, was dedicated on 25 October 1962 as a tribute to his pioneering leadership and outstanding scientific contributions in marine biology (Figure 3.13).

Box 3.11: **Charles H. Edmondson and the Tortugas Laboratory**

In 1902 the trustees of the Carnegie Institution of Washington established a tropical marine biology laboratory at Dry Tortugas, Florida approximately 100 km west of Key West. It was hoped that this laboratory would become the "Naples of the west," comparable in scope and stature to the Stazione Zoologica of Naples (Colin 1980). The laboratory buildings were assembled in New York and transported by schooner to Tortugas. A 17-m ketch-rigged research vessel, R/V *Physalia*, was also constructed for the new laboratory. The laboratory opened in spring of 1905 and during its first 15 years of existence it supported the research of many notable marine biologists including T. Wayland Vaughan who moved to Scripps Institution of Oceanography in 1924 to become their founding director.

According to an authoritative account written by P. Colin (1980), Charles H. Edmondson also studied at the Tortugas laboratory as a new PhD from University of Iowa; this was 1906. This is where Edmondson received the specialized training in marine biology that was so crucial for the eventual development of programs in Hawaii two decades later.

In 1911, the *Physalia* was replaced by the newly constructed *Anton Dohrn*, a 70-foot yacht built at a cost of $25,000. The vessel was named after the famous marine biologist who was also the founding director of the Stazione Zoologica of Naples. The Tortugas Laboratory was closed in 1918 due to World War I; it reopened in 1919. In 1922, after the death of Alfred Mayor, the long-term proponent of marine biology at the Carnegie Institution, the Tortugas laboratory, and marine biology in general, were relegated to a minor position in the Carnegie's activities. In August 1939 the laboratory "closed its doors" (Colin 1980) and the R/V *Anton Dohrn* was donated to Woods Hole Oceanographic Institution. In 1964, the Tortugas laboratory buildings were destroyed by fire; the facility was never rebuilt.

Following World War II, the late Edwin Pauley became one of several owners and eventually the sole owner of Moku O Lo'e or Coconut Island, located in the south basin of Kaneohe Bay on the windward side of Oahu. Once owned by the Bishop Estate, then by Fleischmann yeast heir Christian Holmes, the 25-acre island would eventually become a centerpiece of the emergent marine sciences programs at UH. In 1948, with Pauley's support and financial assistance, a marine biology laboratory was established on Coconut Island using disowned wooden military buildings. In 1951 this facility officially became the Hawaii Marine Laboratory (HML); it was the first major research unit on the UH campus and the beginning of the "organized research unit" (ORU) structure. The administration of the HML was eventually combined with the Cooke Memorial Marine Laboratory under a single director, at that time Robert Hiatt (see *Box 3.7*).

According to Hiatt's own account of the historical developments of the HML published in *Malamalama: A History of the University of Hawai'i*, UH obtained an army surplus target-towing launch as its first research vessel in 1951; it was "46-feet long and well-outfitted, had a good-sized deck and a good engine." The ex-army vessel was renamed the *Salpa* (Figure 3.14).

Figure 3.13: Charles Howard Edmondson (center) with well-wishers, including Spencer Tinker (far left) and Hank Banner (to Tinker's right) at the dedication of Edmondson Hall on 25 October 1962. (from UH at Manoa Masao Miyamoto collection; negative A62-00187)

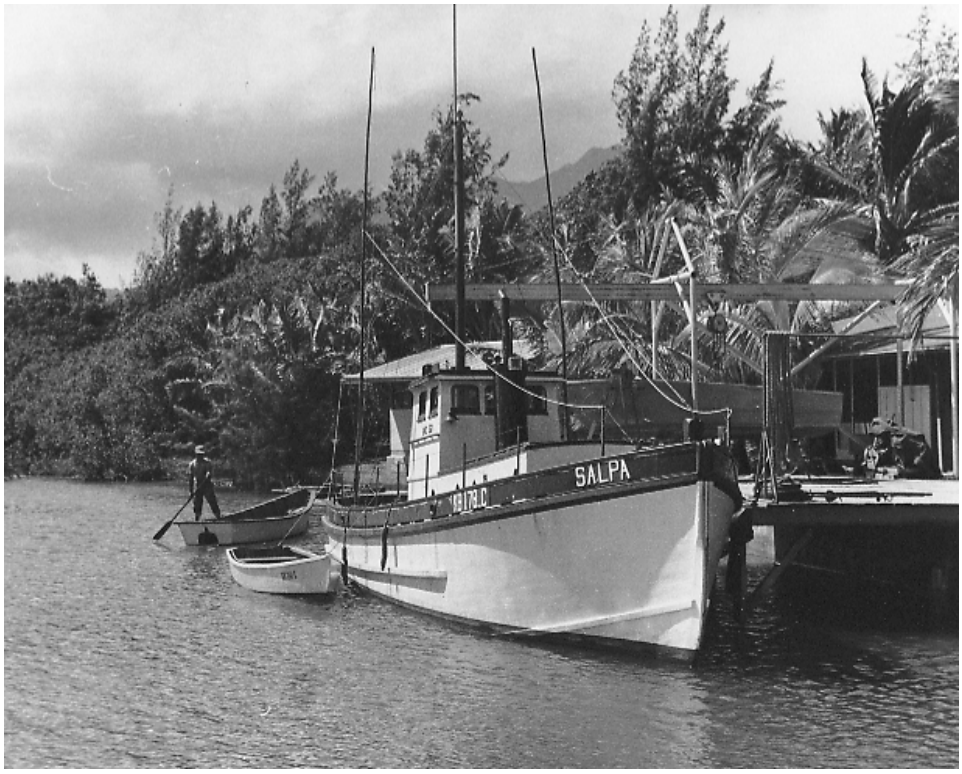


Figure 3.14: The (research vessel) *Salpa* at its berth at the Hawaii Marine Laboratory on Coconut Island circa 1959. (from UH at Manoa Masao Miyamoto collection; negative B59-00004).

In 1951, Edwin Pauley provided a gift of $10 K to help support the new lab. Hiatt was able to get the Rockefeller Foundation to donate another $10 K – so the HML began to take shape (Figure 3.15). The laboratory on Coconut Island received international attention and acclaim when it was featured as the cover story of *The National Geographic Magazine* in October 1959. The article, "Unsung beauties of Hawaii's Coral Reefs," included photographs by *National Geographic* senior staff member Paul A. Zahl that featured the new 50th state and the UH's marine programs. Zahl's personal tour guides for this visit to Hawaii were Hank Banner – then director of the HML – and Vernon Brock – then director of the Hawaii branch of the Bureau of Commercial Fisheries and later founding chair of the Department of Oceanography and director of the Hawaii Marine Laboratory and Hawaii Institute of Marine Biology (see Figure 3.16). UH marine programs were riding a big wave!

Figure 3.15: The original laboratory building at the Hawaii Marine Laboratory on Coconut Island, circa 1959. This structure and its contents were destroyed by fire on 31 December 1961. (from UH at Manoa Masao Miyamoto collection; negative B59-00004)

Then tragedy struck. On 31 December 1961, the main building of the HML on Coconut Island was destroyed by fire. According to news accounts, the old army surplus building – constructed of wood – burned to the ground in about one hour; no cause was determined. Fortunately, no one was injured, but the fire destroyed data and equipment. Hank Banner, the laboratory director at that time, reportedly lost 4 years of data on fish toxins, 7 years of data on snapper shrimp, and 3 years of data on shark behavior, in addition to numerous manuscripts that were in preparation; there were no "back-up computer files" in 1961! Phil Helfrich, a future director of the laboratory, was Banner's collaborator on many of these projects (Figure 3.17). This was an enormous loss for the UH marine sciences programs.

Figure 3.16: UH marine programs hit the "big time" with a cover story in *The National Geographic Magazine* in October 1959 (center). Two key individuals who helped make this all happen were (left) Hank Banner and (right) Vernon Brock. (from The National Geographic Society)

Figure 3.17: A young Phil Helfrich (left) who would later become a key figure and director of the Hawaii Institute of Marine Biology, and Hank Banner – then director of the Hawaii Marine Laboratory – conducting research on fish, circa 1961, before the December 1961 fire. The *Salpa* is in the background. (from UH at Manoa Masao Miyamoto collection; negative B61-00054)

Fortunately, the lab would eventually be rebuilt. NSF provided $350 K and the new laboratory was completed in 1964. In 1965, it was renamed the Hawaii Institute of Marine Biology (HIMB) to reflect its broader and more integrated scientific mission (see section 4.11).

3.7. UH Marine Research at Enewetak Atoll: 1954-1980s

"Now we are all sons of bitches"
Kenneth Bainbridge
(1904-1996)
(remark after directing the first atomic test, Trinity, in New Mexico on 16 July 1945)

Following the end of World War II, the US began an aggressive program of research and testing of nuclear weapons in part centered in the Northern Marshall Islands. Between 1946 and 1958, 43 nuclear devices were tested at Enewetak atoll (see *Box 3.12*). This nuclear weapons testing program was coordinated by the newly created AEC. The AEC was also concerned with broader issues such as peace-time applications of nuclear technology and the ecological and biogeochemical effects of radioactive contaminants. Much of the research at the HML in the 1950s focused on this relatively new field of marine radiobiology, partly in support of AEC-sponsored radiation toxicity studies.

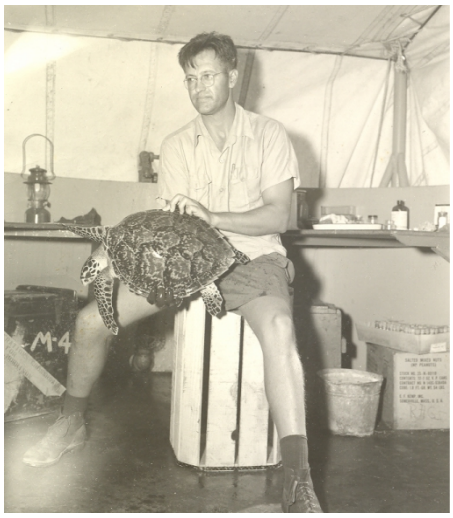
A National Academy of Sciences committee was established to assess the state of knowledge on the Biological Effects of Atomic Radiation; the committee was called "BEAR." Roger Revelle – then a professor at Scripps Institution of Oceanography – was BEAR Chair for the Study Group of Oceanography and Fisheries, and Howard Boroughs – then an associate professor in the UH Department of Zoology and Entomology and instructor for a course on isotopic tracers in biology – was a member of the 17-member group that also included Ed Goldberg, Harmon Craig, Benny Schaeffer, Allyn Vine, Warren Wooster, and Bostwick Ketchum. According to minutes from a 3 March 1956 meeting at Princeton University, Boroughs presented his report on "Fission Production Metabolism in Marine Organisms." His presentation to the study group described in detail how he and his UH colleagues conducted their pioneering tuna feeding experiments using strontium-89. The radioactive material, as carrier-free strontium chloride obtained from the Oak Ridge National Laboratory, was absorbed into cracker crumbs and placed into ordinary pharmaceutical capsules before force feeding. After various periods of time a mass balance was made to determine the distribution of radioactivity incorporated into various tissues and that excreted into the surrounding seawater. This work very likely served as the basis for subsequent radionuclide research at the Enewetak and Coconut Island marine laboratories. According to an article written by Tomi Kaizawa and published in the 22 October 1958 edition of the *Honolulu Star-Bulletin*, "the US-AEC has underwritten a study of the relation of radioactivity to fish toxicity and to determine how various fallout materials from atmospheric nuclear weapons testing enter the marine food web." By 1959, Boroughs was no longer listed as a faculty member in the UH general

catalogue, apparently replaced by a new assistant professor – Signey Townsley – who continued Boroughs' research in marine radiobiology (Figure 3.18), along with Robert Hiatt, Hank Banner and Phil Helfrich.

Box 3.12: **The Pacific Proving Ground – UH Legacy**

"In bad times, you make only bad decisions"
Anonymous
(Sanskrit proverb)

The calm tropical marine climate that characterizes the Marshall Islands was shattered in July 1946 when the US began an aggressive program of atomic weapons testing first at Bikini atoll and later at Enewetak atoll – the so-called Pacific Proving Grounds. During July-August 1946, the US military conducted Operation CROSSROADS to determine – "in a controlled way – the effects of nuclear weapons on ships, equipment, and material." Overall, more than 90 target vessels and 45,000 men were involved – including marine biologist Vernon Brock who would go on to become the founding chairman of the Department of Oceanography in 1964; see section 4.6. These first tests (shot ABLE and shot BAKER) were conducted at Bikini atoll in the Marshall Islands (http://www.dtra.mil/news/fact/nw_crossroads.html).



In July 1946 the US military conducted Operation CROSSROADS to determine, in a controlled way, the "effects of nuclear weapons on ships equipment and material." Among the 42,000 men who participated on site during the CROSSROADS operation (1 July – 31 August 1946) was Vernon Brock, shown here at left. Brock was selected to assess the effects of nuclear weapons on marine life. He later became the founding chair of the Department of Oceanography and the director of the Hawaii Marine Laboratory / Hawaii Institute of Marine Biology. (official US Navy photo)

On 1 November 1952, the first hydrogen weapon test with the code name "Mike Shot" was detonated on Enewetak atoll. The 10.4-megaton explosion was nearly 1,000 times more powerful than that which annihilated Hiroshima in 1945, to end World War II. By 1958, 43 nuclear devices were tested at Enewetak and 23 at Bikini including surface, tower-mounted, underwater, and air-drop detonations. This program was to have long-lasting environmental, social, and political consequences for both the local inhabitants and the global community as we entered the "cold war." An authoritative account was published by Neil Hines in his book *Proving Ground: An Account of the Radiobiological Studies in the Pacific 1946-1961*.

Even before the atomic weapons testing program began, World War II had devastated the islands, the inhabitants, and their culture. According to Robert Kiste in his book, *History of the People of Enewetak atoll*, the Japanese occupied and fortified the islands and, in 1944, an American invasion nearly denuded Enewetak island and eventually led to forced abandonment of the islanders' homeland as the US prepared their former home for weapons testing programs to come.

Continued

Box 3.12: **The Pacific Proving Ground – UH Legacy (continued)**

Following the termination of nuclear tests, the people of Enewetak petitioned the United Nations for help in repatriation. In 1970 the US Congress provided $1 M to the people of Enewetak, the first of many payments. On 18 April 1972, after intensive international legal battles, the US announced that it would surrender Enewetak by the end of 1973 after they completed their "mission" there. What was not publicly disclosed at that time was a plan for a new round of non-nuclear, multiple ton detonations – the Pacific Area Cratering Experiments (PACE). After additional protest by the Enewetakese, the Department of Defense cancelled PACE and in April 1980, after several years of radiological surveys and cleanup, the atoll was finally returned to its former inhabitants.

Thus ended a portion of US history that no American can be proud of. The UH, through their AEC-sponsored marine research at the Enewetak and Coconut Island laboratories (see section 3.7), is now part of that history of nuclear weapons testing.

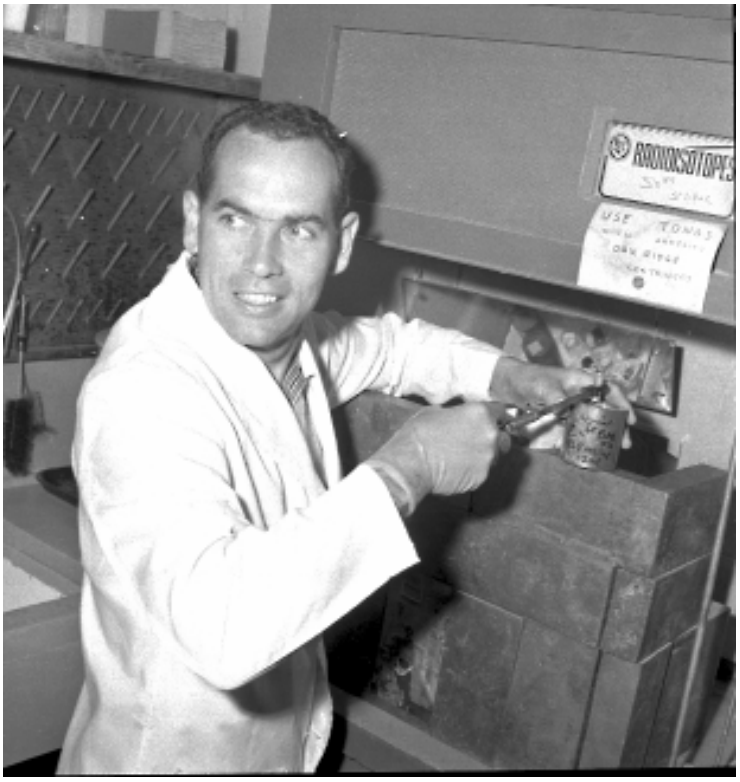


Figure 3.18: Radiobiology laboratory at the Hawaii Marine Laboratory on Coconut Island where Sid Townsley and others conducted pioneering research on the effects of radioactivity in marine ecosystems. The posted advice in these experiments using strontium isotopes was "use tongs." (from UH at Manoa Masao Miyamoto collection; negative B59-00004)

According to an authoritative account of historical developments of the research conducted at Enewetak atoll written by Phil Helfrich and Roger Ray, the eminent marine biologist H. Burr Steinbach of the University of Chicago and later inaugural dean of students at WHOI, was asked by Sidney Galler of ONR to visit Enewetak to consider the feasibility of establishing a marine biological laboratory that would focus, in part, on studies of radiation exposure on marine organisms. Steinbach recommended, and AEC officials agreed, that UH should be contracted to construct and operate a field facility. On 3 June 1954, a contract was signed to establish the Enewetak Marine Biological

Laboratory (EMBL) on the island of Medren; Robert Hiatt, then director of HML, was appointed the inaugural director of EMBL.

Nuclear testing in the Marshall Islands ended in 1958 as a result of a bilateral US-USSR moratorium. In 1960, AEC transferred the administration of the Pacific Proving Ground to the US Navy, and in 1961 the EMBL moved from Medren to Enewetak Island where there were better support facilities. In 1969 the laboratory would move once again and a new director, Vernon E. Brock – the inaugural chair of the Department of Oceanography (see *Box 4.6*) – was appointed. There was also a name change to the Mid-Pacific Marine Laboratory (MPML) to emphasize a broader research mission. A few months later, Philip Helfrich was named director of MPML, a position he would hold until 1 January 1975 when Stephen V. Smith, then a researcher at HIMB, became the director.

About this same time, the AEC was reorganized and it emerged as the new Energy Research and Development Agency (ERDA) which, after a relatively brief existence, became the US Department of Energy (DOE) in 1977. The MPML facility would make one final move to a former US Coast Guard LORAN station in 1978 and undergo another name change to the Mid-Pacific Research Laboratory when it adopted an expanded terrestrial and marine research mission. DOE funding for the laboratory was terminated in 1982, but research continued for several years under alternative sponsorship. In 1987 a two-volume treatise "*The Natural History of Enewetak Atoll*" reviewed the 30 years of diverse research conducted at this remote tropical laboratory.

3.8. Hawaii Institute of Geophysics (HIG) – The Humble Beginnings of a World-Class Organization

"Things are always best in their beginning"
Blaise Pascal
(1623-1662)

A building does not an "institute" make; the latter requires intellectual resources including faculty, staff, and students. However, a specialized, fully equipped building certainly does facilitate matters. So it was with HIG, a novel institute that was not fully functional as a specialized research unit at UH until the HIG building was completed in 1965. Prior to this physical consolidation, HIG functioned only in name with its key personnel scattered across the UH at Manoa campus. Founding director George Woollard would later refer to this early period of HIG's history as being a "paper organization."

According to an informative *Honolulu Star-Bulletin* account of key benchmarks in the development of HIG, an initial gathering of scientists in 1953, Robert Hiatt among them (note: At that time Hiatt was chairman of the Department of Zoology and director

of the HML), drafted a proposal to the Rockefeller Foundation with the hope of obtaining a $50,000 grant to establish a laboratory for geophysical research on the UH campus. As mentioned previously, the Rockefeller Foundation had a long tradition of sponsoring marine research and education programs, most notably at Scripps and Woods Hole (see section 3.3). The UH proposal, however, was declined. The next step would be an attempt to establish a federally-sponsored geophysical laboratory that would be patterned after the Alaska Geophysical Institute established by the US Congress in the late 1940s.

On 22 October 1954, the UH-BOR endorsed an *ad hoc* committee report to establish a geophysics institute as part of the university and formed a formal 11-person faculty committee to oversee the development. Wendell A. Mordy, a Pineapple Research Institute scientist, and Robert Hiatt presented key testimony to the BOR before they reached their decision to move forward with planning. According to news reports at that time, the institute would include "oceanography, meteorology, cloud physics and allied subjects." Mordy was subsequently named chair of the geophysics institute planning committee.

On the national level, Hawaii's congressional delegates worked to gain NSF support for this project. In 1955, with the support and leadership of John A. Burns, then a delegate for the Territory of Hawaii, congress passed a joint resolution charging NSF with conducting an evaluation of the need and the feasibility of such an institute and directed them to report back to congress with their recommendation. The "blue-ribbon" panel selected to evaluate Hawaii as a site for conducting research in earth and ocean sciences included William Benson, Phil Abelson, Cecil Green, King Hubbert, William Rubey, and A. E. Eckhardt.

According to a historical account of this matter in J. Merton England's book, *A Patron for Pure Science: The National Science Foundation's Formative Years, 1945-1957*, the visiting committee found that conditions were remarkably favorable for the creation of a geophysical institute at the University of Hawaii. "Excellent leaders, active research interest and support, good cooperation with local industry and federal installations, and important geophysical problems in the insular environment" were among the arguments for a positive recommendation. NSF's Earth Sciences Advisory Committee unanimously endorsed the report, recommending the establishment of a geophysical institute in the territory, but the MPE divisional committee at NSF was less enthusiastic; according to England – the latter vote was two for, three neutral, three against. In the end, NSF's director Alan Waterman took a positive recommendation to the National Science Board, and bills were introduced in congress in 1956 and 1957 by the congressional representatives for the Territory of Hawaii. A few years later, the US Congress established the institute (see section 4.2)

Back home at UH, hopes were running high and preparations were being made for congressional approval of the plan. In a 4 April 1955 editorial published in *The Honolulu Advertiser* it was announced that the NSF program director of earth sciences would be coming to Hawaii to discuss with the UH administration the establishment of a geophysical institute. According to the article, all earth sciences, from water to soil to

weather, would be combined into a single "intellectual center" to foster true interdisciplinary study of complex natural phenomena. The article also emphasized that there is no place in the world where a center can be more effectively located because scientists in Hawaii are "living in a geophysical laboratory."

In March 1956, at a UH-sponsored public forum on "The University Looking Forward", Kenichi Watanabe, senior professor of physics, discussed the proposed creation of HIG. The following year, the university distributed a prospectus describing a formal business plan for HIG. Robert Hiatt, then dean of the university's graduate school, director of research and chief of the institute's advisory board, indicated that once established the institute would be able to support itself in perpetuity from federal research grants. In an article published in *The Honolulu Advertiser* on 1 February 1957, Hugh Lytle optimistically predicted that "Come the International Geophysical Year (see *Box 3.13*) and establishment of our Hawaii Institute of Geophysics, this place will be jumping with the kind of brains that will turn the University of Hawaii into the University of the Pacific."

Box 3.13: **IGY (1952-1959): The Beginning of "Big Science"**

According to an authoritative account of "big" ocean science programs written by Feenan Jennings for the National Research Council's book, *Fifty Years of Ocean Discovery*, the International Geophysical Year (IGY) was initially proposed as the Third Polar Year by Lloyd Berkner of the Carnegie Institution (note: The First Polar Year was in 1882-1883 and the Second Polar year was in 1932-1933). The concept was adopted by the International Council of Scientific Unions (ICSU), and in 1952 was expanded to include a detailed geophysical study of the entire Earth, including its oceans; G. Laclavére, a French scientist, had lead responsibility for the oceanography component of IGY. At the urging of the NAS, NSF was selected as the lead agency for US science planning within the IGY, planned for 1957-1958 with logistical support from the US Navy, especially for "Operation Deep-Freeze" in Antarctica. According to the NAS website, the records of the IGY in their archives occupy 360 linear feet, including 250 linear feet of paper records, 100 cubic feet of motion picture film, and 10 linear feet of photographs, maps, and, posters! In her article on the history of NSF published in 2000, Sandra Toye characterized IGY as unquestionably big science" – it involved 30,000 scientists and technicians from 66 countries collectively investigating planet Earth. The stated IGY mission was "to observe geophysical phenomena and to secure data from all parts of the world; to conduct this effort on a coordinated basis by fields, and in space and time, so that results could be collated in a meaningful manner."

Two significant Hawaii programs that had their origins with IGY were the Mamala Bay ocean productivity time-series program initiated by UH marine scientist Maxwell Doty at a station outside of Pearl Harbor and the atmospheric carbon dioxide time-series measurement program on Mauna Loa, Hawaii initiated by Charles (Dave) Keeling and Roger Revelle; the latter measurement program is still in existence today after more than four decades of data collection and analysis. The IGY ocean productivity time-series program was the predecessor to the Gollum time-series program undertaken by UH oceanographers in the late 1960s; these efforts led eventually to the contemporary Hawaii Ocean Time-

continued

Box 3.13: **IGY (1952-1959): The Beginning of "Big Science" (continued)**

series (HOT) program that was initiated in October 1988. The NRC ocean studies and polar research boards of the NAS (see *Box 3.1*) also grew out of IGY.

The US science budget for IGY, all new money, was approximately $43.5 M for the planned 18-month campaign; ocean sciences was allocated $2 M, most of which went to Columbia University, Scripps, Texas A&M University, University of Washington, and WHOI. However, IGY would have a major, positive impact on marine sciences as a whole and would lead to the development of the Hawaii Institute of Geophysics and the development of marine expeditionary research at UH. It would also fuel other international "big science" programs like the International Indian Ocean Expedition (IIOE) from 1962-1967, and the International Decade of Ocean Exploration (IDOE) from 1971-1980; UH would have major science leadership roles in these follow-on marine research field programs.

Even before IGY had ended, there was great interest in other potential international programs including those with an ocean focus. According to Feenan Jennings, ICSU invited Roger Revelle, then director of Scripps, to appoint a special subcommittee to examine the needs for marine science; this was the start of the Scientific Committee on Oceanic Research or SCOR. From that point on, oceanographers have always had a role in the affairs of ICSU.

The first SCOR meeting, held in August 1957 at Woods Hole, planted the seed for the IIOE. The least studied of all major ocean basins, the Indian Ocean was a potentially important region for biological production; the monsoonal winds made it a unique natural laboratory for marine meteorology and ocean physics.

In April 1962, NSF Director Alan Waterman signed directive O/D-102 establishing the NSF Coordinating Group on Oceanography (CGO) and tasked them with the coordination of ships and other facilities that would be needed for this new field research program. By the end of 1967, the US contribution to the IIOE program was nearly $13 M including nearly $1 M awarded to UH scientists Klaus Wyrtki and Colin Ramage who led the marine meteorology component.

In many regards, IGY was the seed for the eventual growth and promotion of big science, much of which demanded multiple ships and other complex infrastructures. Proponents for the move into big ocean science programs argued that big questions required big science; large-scale observations or experiments could never be done by an individual or even a small team of collaborators. Others, including the great oceanographer Henry Stommel, responded that "breaking new ground in science is such a difficult process that it can only be done by an individual mind." Over the years there has evolved a mix of big and small ocean science programs in the federal portfolio, and this is likely to continue well into the future.

The following month, the university sponsored a "Symposium on Oceanography" as one part of their 50th anniversary celebration. Two distinguished oceanographers, Hans Pettersson, the former Director of the Oceanographic Institute of Göteborg, Sweden and former UH faculty member, and Norris W. Rakestraw of the Scripps Institution of Oceanography, spoke about oceanography in the 20th century. They both urged the establishment of a geophysical institute, one that Pettersson said should "embrace oceanography" and be equipped with vessels for deep-sea research. The symposium chair, physics professor Walter Steiger (note: Later, in retirement, Steiger would become a key member of the UH-BOR), told the audience that UH administrators were waiting for congress to act on a proposal to establish the institute and, of course, to provide funding for the HIG building (see section 4.2).

3.9. Crossing a Turbulent Sea Towards Departmental Status for Oceanography

Fisherman #1: "Master, I marvel at how the fishes live in the sea."
Fisherman #2: "Why, as men do a-land, the great ones eat the little ones."

William Shakespeare (1564-1616)
Pericles, Act 2, Scene 1

By 1950, a diverse portfolio of marine programs had already been established at UH, including the HML, the collaborative POFI, and related coursework and research conducted through the departments of zoology, botany, and chemistry. One course in particular, Zool 290 – Oceanography, "Theory and techniques of physical, chemical and biological oceanography with emphasis on the pelagic life of the oceans", instructor A. H. Banner, was an excellent introduction to the discipline. Another key course was Zool 200 – Science of the Sea "Origin, water movements, life, oceanographic exploration, fertility, fisheries", instructor R. Hiatt (note: This course would later, in 1959, change to Zool 201 – Science of the Sea and eventually to Ocean 201 – Science of the Sea when the Department of Oceanography was created in 1964.) Additional marine science courses were also available at this time.

On 1 August 1956, two years before HIG was established (see section 4.2), Robert Hiatt, then UH dean of the graduate school and director of research, convened an *ad hoc* committee to determine whether it was appropriate to establish oceanography as a graduate field of study for the MS degree at UH. The expected approval of a new geophysical institute provided new opportunities and thus, in Hiatt's words, "makes such a program desirable." This special *ad hoc* group served as a subcommittee of the parent committee on research and graduate study. It was chaired by Agatin Abbott, chairman of the Department of Geology and Geophysics, and included the following members: T. Austin (POFI), H. Banner (zoology), M. Doty (botany), I. Miyake (physics), A. Tester (zoology), and H. Zeitlin (chemistry). Specific areas to be investigated by the committee were:

- scope of the curriculum in oceanography
- demand at UH for this curriculum
- staff needs
- potential affiliated institutions and departments
- library and facilities needs

In his final charge, Dean Hiatt asked the committee to "move rapidly in order to take advantage of the interest which will be developed during the period in residence at UH of Drs. Hans Pettersson and Norris Rakestraw," two world-class marine scientists. Rakestraw, on leave from Scripps, was the first graduate dean of students in what many considered to be the best marine science academic program at that time. A positive

recommendation from this "blue ribbon" committee on oceanography would be carried forward by Hiatt, and others, with great vigor and momentum.

A meeting was called for 22 August 1956 at 3:00 pm in Austin's office at the POFI building. The one-sentence minutes of that initial meeting, distributed to the committee two months later, asked the members to submit to Chairman Abbott – as soon as possible – the suggested undergraduate preparation one would deem necessary for a prospective oceanography MS degree candidate. Clearly the committee seemed not to share Hiatt's urgency of this matter – despite being "hand picked" and presumably supportive of his oceanography initiative

A second meeting was held on 13 November 1956 from 3:15 pm to 4:30 pm where the above-mentioned topics were again discussed. Of the seven committee members, apparently only Doty, Zeitlin, and Miyake ever submitted suggested curricula within their disciplines, and this presumably served as the basis for subsequent discussion. The following verbatim decisions and recommendations were made at this second, and final, committee meeting:

1. That plans for a MS degree in oceanography be shelved, for reasons of lack of proper and sufficient course offerings and lack of teaching personnel.
2. That a MS degree be given in marine biology.
3. That the UH consider an undergraduate program in oceanography for future years.
4. That present course offerings in oceanography and closely related subjects be coordinated in content to avoid overlap of material and in time of offering to avoid crowding in one semester.

Dean Hiatt, the lead supporter of the "oceanography movement," was politely outraged by what appeared to have been a "turf protecting" whitewash of his marine program vision. He agreed to hold this project in abeyance until further development occurs, and assured the committee, in writing, that steps had already been taken to avoid overlap in course materials and course offerings. As for the remaining two recommendations, Hiatt stated that "it is contrary to administrative policy at this time to offer a MS degree in marine biology because I feel that it is more fundamental and appropriate to maintain our present MS degrees in zoology and botany," and "The remaining suggestion (to establish an undergraduate program in oceanography) will be turned over to the dean of arts and sciences whose responsibility this would become."

(note: While neither a MS degree program in marine biology nor a BS degree program in oceanography have ever been established at UH to date, a BS degree in marine biology was established in fall 2002 – currently administered through the biology program, College of Natural Sciences, and a BS degree in Global Environmental Sciences was established in 2000 – currently administered through the Department of Oceanography, School of Ocean and Earth Science and Technology; see section 10.3.)

Fortunately, for all future UH oceanographers, Hiatt was down but not yet out. He would eventually succeed in his efforts to establish a new graduate field of study and

department of oceanography, though it would take nearly six years for his proposals to get back on track (see section 4.5).