

## No. 2: Scientists and Naval Officers at Sea

In the Pacific, 1930-1940

Dr. Gary E. Weir

Business as Usual?:

In the decade before the Japanese attack on Pearl Harbor, Pacific oceanographic research labored in the shadow of the R/V *Carnegie* disaster of 1929. The unique and valuable ship exploded while at the pier in Apia, Samoa. This Carnegie Institution research vessel provided the ideal non-magnetic platform for geophysical research and accommodated virtually every other instrument for dynamic ocean surveys, lacking only a winch for deep dredging. During her seven cruises, *Carnegie* sailed through immense portions of the Pacific still waiting for thorough study. Losing this ship dramatized both the need for a well-equipped research vessel working regularly in the Pacific and the extent to which the Navy and civilian science still lacked very basic knowledge about the largest portion of the world ocean.

Although *Carnegie's* non-magnetic properties led many to emphasize its work on variations in the Earth's gravitational field, the Carnegie Institution's Department of Terrestrial Magnetism actually designed a much more diverse and ambitious program for the ship. They emulated the basic plan of the German Meteor Expedition which concluded successfully two years before the *Carnegie* tragedy. On her last cruise, the American vessel conducted geophysical experiments designed to examine the distribution of terrestrial magnetism over a wide expanse of ocean. The methodology employed required the crew and scientific staff to observe on their instruments the intensity of the directive force on the magnetic needle, as well as both the variation in the inclination of the Earth's magnetic field and any changes in magnetic declination between stations deliberately set at relatively close intervals. The Navy Hydrographic Office (Hydro) employed information on compass variation, magnetic inclination or Dip, and the horizontal intensity of the Earth's magnetic field gathered by *Carnegie* in its official charts for 1930.

The ship's staff had also collected data on atmospheric electricity and general meteorology, as well as the physical and chemical properties of the ocean. Scripps, the Carnegie Institution, and the vessel's surviving staff digested all of the information gathered on that seventh and final voyage and published a series of analytical papers as well as much of the data.<sup>i</sup> The need for a geologist at Scripps to linger over the sediment samples gathered by *Carnegie* led the institution director, Thomas Wayland Vaughan to recruit Roger Revelle, still a student at the University of California, Berkeley.<sup>ii</sup> The ship's diverse research program generated information worth the time and trouble, and the expertise of its staff, including the physicist Floyd Soule from the National Bureau of Standards and H.R. Seiwel, who would later join the faculty at the Woods Hole Oceanographic Institution (WHOI), assured its productivity. After the destruction of the ship, both Soule and Seiwel joined the team analyzing the results of the voyage.

Once Hydro and concerned civilian scientists had time to appreciate the enormity of the disaster for oceanographic research, a search began for ways to continue the work begun by the Carnegie. In May, 1930, the American Geophysical Union passed a resolution at its yearly meeting calling for the oceanographic community to continue the program of research planned for the lost vessel. In a memorandum composed four months later, Hydro's Admiral Gherardi demonstrated his agreement with the AGU and appealed to the chief of the Bureau of Navigation for a naval ship to replace *Carnegie*. He wanted a naval vessel employing the latest instrumentation and methodologies dedicated completely to oceanographic research as opposed to traditional hydrographic surveys. In the early months of the Great Depression Gherardi knew that he would have to justify the request and demonstrate its cost-effectiveness. The Carnegie Institution of Washington had gone to great expense to acquire a non-magnetic ship, made of wood with copper and bronze parts, that would facilitate the collection of data on the earth's magnetic field. In the present state of the economy Gherardi knew that the Navy might not approve the construction of an expensive specialized vessel.

But did Hydro need a non-magnetic ship to take up exactly where *Carnegie* left off? The admiral argued that the scientific staff for that seventh and last voyage had already completed most of the scheduled magnetic work before arriving in Samoa. Hydro could collect any future geophysical measurements on board steel vessels vulnerable to magnetic phenomenon by making repeated cruises and measurements in a particular region, but at different stations set in relatively close geographical proximity. Such repetition and station site selection would provide ample data for comparison,

correction, and analysis. Beyond that, a dedicated oceanographic ship built with iron and steel could easily continue the broad spectrum of research originally planned for *Carnegie*.

Gherardi went so far as to suggest that a suitable ship did exist and might provide an inexpensive way of replacing *Carnegie*. After twenty-seven years as the presidential yacht, in 1929 the USS *Mayflower* became a prime candidate for a high-profile economy measure by President Herbert Hoover. If the ship could no longer serve the president, then why not science? According to the hopeful head of the Hydrographic Office,

"it would require no new authorization or appropriation to maintain the prestige of the United States in the field of usefulness which the "Carnegie" filled, if the unused USS *Mayflower* could be prepared for this higher purpose of advancing the control and utilization by mankind of the forces of Nature, by the installation and employment of the apparatus and instruments already in the possession of the Government which would fit this vessel to be employed in continuing the enlightening service which was interrupted by the disaster which befell the "Carnegie." [Gherardi, "Memorandum. . ." 19 September 1930]"<sup>iii</sup>

Unfortunately for Gherardi and his supporters within civilian science, the Hoover Administration's reaction to the advent of the Great Depression eliminated the possibility of dedicating a naval vessel to the *Carnegie* role. The Navy Department under Secretary Charles Francis Adams refused to accept any responsibility for the cost of conversion, preparation, and operation of *Mayflower*. In a letter to George K. Burgess, chairman of the NRC, the secretary of the Navy praised Carnegie's work, but lamented that the Navy did not have the dollars to spare. Rather, he stated that these costs "could not be borne by naval appropriations, and it will probably represent a larger figure than you would be able to meet." Copies of the letter went to the CNO, the Bureau of Aeronautics, and Gherardi's superiors at the Bureau of Navigation, as well as the staff of the Naval Research Laboratory.<sup>iv</sup>

Until Roosevelt's New Deal brought a different perspective to the nation's fiscal crisis, even attempts to collect data from Navy ships on their regular routes met with some opposition. In October 1932, Professor John A. Fleming wrote to secretary Adams noting that USS *Ramapo*, a single-screw, 19,189 ton Navy oil tanker, regularly crossed the Pacific and could collect important scientific information along her normal route. For nine years beginning on 21 June 1928 *Ramapo* moved

oil from San Pedro, near Los Angeles, to the Asiatic Fleet in the Philippines and China. She made four round trips each year along a very regular course providing an opportunity, Fleming argued, for the crew or an on-board scientist and his assistant to study temperature, salinity, marine life, and other important scientific phenomena.

Even though this scenario offered great opportunity, the absolute fiscal restraint of the era led Adams to refuse his permission. Captain Husband E. Kimmel, head of the Ship's Movements Division of the CNO's office, argued in a December 1932 memorandum that the Navy could ill afford the expenditure involved in Fleming's proposal. He reasoned that in four annual round trips, eight Pacific crossings with an average duration of twenty-eight days, the ship would spend approximately three hours each day hove-to performing a scientific task. For the year that would amount to twenty-eight days of research. Rather than evaluate the significance to Hydro of the data collected and the interest of civilian scientists, Kimmel concluded in the spirit of the fiscal crisis that these activities would deprive the Navy of roughly \$17,000 worth of ship time. In spite of an endorsement from Thomas G. Thompson, director of the oceanographic program at the University of Washington, it did not take long for Secretary Adams to reply to John Fleming that the Navy could not afford to spare the time during *Ramapo's* trans-Pacific jaunts. The secretary's advisor in this case, Captain, later admiral, Husband Kimmel, would go down in history for losing much of the surface fleet to the Japanese at Pearl Harbor on 7 December 1941<sup>v</sup>

With their hope dashed that the Navy might step in to replace *Carnegie* or permit naval warships and logistics vessels to carry scientists, Gherardi and his civilian colleagues resorted to their only tried and tested alternative. Hydro's survey ships still planned to do hydrographic and oceanographic work for the Navy, and scientists "piggybacking" on naval expeditions could serve both naval needs and private scientific inquiry. In addition, all naval vessels equipped with an SDF or some other type of fathometer had authorization to continue taking bottom soundings. Thus, although *Ramapo* never executed the research program proposed by John Fleming of the Carnegie Institution's Department of Terrestrial Magnetism, the ship did take 37,000 soundings during fifty-one crossings of the Pacific from 1929 through 1938. On 30 April 1933, during one of these crossings, *Ramapo* discovered a record depth in the Tuscarora Deep, at 30 degrees 43 minutes north, 142 degrees 28 minutes east. Initially measuring 33,006 feet, Gherardi's staff corrected the sounding to 34,623 feet by applying information about the region collected by *Carnegie*. Hydro used the massive amount of data from *Carnegie*, *Ramapo*, and scores of other ships to obtain information on depth, bottom topography, and circulation patterns

for its publications, maps, and charts.<sup>vi</sup>

Thus the *Carnegie* disaster neither completely arrested Hydro's survey efforts nor altered its growing cooperative relationship with the scientific community. At the same time, money, ships, and expensive instrumentation were scarce, making mutual dependence more obvious and cooperation more necessary than ever.

In spite of the Navy's decision not to provide a west coast version of WHOI's *Atlantis*, Thomas Thompson of the University of Washington did not miss a beat in trying to extend his research program. He followed the lead of Thomas Wayland Vaughan, director of Scripps, and asked the Navy for both an SDF for the university's research ship *Catalyst* and space on board a naval vessel participating in the impending survey of the Aleutian Islands in 1933. He met with success on both counts.

On 24 October, when Thompson wrote John Fleming in support of his suggestions to the Navy regarding *Ramapo*, the former also suggested that the University of Washington would certainly help in the sounding effort by committing *Catalyst* to work inside the continental shelf. The ship's echo-sounder, a Submarine Signal Company number 431 model, imposed this operational restriction because its range extended to only 400 fathoms. For research in Puget Sound and much of the coastal passage to Alaska, the 431 provided excellent data. Because of its limits, the staff on board *Catalyst* never bothered to use this device in the extraordinary depths beyond the continental shelf. Nonetheless, Thompson wanted a partnership with the Navy. He offered the services of his colleagues and the University's vessel to the Aleutian Islands survey of 1933.

Organized during the first quarter of 1933, Hydro commissioned the Aleutian Islands Survey Expedition, led by Commander H.A. Badt, to conduct a complete hydrographic survey of Adak Island and the surrounding waters. The USS *Argonne*, *Swallow*, *Kingfisher*, and *Gannet* received instructions to supplement their hydrographic work with topographic survey of not only Adak, but also Kanaga and Kagalaska Islands, supplemented by the same kind of aerial photographic work done by *Nokomis* and *Hannibal* in the Caribbean approximately four years earlier. Hydro approved Thompson's request to participate in the expedition and the University of Washington sent Clifford A. Barnes from Bremerton to the Aleutians and

to *Argonne* on board the USS *Patoka*. Before sailing, Thompson shipped all of the equipment Barnes needed to the *Patoka* via R/V *Catalyst*.<sup>vii</sup>

Hydro and the commander of the expedition made a very strong appeal for time, ships, instruments, and funding based on strategic and tactical considerations. Commander Badt pointed out that other countries frequently visited the area and knew far better than the US Navy the choice passages and anchorages, as well as the challenging weather conditions. According to Badt,

“It has taken us a long time to make a start in obtaining knowledge of and getting acquainted with the Western Aleutians; to find out where the suitable anchorages, if any, are located; and to gather information regarding currents, channels, weather and operating conditions in an area that may some day be used for Naval Operations . . . If the islands are of any military value; . . . then it is high time that the western Aleutians be thoroughly investigated . . . and for the personnel of the Naval Service to operate under the prevailing weather and other conditions in an area which we may have to use some day. [Aleutian Islands Survey Expedition, Final Report]”

The detailed final report submitted by Commander Badt insured that Hydro would remain in the area performing passage, bay, and harbor surveys for a few years to come. He emphasized the lack of information on these islands as well as the absence of adequate naval assets and personnel to provide the Navy with operating bases, station ships, or personnel with experience in the region. With eighteen weeks of work in the western Aleutians, the expedition personnel laid the foundation for naval expertise and future work. Furthermore, thanks to Gherardi, Thompson and his representative on the expedition, Clifford Barnes, could now count themselves among those few civilians initiated to the Aleutians.

As a consequence of their participation, Hydro convinced the Bureau of Engineering to give the University of Washington oceanographers an obsolete SDF model SE-1987 just removed from USS *Detroit* (CL-8) for installation on board R/V *Catalyst*. This would allow Thompson's staff to take soundings well off the continental shelf. Unfortunately it took the Bureau of Engineering months to find a more current model and then the University's research ship could not accommodate the system without facing prohibitive structural alterations. While they could not equip *Catalyst* with an improved SDF, the

University came away from the Aleutians experience with Hydro's confidence.

Nor was Washington the only research center to see possibilities in a further survey of the Aleutians. At Scripps, Vaughan suggested that Pacific research also needed a series of soundings from the Aleutians, near the center of the island chain, to the northern Hawaiian Islands. While a shortage of time and resources did not permit him to fulfill Vaughan's request on the 1933 trip, Gherardi agreed with Vaughan's perspective and kept his letter on file, planning to make the string of stations at the earliest possible convenience.<sup>viii</sup>

Hydro went back to the Aleutians during the Spring and Summer of 1934. Following Commander Badt's recommendations, the expedition, built around USS *Oglala* (CM-4) and USS *Tanager* (AM-5), did triangulation work to plot coastlines accurately, took surveys of harbors and potential anchorages, recorded depth and bottom soundings, made magnetic field measurements, and conducted aerial photo surveys.

As the Navy accumulated the data on the island chain, Gherardi found an opportunity to accommodate Vaughan's request for a string of vertical sections for temperature and salinity extending between Dutch Harbor on Unalaska Island south across the northern Pacific to Pearl Harbor in the Hawaiian Islands. At the conclusion of the Aleutians expedition USS *Bushnell*, submarine tender and flagship of Submarine Division Twelve, planned to make the journey to Hawaii over the exact route that Vaughan had requested for his research. Admiral Gherardi succeeded in obtaining permission from both the CNO and Rear Admiral C.W. Cole, the new commanding officer of the submarine division, for *Bushnell* to perform the tests Vaughan requested during the voyage southward. Furthermore, the Scripps' director obtained permission for one of his scientists to direct the work. The Navy offered to transport Vaughan's candidate from San Diego to Dutch Harbor and then on-board *Bushnell* to Pearl Harbor.

Vaughan chose Roger Revelle for this job, a University of California graduate student in oceanography and friend of Richard Fleming who went to sea on board Hydro's *Hannibal* in 1933. Revelle had graduated from Pomona College in 1929 and immediately initiated his graduate work in geology at Berkeley. He moved down to Scripps in 1931 to work on the ocean bottom samples sent back to the continental United States by *Carnegie*, and rapidly acquired a significant expertise in ocean

sediments. Earlier in 1934 he spent ten days with *Pioneer*, the research vessel of the U.S. Coast and Geodetic Survey. On board *Bushnell* from 17 to 24 August, Revelle made eighteen dynamic ocean surveys en route from Dutch Harbor; usually two each day, one hundred miles and twelve hours apart, at 5 am. and again at 5 pm.

These dynamic ocean surveys differed from ordinary station taking because they provided additional water samples as well as temperature and salinity data from various depths to determine circulation patterns and water density. Usually two "casts" were made in this type of survey, with water sampling bottles at different levels on the cable going over the side of the ship. The first cast had bottles at 25, 50, 75, 100, 150, 200, 300, 400, and 500 meters. Starting at 500 meters, the second cast went to 600, 800, 1000, 1500, 2000, 2500, 3000, and then 3500. Revelle's surveys crossed routes and stations in the north Pacific occupied at different times by both *Ramapo* and *Carnegie*. Vaughan designed the research surveys this way so Hydro and Scripps could use the data from all three vessels to confirm single or mutual observations and to correct the data for chemical and climate conditions.<sup>ix</sup>

#### Validating a Common Practice:

Revelle's work at sea with Hydro from the Aleutians to Hawaii in 1934 confirmed, as did the research in the Caribbean, the cooperative nature of oceanographic exploration during the decade before Pearl Harbor. The Navy and civilian science each made their distinctive independent contribution to a fruitful common practice. Driven by the imperatives defined in 1924 at the Interagency Conference on Oceanography, Hydro applied its resources to traditional surveys and an extended program of data gathering. Regular naval vessels obliged the Hydrographic Office and took thousands of soundings for depth and bottom topography during long voyages between the west coast of the United States and the Navy's distant bases in the central Pacific and the orient. As in the Gulf of Mexico and Caribbean, Hydro's survey vessels performed as much ocean science as the budget and naval strategic priorities would permit while compiling information for charts and maps to aid the navigator and those responsible for estimating the strategic value of many American possessions throughout the Pacific.

Their common practice was not merely a naval creation, but emerged also from the needs of the civilian scientific community. Leaders in oceanographic research like Vaughan and Thompson realized that only by sharing their insights,



energy, ships, instruments, and talent could they achieve the maximum result from their modest resources. This inclination to recognize common ground and seek the Navy's assistance created an informal system that propelled their cooperative research beyond the ordinary.

In each of the major Pacific ventures launched by Hydro, this common practice not only brought results, but also often led to potentially fruitful opportunities to advance ocean science even further. The expedition to the Aleutians in 1934 began as the first survey to examine the strategic potential of a major string of islands in the often-inclement north Pacific. In the end, the expedition not only succeeded in its primary mission but also prompted the Navy's leadership to pursue further scientific investigation in the region. Hydro's experience and the advice received from Scripps and Washington, as well as the participation of their scientists insured that time and resources were well spent.

Indeed, Hydro and its civilian colleagues rarely wasted any opportunities. Over a decade of common practice made it natural for Rear Admiral Gherardi to recognize in the 1934 return voyage of *Bushnell* an opportunity to grant the request for dynamic ocean soundings in the north Pacific made months earlier by Vaughan. No doubt the admiral took pleasure in granting his old friend wide latitude in personnel and technical matters on that leg of Bushnell's journey. The Navy and civilian science built their common interwar practice on this flexibility, their willingness to accommodate each other, and the regular data collection and analytical services performed by both naval and civilian activities. Both Hydro and their colleagues outside the Navy looked to serve their own interests by serving each other. In the economic environment of the Great Depression they could achieve together things they could only dream of separately.

The significance and productivity of their common practice escaped no one and few took it for granted. Participation was far too profitable for all concerned. On 2 July 1934, Vaughan wrote to Albert Barrows, executive secretary of the NRC, reporting on a meeting of the Committee on Oceanography of the American Association for the Advancement of Science (AAAS) attended by his assistant director. While commenting on the various issues and activities of members and their institutions, Eric Moberg, attending the meeting for Scripps while Vaughan was ill, particularly noted the presence of a Navy captain from the Hydrographic Office. Captain R.S. Culp expressed Admiral Gherardi's thanks for the cooperation of private research institutions, particularly Scripps, and made a point of pledging "the continued willingness of the Navy to

cooperate."

The word cooperation did not fully reveal the extent of the dynamic, remarkably productive, and largely informal system they had created since 1924. Just a few days before the AAAS gathering, Richard Fleming had returned the Scripps analysis of temperature and salinity data taken by nine different Hydro vessels working along the American west coast. Revelle departed for the Aleutians hours before Culp's comments at the meeting and no sooner had the captain's remarks concluded than Vaughan once again put in a request for additional dynamic soundings and ocean surveys. Both sides of this relationship repeatedly demonstrated comfort with regular interaction and high mutual expectation.

This time Vaughan asked Hydro for naval aid to perform independent or piggyback research in an area bounded by the Great Circle route between Hawaii and the Canal Zone on one side, with the third point of the scalene triangle at Los Angeles-San Pedro. He also commented on the desirability of using a submarine in the Pacific for gravity measurements. Gherardi's initial response revealed that Hydro could not find ships to take these measurements because projects already underway in the Pacific and Caribbean had nearly exhausted the Navy's resources. However, discouraging realities had rarely deterred either Hydro or the civilian scientific community in the past. By this time, their natural reaction compelled them to try and find a way to do the necessary research. With expensive and demanding gravity work ongoing with special instruments and submarines in the Caribbean, Gherardi encouraged Vaughan in his other requests by suggesting that he have the NRC approach the secretary of the Navy. The admiral rarely closed the door on any valid project, and this advocacy had worked in the past.<sup>x</sup> With his five years as Hydrographer of the Navy coming to a close in 1935, Gherardi had worked with Scripps many times and had come to know Thomas Wayland Vaughan very well. The admiral knew that the Scripps director would relentlessly pursue any suggestion that the Navy might provide transport, funds, or other forms of support for oceanography. Thus Gherardi fully expected the secretary of the Navy to receive a Vaughan-inspired letter in support of his new request for soundings and surveys between Hawaii, southern California, and the Canal Zone. On 17 April 1935, Secretary Claude Swanson received just such a letter, not from the chairman of the NRC, but from William Campbell, president of the National Academy of Sciences. Campbell supported Vaughan's request, asked for more naval assistance in Pacific research, and, in general, urged the Navy to continue its vital work in oceanography. Gherardi certainly knew his man.

## A Change in Depression Era Pacific Policy:

Shortly after the admiral's departure from Hydro, the Bureau of Navigation received an instruction from CNO Admiral William H. Standley that gave Vaughan's request a boost and signalled a significant change in policy. The CNO took measures to create an environment as favorable as possible to the common practice developed by the Navy and civilian science; a significant departure from the early days of the Depression when Secretary Adams and Captain Kimmel refused to allow *Ramapo* to spend twenty-eight days annually doing trans-Pacific research planned by the Carnegie Institution. Gherardi's initiative, Vaughan's request, and Campbell's support prompted the CNO to reexamine the Navy's options in these matters.

To what extent could operational vessels on routine missions cooperate with Hydro and civilian scientists? Certainly the fiscal restraints still existed, but now Standley looked for a way to fulfill requests from Hydro if at all possible. He insisted, however, that any authorized diversion of ships, men, or resources could not interfere with mission-related work. If the Bureau of Navigation could find a way to perform both tasks in a complementary manner within the budget, he would not stand in the way. In a letter to the Bureau of Navigation on 6 May 1935 Standley even provided a list of six ships suitable to carry out requests made by Vaughan for research in the San Pedro - Hawaii - Canal Zone triangle as well as by Campbell for greater exploitation of the frequent naval presence on trans-Pacific routes. Standley also encouraged Hydro to explore, with the commanding officer of the *Oglala*, the possibility of taking an alternate, more scientifically productive route back to Puget Sound after concluding the 1934 surveys of the Aleutians. Since *Oglala* returned to Pearl Harbor and then to the west coast, the University of Washington scientists on board and the naval scientific staff could make significant soundings and surveys between the islands and the mainland. In addition, the CNO authorized the bureau to communicate directly with other ships to discuss course alterations if these could fulfill both the naval mission and a valuable scientific purpose. Furthermore he expected Hydro to continue collecting sounding data from SDF-equipped fleet units operating all over the world.

In this environment, Vaughan's desire for dynamic ocean surveys along the triangle Canal Zone, Hawaii, San Pedro received serious consideration but not immediate action. Pacific and Caribbean-Gulf projects strained Hydro's resources to the limit. The preferred ship, *Hannibal*, had responsibilities in the latter area, keeping her out of the Pacific. It took some

time for Captain Leahy to locate an available vessel capable of accommodating the equipment needed to carry out the Vaughan proposal. Just as Vaughan left Scripps to his successor Harald Sverdrup in August 1936, Captain Leahy wrote that he had selected the heavy cruiser USS *Louisville* (CA-28) to do the job. Sverdrup and Leahy had obviously taken up the roles vacated by Gherardi and Vaughan without missing a beat.<sup>xi</sup>

Before he left Scripps, Vaughan made a series of suggestions about *Louisville*'s program and itinerary strongly influenced by *Carnegie*, the ever-present benchmark of Pacific oceanographic exploration. On 3 September 1936, Roger Revelle visited Hydro in Washington at Sverdrup's behest to discover the route planned for *Louisville* from San Pedro to Honolulu and the location of the eight proposed oceanographic stations. When Revelle returned, he and Moberg discovered that the projected course very closely resembled that plotted for *Carnegie* between San Francisco and Honolulu in 1928. The new Scripps director immediately requested a slight change in course to permit *Louisville* to duplicate as many of the Carnegie stations as possible. According to Sverdrup,

“Such observations will indicate the magnitude of differences which may be found in different years. Such information is of special importance when planning a more systematic survey of the region in question, and a repetition of the CARNEGIE stations would, therefore, be of very great help to this institution.[Sverdrup to Leahy, 11 September 1936] “

He realized the possibility that the Navy might grant his request, but he wanted to make sure by admitting that some of the Carnegie stations, like number 131, did appear a bit off the projected route. He gracefully pleaded for a repetition of even this station because of its special importance.

In his letter of 29 September, Leahy informed Sverdrup that *Louisville* would leave San Pedro on 23 November and the commanding officer's instructions would provide him with both the Scripps's request to duplicate the Carnegie stations and the latitude to do so if he wished. Hydro did not limit the vessel's program to the eight stations originally planned. Scripps assistant director Eric Moberg and his aide Russell Droescher received permission from the CNO to lead the scientific effort on board *Louisville* on the outbound leg and to take additional surveys on the way home with USS *Minneapolis* from Honolulu to San Pedro. At sea between 23 and 29 November, *Louisville* occupied ten stations in a rectangle bounded by twenty-one and thirty-three degrees north latitude and 120 and 156 degrees west longitude. On the return trip, the terrible weather permitted only a few temperature and salinity measurements, not the four dynamic ocean survey stations

originally planned. Scripps scientists successfully carried out research that, when combined with the earlier work done in the area by *Carnegie*, enabled science to achieve a greater understanding of temperature, salinity, currents, and seasonal changes in the nature of the extraordinary ocean off the American west coast.<sup>xii</sup>

Endnotes:

---

i.

**National Academy of Sciences Archive**

NRC Division of Geology and Geography

"Report of the Committee on Submarine Configuration and Oceanic Circulation," 25 April 1931

ii.

**Archive of the Scripps Institution of Oceanography, LaJolla California**

Revelle Papers

box 1, folder 33

Roger Revelle interview with Robert A. Calvert, Texas A&M Oral History Collection, 4 July 1976

iii.

**National Archives, Washington D.C.**

Secnav Gencorr 1926-1940, RG-80

box 828

W.R. Gherardi, "Memorandum for the Chief of the Bureau of Navigation," 19 September 1930

Resolutions of the Eleventh Annual Meeting of the American Geophysical Union, 2 May 1930

**Secondary Sources:**

Schlee, The Edge of an Unfamiliar World, 266-272

Naval History Division, Dictionary of American Naval Fighting Ships, IV, 281-282.

iv.

**National Archives, Washington D.C.**

Secnav Gencorr 1926-1940, RG-80

box 828

Jahncke (Acting) to Burgess, 17 October 1930

In 1935, the Carnegie Institution learned that the Hydrographic Office of the Royal Navy had received appropriations to build a non-magnetic ship of the Carnegie type. The British wrote to John Fleming asking for specifications on the *Carnegie* and advice from both the Department of Terrestrial Magnetism and former members of the stricken vessel's crew.

---

v.

**National Archives, Washington D.C.**

Secnav Gencorr 1926-1940, RG-80

box 828

Fleming to Secnav, 18 October 1932

Hydrographer to CNO, 1 December 1932

Kimmel, "Memorandum for Chief of Naval Operations on Oceanographic Data (Ramapo), 16 December 1932

Adams to Fleming, 30 December 1932

vi.

**National Archives, Washington D.C.**

HO Gencorr 1924-1945, RG-37

box 141

Gherardi to Vaughan, 3 May 1933

**Secondary Sources:**

Nelson, Oceanographic Ships, 88

vii.

**National Archives, Washington D.C.**

Secnav Confidential [unclassified] Corr 1927-1939, RG-80

box 104

Aleutian Islands Survey Expedition, Final Report, 19 January - 4 October 1933

HO Gencorr 1924-1945, RG-37

box 141

Hydrographer to CO USS Patoka, 18 April 1933

viii.

**National Archives, Washington D.C.**

Secnav Confidential [unclassified] Corr 1927-1939, RG-80

---

box 104

Aleutian Islands Survey Expedition, Final Report, 19 January - 4 October 1933

HO Gencorr 1924-1945, RG-37

box 141

Soule to Hydrographer, 17 January 1934

Robinson to Hydrographer, 21 February 1934

Gherardi to Thompson, 2 April 1934

Ravenscroft to Bryan, 9 December 1937

Gherardi to Commanding Officer Aleutian Islands Expedition, 3 May 1933

ix.

**National Academy of Sciences Archive, Washington D.C.**

NRC Division of Foreign Relations, International Organizations 1927-1939

Vaughan to members of the Committee on the Oceanography of the Pacific [Pan-Pacific Science Association], 23 October 1934

"Studies Japan Current," 11 October 1934, p.2ff

Vaughan et. al., "Report of the Committee on Oceanographic Activities of North America During April 1933 to April 1934, American Geophysical Union, 1934

Secnav Gencorr 1926-1940, RG-80

box 833

Vaughan to Secnav, 30 April 1934

Taussig to Vaughan, 5 May 1934

Taussig to Vaughan, 1 June 1934

Vaughan to Taussig, 24 May 1934

CNO to Commanding Officer, BUSHNELL, 18 May 1934

Taussig to Vaughan, 18 May 1934

Vaughan to Taussig, 12 May 1934

box 839



---

Gherardi to Commander, Aleutian Islands Expedition, 12 April 1934

Secnav Confidential [Unclassified] Gencorr 1927-1939, RG-80

box 104

Sellers to CNO, 29 January 1934

Commander, Minecraft, Battleforce to Commander-in-Chief, U.S. Fleet, 13 January 1934

HO Gencorr 1924-1945, RG-37

box 142

Commander, Aleutian Islands Survey Expedition to Hydrographer, 9 May 1934

box 143

Leahy to Commanding Officer USS *Louisville*, 19 August 1936

Memorandum for Files by R.C. Needham [detailed information with enclosures on the procedures and equipment for dynamic ocean surveys], 9 June 1930

**Secondary Sources:**

Raitt and Moulton, Scripps, 117.

x.

**National Academy of Sciences Archive, Washington D.C.**

NRC Division of Foreign Relations International Organizations 1927-1934 - General, Committee on the Oceanography of the Pacific, Pan-Pacific Science Association

Vaughan to Barrows, 2 July 1934

**National Archives, Washington D.C.**

HO Gencorr 1924-1945, RG-37

box 142

Enclosure with Vaughan to Gherardi, 29 June 1934

Gherardi to Vaughan, 18 December 1934

Thompson to Leahy, 1 August 1935

Thompson to Hydrographer, 7 October 1935

xi.

---

Scripps and Washington were not the only institutions that appealed to the Navy for cooperation. The University of California at Los Angeles worked with Hydro to place Professor Loye Miller (Professor of Biology) on board the survey vessel USS *Nokomis* off the Central American coast during the 1936 survey season.

**National Archives, Washington D.C.**

HO Gencorr 1924-1945, RG-37

box 142

Gherardi to Vaughan, 18 December 1934

Campbell to Secnav, 17 April 1935

Gherardi to CNO, 29 April 1935

CNO to BuNav, 6 May 1935

Gherardi to Thompson, 16 May 1935

Leahy to CNO, 12 December 1935

Miller to Leahy, 4 February 1936

Leahy to BuNav (Memorandum), 8 February 1936

Leahy to BuNav, 22 January 1936

Miller to Hydro, 17 January 1936

Leahy to Vaughan, 16 January 1936

William D. Leahy to Campbell, 20 May 1935

Vaughan to Leahy, 11 April 1936

Leahy to Vaughan, 15 April 1936

Leahy to Vaughan, 17 August 1936

**Archives of the Scripps Institution of Oceanography, LaJolla CA**

Office of the Director [Sverdrup]

box 1

1936 Correspondence, folder 4

Sproul to Sverdrup, 20 March 1936

Sverdrup to Leahy, 11 September 1936

---

Leahy to Sverdrup, 29 September 1936

Sverdrup to Leahy, 5 October 1936

Leahy to Sverdrup, 6 November 1936

Kays to Sverdrup, 23 December 1936

January-June 1938 Correspondence, folder 9

Sverdrup to Hydrographer, 29 April 1938

Leahy to Sverdrup, 13 May 1938

xii.

**National Archives, Washington D.C.**

HO Gencorr 1924-1945, RG-37

box 143

Hydrographer to Commanding Officer, USS *Louisville*, 19 August 1936

Sverdrup to Leahy, 11 September 1936

Leahy to Sverdrup, 29 September 1936

Sverdrup to Leahy, 5 October 1936

Farber to Traynor, 10 October 1936

Leahy to Commanding Officer, USS *Louisville*, 14 October 1936

Leahy to Sverdrup, 15 October 1936

Leahy to Commander-in-Chief, US Fleet, 19 October 1936

Kays to BuNav, 27 October 1936

Sverdrup to Leahy, 20 October 1936

Hepburn to Commanding Officer, USS *Minneapolis*, 28 October 1936

Nimitz to Commanding Officer, USS *Minneapolis*, 2 November 1936

Leahy to Sverdrup, 6 November 1936

Sverdrup to Leahy, 10 November 1936

Moberg to Leahy, 11 January 1937