

# Harald U. Sverdrup and the War Years

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## Prologue<sup>2</sup>

By 1940 the U.S. Navy Radio and Sound Laboratory at Point Loma in San Diego, California was working intensively on problems of anti-submarine warfare (ASW). It was a matter of great urgency; German U-boats were taking an increasing toll of allied shipping. The Scripps Institution of Oceanography involvement, starting informally as early as 1940, was part of a rapidly growing effort by the civilian science community to work with the uniformed Navy under the umbrella of the University of California Division of War Research (UCDWR). Collaboration between the civilian oceanographers and the uniformed Navy proved to be extraordinarily productive at Point Loma and elsewhere. The oceans are opaque to light and transparent to sound, and most of the progress in submarine detection had to do with ocean acoustics. The formation of a shadow zone in which submarines could hide, called the “afternoon effect,” was the result not of lethargic sonar operators after a heavy luncheon at the Chief’s mess, but could be traced to the refraction of sound by surface warming. Noisy shrimp beds could provide a haven for hiding submarines. A false shallow bottom indicated on fathometers at night was immediately identified by Scripps Professor Martin Johnson as related to a *deep scattering layer* associated with the diurnal migration of copepods.

Starting in 1941, a group of Scripps oceanographers reported daily at 0730 to the Navy Laboratory. Getting from Scripps to the Navy facility at Point Loma was not then an easy task. Gasoline rationing was in force during the war and car pools were the order of the day for the fifteen mile commute. The car pool started from Scripps campus each morning just after dawn when Scripps Director, H.U. Sverdrup, K.O. Emery and Gene LaFond piled into the Director’s new Chevrolet sedan. Anthony Shepard recalls that his father, marine geologist Francis Shepard, had to wolf down his breakfast and rush to Torrey Pines Road where he waited, lunch pail in hand, for the sedan to pick him up.

On 1 March 1942 the Director’s Chevrolet arrived as usual to pick up Shepard. Sverdrup was not in the car. “*What happened to Harald?*” Shepard asked. “*They pulled his security clearance,*” replied LaFond, and he produced Sverdrup’s I.D. card. “*He was so upset he asked me to turn it in for him.*”

**It was another fifty years until we learned what had happened.**

## Harald Ulrik Sverdrup, The Early Years

Harald Ulrik Sverdrup came from Norway in 1936 to serve as the third Director of the Scripps Institution of Oceanography. A cosmopolitan scientist fluent in Norwegian, Swedish, Danish, English and German, and somewhat in French<sup>3</sup> he had earned a reputation as a tough polar explorer.

The Sverdrup family came to Norway from Denmark about 1620. In the nineteenth century the family played a prominent role in Norwegian liberal politics. His great-grandfather studied history, language and botany, and in 1825 bought his own farm and established the first agricultural school in Norway. His son became the leader of the liberal party. Otherwise the family was heavily involved in the Lutheran church, and his father and his four brothers all became ministers. Sverdrup’s father was Johan Edvard Sverdrup, a conservative Lutheran pastor and

theologian. Johan’s first wife, Marie Vollan, died in 1891, leaving Gudrun (b. 1887) and Harald (b. 15 November 1888). His second wife was Marie’s sister Agnes, who had five children including Sverdrup’s brothers Einar and Leif.

As a boy, Sverdrup was interested in evolution and astronomy. His family favored the classics. Upon entering gymnasium, Sverdrup selected the classics option with emphasis on Latin rather than physics and mathematics. But then he welcomed an opportunity to return to the technical subjects by attending the Norwegian Academy of War for one year (and finishing as top man in athletics). In 1914, he passed the University examinations in physics, mathematics, chemistry and botany, planning to major in astronomy. When Vilhelm Bjerknes offered him one of the coveted assistantships endowed by the Carnegie Institution of

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<sup>2</sup>Freely adapted from Anthony Lee Shepard’s manuscript biography of his father entitled *The Beachmaster*, p. 239–240.

<sup>3</sup>Sverdrup also noted that he had learned a Chukchi dialect while overwintering with the tribal people in Siberia.



**Figure 1.** Sverdrup Family, Norway, c1914. Back row (L to R): Harald, Einar, Mimi, Jacob; front row: Gudrun, Edvard, Agnes, Helga. (All figures are from the S.I.O. Archives, UCSD, except as noted.)

Washington, Sverdrup turned to meteorology and oceanography, and he published his first paper (on atmospheric inversion layers). In 1914 Bjerknes was offered a professorship at the University of Leipzig, and he took Sverdrup with him. It was there during the war years (and experiencing hunger) that Sverdrup wrote *Der Nordatlantische Passat* (North Atlantic Trade Winds), for which he was granted a degree from the University of Oslo in 1917.

Sverdrup could have fallen into a comfortable and respected university career, but instead he accepted the offer by Roald Amundsen to take charge of the scientific work on the North Polar *Maud* expedition. In his words:<sup>4</sup>

*"I felt that since I had spent many years partly in theoretical work, partly in the discussion of observations which had been collected by others, it would be extremely valuable for me to spend a number of years in close contact with the events in nature and with the opportunity to get fully acquainted with various techniques of observation."*

To these words, he added by hand: "*And I did not mind the adventure.*"

The expedition left Norway in July 1918, expecting to return in three or four years. It did not return until December 1925. The expedition carried out an intense program of observations, the analysis of which occupied Sverdrup up to 1933.

There were a number of important interruptions.

- In 1928 he married Gudrun Bronn Vaumund and adopted her daughter Anna Margrethe.

- In 1929 he signed up with Fridtjof Nansen to take the *Graf Zeppelin* across the North Pole.
- In 1930 he spent half a year at the Carnegie Institution in Washington for analysis and discussion of the oceanographic observations taken on the last cruise of the *Carnegie*.
- In 1931 he participated in the Lincoln Ellsworth North Polar Submarine Expedition, again as leader of the scientific work.
- In 1934 he spent eight weeks on the high-lying snow fields of Spitzbergen with glaciologist Hans Ahlmann.

Although *Maud* never came close to the pole, and the *Zeppelin* did not fly, and the submarine did not dive, Sverdrup somehow managed to improvise, turning all these activities into a positive experience. He did this by taking advantage of every opportunity for careful observations and by subsequent analysis and synthesis. Improvising is a way of life for oceanographers.

## The *Maud* Expedition

The *Maud* Expedition epitomizes Sverdrup's approach, discipline and scientific style. In 1918, with World War I still raging, a twenty-nine year old Sverdrup took charge of the scientific work (with additional duties as navigator and cook) aboard *Maud* on Amundsen's North Polar Expedition. At the turn of the century, Nansen had conducted his famous drift aboard the *Fram*. From the measurements taken and a brilliant subsequent analysis, Nansen had concluded that there was no land in the central Arctic, and that the currents entering and leaving the Arctic play a major role in climate. This was not accepted at the time. Amundsen's plans provided the opportunity to test these unpopular notions. To family friends who opposed his plans, Sverdrup wrote "...I was not cut out to be a theoretician. And not the least, if I am able to make a little scientific contribution, then it will be a contribution to Norwegian science."<sup>5</sup>

Two years later, unable to break into the ice pack, *Maud* entered the port at Nome, Alaska, to take on fresh supplies. One year later she had to pull into Seattle to repair a broken propeller. Much has been said about the frustrations encountered on the expedition, and too little about the valuable work that was done: on tides, currents, physical properties of sea water, sea ice, marine geology, aurora, gravity, magnetism, atmospheric electricity, astronomic observations, and the animal and bird life in the drift ice. Sverdrup used every interruption to push his work forward. During

<sup>4</sup>Harald Sverdrup to Vern Knudsen, February 1, 1938. Scripps Family Papers, Accession 92-38, Box 4, folder 39, "Scripps Institution of Oceanography, 1938." SIO Archives UCSD. The matter of judging the quality of data was always foremost in Sverdrup's mind. He wrote Vern Knudsen: "I would obtain experience in performing observations and, later, on the basis of these experiences I could know the accuracy of various methods and the limits of errors which would have to be considered."

<sup>5</sup>Robert Marc Friedman, "The Expeditions of Harald Ulrik Sverdrup: Contexts for Shaping an Ocean Science." La Jolla, California: Scripps Institution of Oceanography, University of California, William E. and Mary B. Ritter Memorial Fellowship Lecture, 1994, page 4. This 1992 lecture was reprinted by Umeå Universitet Centrum för regionalvetenskap as Reprint No. 11 in 1996.



**Figure 2.** Harald Sverdrup, just behind the white dog, aboard R/V Maud, c1921.

the port calls in Alaska, Amundsen allowed participants to leave the expedition, and some did. Sverdrup admits to being tempted, but decided to fulfill his obligation, in spite of the immense difficulty in carrying out the observational program. *"These years were really valuable because they brought me in the closest possible contact with nature, a circumstance which to one who works in geophysics cannot be overestimated."*<sup>6</sup>

The most significant of the Maud papers, *Dynamics of Tides on the North Siberian Shelf*, was completed on shipboard (oceanographers will appreciate this feat).

These were the formative years of Sverdrup's scientific career; he developed a first-hand appreciation of the interdependence of the ocean environment. The Arctic years also formed the basis of developing his personal qualities, particularly a high degree of self-discipline. Amundsen was vain, opinionated and not well informed on scientific issues. The relation between the expedition leader and the chief scientist was not an easy one. But Sverdrup made it work. Years later he wrote, *"the thing I am most proud of was that after years .... we departed as friends."* He thanked Amundsen *"not just because you provided me with a wonderful opportunity to work with things that interest me, but even more because you helped make a man of me."*<sup>7</sup>

## Sverdrup is Called to America

In 1930, while spending half a year at the Carnegie Institution in Washington, Sverdrup was approached by Carnegie President, John C. Merriam, a member of the U.S. National Academy of Sciences Committee on Oceanography, and offered the initial Directorship of the Woods Hole Oceanographic Institution.<sup>8</sup> Sverdrup turned down the offer because he needed more time to complete the Maud work.

In 1935 Bjørn Helland-Hansen, returning from a visit to the United States, asked Sverdrup whether he would consider taking the Directorship of the Scripps Institution of Oceanography for a limited number of years. Sverdrup accepted the position for a period of three years, later extended to five. Then war broke out, and it was to be twelve years before he returned to Norway.

## Scripps Institution, The Early Years

The Scripps Institution of Oceanography was founded in 1903 as the Marine Biological Association of San Diego by William E. Ritter, a zoologist from the University of California in Berkeley. Its research program was fixed on marine biology, although Ritter took a broad ecological view and wished to study marine creatures in their full biological and oceanographic context. To that end, he hired George McEwen as physical oceanographer.<sup>9</sup> *"The particular satisfaction in having a physical laboratory operating in conjunction with the biological work,"* Ritter wrote, *"lies in the fact that whenever a special biological question comes along requiring information from the physical side, the physicist can be appealed to then and there."*<sup>10</sup>

Ritter and the institution's benefactors, E.W. Scripps and his sister Ellen Browning Scripps, agreed from the beginning that the institution would eventually become part of the University of California. That union was effected in 1912, when Miss Scripps endowed the institution. The University of California, reluctant to adopt a poor and distant marine laboratory in 1903, was delighted to accept a well endowed and thriving station in La Jolla in 1912.

During his weekly visits from his nearby Miramar Ranch to the marine station in La Jolla, E.W. Scripps shared his thoughts on biology and philosophy with members of the staff. Biology was the science that captured the public imagination at the turn of the century. Acceding to E.W. Scripps' wishes, Ritter in 1912 expanded the research program to encompass all of

<sup>6</sup>Sverdrup Autobiographical Sketch, April 11, 1936. SIO Office of the Director (Sverdrup) Records, Box 1, folder 1.

<sup>7</sup>Ibid, p. 17.

<sup>8</sup>H.U. Sverdrup to Vernon Knudsen, February 1, 1938, page 2. See also Henry Bryant Bigelow, *Memories of a Long and Active Life*. Cambridge, MA: The Cosmos Press, 1964, p. 31.

<sup>9</sup>Eric L. Mills, "Useful in many capacities, An early career in American physical oceanography." *Historical Studies in the Physical and Biological Sciences* 20, no. 2 (1990), 265–311. Mills quotes Ritter, "mathematics called to the service of biology and kept strictly in its place as an assistant, is not only enormously important but for many of the deepest problems absolutely indispensable," p. 273.

<sup>10</sup>William E. Ritter, "The Scientific World of the San Diego Marine Biological Station during the Year 1908." *Science* 28, no. 715 (September 11, 1908), p. 332.



biology, but the finances, provided by the Scripps family and matched by Berkeley, were insufficient to support a broad biological program. Only one biologist on campus, Francis Bertody Sumner, was actually working outside marine biology, and he was eventually ordered by Ritter's successor, Vaughan, to terminate his work with field mice and turn to marine specimens. Sumner's abandonment of the Lamarkian hypothesis, following a lifelong sequence of experiments intended to support it, was a landmark in the evolutionary synthesis.<sup>11</sup>

Ritter was succeeded in 1923 by the geologist Thomas Wayland Vaughan. The Directorship had previously been offered to Henry Bryant Bigelow, who declined and went on to become Director of Woods Hole. It was time for change. The institution was renamed the Scripps Institution of Oceanography. The moment was ripe to make Scripps an oceanographic institution in fact as well as in name. Vaughan tried to do just this, but he was thwarted at every turn. The tuberculosis that Vaughan had contracted while studying corals in the West Indies prevented him from personally leading the work at sea.<sup>12</sup> Some members of the faculty, especially Francis Sumner, considered Vaughan's leadership autocratic. Vaughan succeeded in hiring several young faculty before the Depression precipitated severe budget cuts. The institution had already lost income when E.W. Scripps died in 1926. Promotions and campus maintenance were deferred. Scripps had to depend on WPA workers for campus maintenance and for the compilation of physical and chemical charts.<sup>13</sup> The struggling faculty was asked to take voluntary pay cuts. Resentments flared up when some did and others did not.<sup>14</sup>

Leadership in oceanography remained in Europe with Bjerknes and his students at the Bergen School in Norway and with the Austrian Albert Defant and German George Wüst of the *Meteor* expedition. In Britain, William Herdman and John Murray paved the way for George Deacon. Leading American scientists including Bigelow, John Merriam, Frank Lillie, and Tommy Thompson wished to build strength in oceanography in the United States. Marine ecological studies of the type promoted by Ritter had become passé.

After thirteen difficult years, Vaughan was ready to look for a successor. He turned for advice to

oceanographer Bjorn Helland-Hansen who recommended fellow Norwegian Harald Sverdrup. Helland-Hansen found Vaughan's assistant director, the ambitious young Claude ZoBell too narrow, and Vaughan's doctoral student Roger Revelle brilliant but too young for the Directorship. In the end, Vaughan commented that his greatest accomplishment was to persuade Sverdrup to become the third Director of Scripps.

## Sverdrup Comes to Scripps

When the Sverdrup family arrived in La Jolla in July 1936, they found an isolated community of researchers housed in sub-standard cottage accommodations on campus. These 'shacks,' according to the outspoken Gudrun Sverdrup, were simply a disgrace. Prior to Sverdrup's arrival, the Director's House, built by Mrs. Ritter along plans made by Julia Morgan, had its craftsman redwood interior covered by a fresh paint job. Mrs. Sverdrup did not appreciate the local La Jolla characterization of Scripps as the "*intellectual shantytown along the Biological Grade marking the entrance to the fishing pier.*"

The family soon adapted to the beautiful surroundings. Daughter Anna was registered at the Bishop's School in La Jolla. There was a clay tennis court next to the Director's residence, and when Walter Munk arrived in the summer of 1939, Gudrun recruited him as a tennis partner. If she won, Munk would be invited for a dinner of fiske pudding and an account of Arctic adventures. On other nights, Munk recalls, one could satisfy one's food needs by picking abalone off the pier.

Sverdrup found an institution without sea-going facilities and without sea-going oceanographers. There was no underlying research theme, no creditable teaching program. When Sverdrup accepted the position, he wrote Robert Gordon Sproul, President of the University of California, that he intended to make the institution live up to its new name by taking it to sea.<sup>15</sup> Sverdrup had brought two current meters with him from Norway, and he hit the ground running.<sup>16</sup>

The staff learned only four months earlier that Sverdrup was coming,<sup>17</sup> and some viewed the appointment with apprehension. During the era when Scripps

<sup>11</sup>William B. Provine. "Francis B. Sumner and the Evolutionary Synthesis." *Studies in History of Biology*, (1979): 211-240.

<sup>12</sup>Vaughan was nevertheless committed to work at sea. When he recruited Martin Johnson in 1934, Vaughan specifically mentioned to him the importance of work at sea. "I think that you are accustomed to working on a research boat and that that would offer no obstacles. We expect during the coming year that virtually everybody on the scientific staff of the Institution with the possible exception of two men, will participate in the work at sea. We have on the Institution's staff a few people who are not sea-going. I do not intend to add to the staff any body else who will not work on the water." Vaughan to Martin Johnson, June 9, 1934. Martin Johnson Papers, Box 1, SIO Archives, UCSD

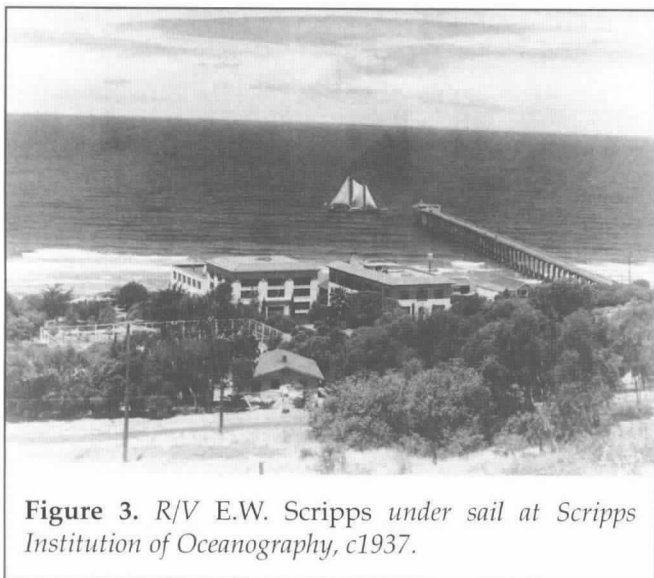
<sup>13</sup>"Narrative Report, WPA Project No. 6912, Scripps Institution of Oceanography, University of California, La Jolla, California," May 1936. SIO Subject Files, Box 24, folder 43.

<sup>14</sup>W. E. Allen to Harald U. Sverdrup, November 9, 1936. W.E. Allen Papers, Box 2, folder 19, SIO Archives, UCSD.

<sup>15</sup>Sverdrup wrote Vaughan on April 11, 1936 that he wanted to help make Scripps a center for dynamic oceanography. SIO Office of the Director (Sverdrup) Records, Box 1, folder 8.

<sup>16</sup>Sverdrup to Sproul, August 31, 1936. SIO Office of the Director (Sverdrup) Records, Box 1, folder 8.

<sup>17</sup>In his autobiography, "Oceanographic Medley," Martin Johnson recalls that Vaughan called a staff meeting to announce Sverdrup's appointment. "Although the staff had not been consulted beforehand, no voices were raised in either objection or approval. Personally, I had a feeling of both surprise and elation..." Martin Johnson Papers, Box 2.



**Figure 3.** R/V E.W. Scripps under sail at Scripps Institution of Oceanography, c1937.

was a “marine observatory,”<sup>18</sup> Ritter had appointed a series of “collectors”. For example, Percy Barnhart curated specimens, Stanley Chambers wound the mechanical devices at the end of the pier that measured tide and temperature, and others recorded data daily in big bound volumes. What role did they have in an institution focused on offshore rather than coastal research? These men had more to fear than the loss of their salaries, for their families lived in little cottages rented from the university at moderate rates.

On the other hand, staff members already working on biological oceanography were pleased.<sup>19</sup> Professor W.E. Allen welcomed the appointment of Sverdrup,<sup>20</sup>

*“This seems to indicate a definite commitment to oceanography. I understand that the new Director is to get here about Aug. 25. The Bacteriologist, Dr. C.E. ZoBell, has been appointed Assistant Director with the duty of trying to organize or harmonize the biological work. Dr. Sumner has been greatly upset by the changes but seems to be unable to do anything about it. The Institution may get down to some real oceanic work after all.”*

## Scripps Goes To Sea

Sverdrup had a very direct style. He reorganized weekly faculty meetings into research seminars on spe-

cific themes. Minutes were taken recording the remarks of each faculty member by name. At one of his first faculty meetings in 1936, Sverdrup asked each staff member for his opinion “on the value of a ship to your particular research.”<sup>21</sup> This was a loaded question. The institution owned only one vessel, a sixty-four foot purse seiner named *Scripps*, which was capable of only short coastal day cruises. Shortly after Sverdrup’s arrival, this ship exploded and burned at anchor at the San Diego Yacht Club.<sup>22</sup> Sverdrup turned to Robert Paine Scripps, the heir to the estate both of his father, E.W. Scripps and his aunt, Ellen Browning Scripps.

Bob Scripps was well prepared for his first meeting with Sverdrup. He had a copy of Helland-Hansen’s 1935 report recommending Sverdrup for the Directorship, and he was privy to the negotiations that brought Sverdrup to La Jolla. In his report, Helland-Hansen mentioned the inadequacies of *Scripps* and pointed out the need for a ship of substantial size capable of undertaking a dynamical survey of the North Pacific.<sup>23</sup> Scripps had offered his yacht *Novia del Mar* for the occasional use of the institution, and by March 1937, he had agreed to finance the purchase and reconditioning of a new ship for the Scripps Institution, and he already had an eye on the former yacht of actor Lewis Stone.<sup>24</sup>

When *E.W. Scripps* was ready for sea, Sverdrup organized a cruise to Guadalupe Island and two expeditions to the Gulf of California. However, he decided to focus on repeated visits to a limited ocean area similar to Henry Bigelow’s work in the Gulf of Maine rather than traditional wide-ranging scattered deep-sea expeditions. This was consistent with his conviction that the Scripps program should ask well-posed significant questions, and do the work to answer those questions. The Marine Life Research (MLR) program, which was first proposed in 1939,<sup>25</sup> and which continues to this day, fell in perfectly with Sverdrup’s plans and gave the institution an opportunity to begin intensive work in a narrowly defined and important area off the California coast. The resulting departure from the traditional expedition era to properly sampled time series is a benchmark in the history of ocean science.

Scripps faculty and staff who did not go to sea felt themselves at a disadvantage. Funds continued to be scarce, and Sverdrup allocated his meager resources to work at sea. He tried to bring chemical and physical

<sup>18</sup>W.E. Allen, “The Growth of a Marine Observatory.” *Internationale revue der Gesamten Hydrobiologie und Hydrographie*, 39 (1939), 464-471. Vaughan disliked Allen’s characterization of SIO as a marine observatory.

<sup>19</sup>Allen to Wesley Coe, March 31, 1936, Allen Papers, Box 1, folder 19. W.E. Allen wrote Wesley R. Coe, May 25, 1937 “Our new Director is just as agreeable as the other was otherwise and I think you would find working conditions here much more pleasant than formerly.” W.E. Allen Papers, Box 1, folder 46.

<sup>20</sup>Allen to Coe, August 16, 1936, *ibid*.

<sup>21</sup>“Other Business,” Minutes of the September 22, 1936 staff meeting, SIO Subject Files, Box 23, folder 34.

<sup>22</sup>Its hull was salvaged and refitted as a garbage scow.

<sup>23</sup>Helland-Hansen memorandum, November 18, 1935 in Scripps Family Papers, 92-38, Box 3, folder 37.

<sup>24</sup>Robert Paine Scripps to Curtis Hillyer, March 26, 1937. Scripps Family Papers, Box 3, folder 38, SIO Archives, UCSD.

<sup>25</sup>MLR began as the Scripps arm of the California Cooperative Oceanic Fisheries Investigation. Its early history is recounted in: Harry N. Scheiber, “California Marine Research and the Founding of Modern Fisheries Oceanography: CalCOFI’s Early Years, 1947-1964.” *California Cooperative Oceanic Fisheries Investigations Reports*, 31 (October 1990), 63-83.



**Figure 4.** Detail, Group Portrait, Scripps Institution of Oceanography, 1939. Standing (L to R): Stanley Chambers, Ruth Ragan, Peter Doudoroff, Eric Moberg, Harald Sverdrup, Richard Fleming, Tillie Genter, Helen Steward, Yale Mintz, Denis Fox. Seated: Bob Durant, Claude ZoBell, Marston Sargent. See FBI quote 19 April 1943 for XYZ.

oceanography up to par with biological oceanography/marine biology. As there were no new faculty or staff billets and no new funds, this change was a painful one.

Sverdrup quietly made some staff changes. George McEwen had been issuing yearly climate predictions for San Diego. Sverdrup asked McEwen to discontinue this practice; he perceived (and we now know) that the predictions were without skill.<sup>26</sup> Under McEwen's supervision, refugee Polish climatologist Wladyslaw Gorczynski<sup>27</sup> was building a little fiefdom for computing a climatological constant (suitably labeled "G") that combined temperature, rainfall, sunshine and

other local statistics into a single number. It was normalized to G=100 for San Diego, and was less than 100 for all other communities (thus enjoying a popularity among local officials). Sverdrup put an end to this. Sverdrup took a research position from biologist Easter Cupp and gave it to phycologist Marston Sargent. He regretfully let chemist Erik Moberg go when alcohol got the better of him, and recruited Carl Hubbs at Francis Sumner's retirement. Richard Fleming and Roger Revelle, both with newly minted doctorates, found themselves with unparalleled opportunities for research at sea because the older faculty were unwilling or unprepared for sea duty. The faculty who did not go to sea felt fiscally beached.

Two of the younger faculty whose work was in the laboratory, biochemist Denis Fox and bacteriologist Claude ZoBell, were concerned about the increased focus on seagoing activities. ZoBell was used to working independently and did not distinguish between seagoing and laboratory scientists at Scripps.<sup>28</sup>

*"While it has been the policy of the Institution to allow the staff members a high degree of freedom in the selection of problems for investigation, it has been the common objective of all to contribute to the science of the sea and its relation to man."*

As Assistant Director, ZoBell had assumed quite a bit of administrative responsibility towards the end of Vaughan's term as director, but he acknowledged Sverdrup's leadership.<sup>29</sup>

Fox wrote Sverdrup that after three hours of discussion, the faculty could not agree on the definition of "oceanography" and suggested that the term "marine science" be used instead.<sup>30</sup> Fox was fussy about titles and wrote lengthy memoranda to the Director on the lack of proper institution stationery and the unsightly defecation of seabirds on university grounds. He felt himself slighted when the young postdocs Fleming and Revelle were given plum assignments. Both Fox and ZoBell had been proposed for promotion to Assistant Professor in 1933, but this was delayed until 1936 because of the Depression. Sverdrup recommended the promotion to Associate Professor in 1938, but this was denied until 1942! Both men felt that the delays were unjust.

Money was always a problem. Ten years before the Office of Naval Research was to become the catalyst of ocean research, Sverdrup contemplated going to the

<sup>26</sup>Eric Mills, "Useful in many capacities, An early career in American physical oceanography," *Historical Studies in the Physical and Biological Sciences* 20 (1990), no. 2: 265–311.

<sup>27</sup>Gorczynski, director of the Polish Meteorological Service, was in New York at a meteorological meeting when Poland was invaded. Reichelderfer and Brooks appealed to Sverdrup to give him a research associate appointment at SIO, and Gorczynski arrived at La Jolla on November 17, 1939. Michael Le Huquet was employed in 1940 to do some drawings for Gorczynski. Gorczynski's research assistantship was not renewed in 1941. SIO Biographical Files, Box 7, folder 232, SIO Archives, UCSD.

<sup>28</sup>Claude E. ZoBell, *Biological Research at the Scripps Institution of Oceanography*. Collecting Neg, XI, no. 5 (August 1, 1936): 1.

<sup>29</sup>Claude ZoBell wrote Karl Meyer, September 17, 1936: "They have piled plenty of extra work and responsibility upon me during the last three months but I think it will be easier now. Incidentally you will be interested to hear that Dr. Sverdrup, our new director, has already convinced the staff members that he is a man of vision far beyond their fondest expectation, and he is a real leader of men." SIO Biographical Files, Box 21, folder 626.

<sup>30</sup>Fox to Sverdrup, September 24, 1936. Denis Fox Papers, Box 4, folder 39.

Navy for support, but concluded, "The Navy, when you get right down to it, doesn't care about oceanographic research."<sup>31</sup>

## Teaching Oceanography

Sverdrup began reforming the curriculum of SIO as soon as he arrived on campus. SIO was not empowered to grant degrees. During the Sverdrup years, degrees for graduate work at SIO were granted by UCLA. Sverdrup worked closely with a select faculty committee, which included Claude ZoBell to outline a new syllabus in time for publication in the University Catalog. In 1938, Sverdrup began working on a textbook, *The Oceans*, with two co-authors from the Scripps staff, Richard Fleming and Martin Johnson. Even before it was published, chapters were used to shape the course in oceanography at Scripps. The entire faculty was organized to teach a comprehensive series of lectures, which covered biological, chemical, geological and physical oceanography. Claude ZoBell felt that physiology of marine organisms was not sufficiently represented in the curriculum. In Sverdrup's view oceanography was not synonymous with marine science. Francis Sumner felt that scientists should be free to follow wherever their research led them and therefore disagreed with the concept of an organized program. Sverdrup listened to the opinion of his faculty, but then held his course.

It is interesting to contrast Sverdrup's views with those of Ritter. Ritter wanted physical oceanography to serve the interests of biologists. Sverdrup wanted broad cooperative interdisciplinary studies. "I wish to underline the necessity of broad training," Sverdrup wrote:

*"Every oceanographer, regardless of how narrow his specialty may be, should have some basic knowledge of the fields of all the marine sciences, partly because he ought to be acquainted with the terminology of his fellow workers and partly because he should be able to recognize results within his own field which have a bearing on problems of others or to know where he may obtain information that has a bearing on his own."*<sup>32</sup>

Sverdrup's goal was to train oceanographers through a rigorous academic program, but he always emphasized the importance of experience in the field:

*"Much as I respect the theoretical and laboratory physicists and chemists, it has frequently struck me that these have a tendency to identify conditions in*

*nature with such which can be reproduced in the laboratory. They often lack an appreciation of the complexity of the atmosphere and the ocean and the physics of the earth—and many of those I have met have little knowledge of how far we have advanced in our understanding of the phenomena encountered. I have repeat[ed]ly seen physicists embark on programs of observation without knowledge of what had been accomplished."*<sup>33</sup>

Sverdrup did not feel that atmospheric science should be part of the curriculum of the Scripps Institution in 1936. This was certainly a departure from the Bergen School model. There were several reasons for it. First, Scripps' Depression era budget was not adequate to support an expansion into atmospheric science. Second, Sverdrup knew from his frequent trips to UCLA and his interactions with Vern Knudsen and Joseph Kaplan that the UCLA Department of Physics was interested in expanding in geophysics.<sup>34</sup> In fact, Sverdrup helped UCLA recruit his Norwegian colleagues Jacob Bjerknes and Jörgen Holmboe in 1940 to make the nucleus for a Department of Meteorology. Atmospheric science would have a home at UCLA, and there would be fertile opportunities for oceanographers from La Jolla to interact with geophysicists from Los Angeles.

Sverdrup tried to bring the Scripps Institution of Oceanography in line with the academic policies of the rest of the University of California. Students at Scripps before the Sverdrup years were attached to and dependent upon individual faculty members, who were empowered to shape and control their graduate work. Sverdrup centralized procedures for admitting and supervising graduate students. Students from other departments could enroll in Scripps courses, and Sverdrup even approved the enrollment of university undergraduates in single courses under certain conditions. However, Sverdrup required that all graduate students enrolled in oceanography complete the curriculum before they focused on a particular sub-discipline within oceanography. The faculty at Scripps and elsewhere lauded these reforms.<sup>35</sup> One effect of this change was to diminish the power of the individual faculty advisor. Sverdrup, as chairman of the Department of Oceanography, had the sole power to accept or reject prospective students.

Sverdrup put research before the educational program of the Scripps Institution. His first priority was always to take the institution to sea. The training of oceanographers, for whom there were no fellowships

<sup>31</sup>Sverdrup to Bjørn Helland-Hansen, 2/3 January 1938, quoted in: Robert Marc Friedman, "Polar dreams and California sardines: Harald Ulrik Sverdrup and the study of ocean circulation prior to World War II." In: Margaret Deacon, Tony Rice and Colin Sommerhayes, eds. *Understanding the Oceans: A century of ocean exploration*. London and New York: UCL Press, 2001, 168.

<sup>32</sup>Sverdrup, "The Place of Physical Oceanography in Oceanographic Research." *Journal of Marine Research* 14, no. 4 (1955), 288.

<sup>33</sup>Sverdrup to Vaughan, April 20, 1945 in Thomas Wayland Vaughan Papers, Smithsonian Institution, Box 109.

<sup>34</sup>Deborah Day, "Bergen West: Or how Four Scandinavian Geophysicists Found a Home in the New World." *Historisch-Meereskundliches Jahrbuch* 6 (1999), 74.

<sup>35</sup>See for instance the reactions of SIO faculty reflected in minutes of the September 22, 1936 staff meeting. SIO Subject Files, Box 23, folder 34.

and little prospect of employment, was secondary. Nevertheless, he did accept some doctoral students. Walter Munk, from the California Institute of Technology, became Sverdrup's student in 1940.

## The Ocean Bible

Amidst all the challenges of the institution, Sverdrup continued his personal research. He devoted much effort with Martin Johnson and Richard Fleming to *The Oceans: Their Physics, Chemistry and Marine Biology*, known as *The Bible* (this is the closest he came to living up to the Sverdrup family church tradition). *The Oceans* is the last comprehensive work covering all aspects of oceanography between two covers; it reflects Sverdrup's broad exposure during his seven years in the Arctic.

*The Oceans* is such a landmark accomplishment for Sverdrup and the Scripps Institution that one ought to take a closer look at how it came about. In the spring of 1937, Sverdrup and Robert Millikan discussed the need for a textbook in oceanography to replace the outdated volume in the National Research Council's *Physics of Earth* series.<sup>36</sup> Prentice Hall college textbook editor D.A. Tacke wrote Harald Sverdrup on 21 December 1937 at the recommendation of Theodore von Kármán to ask if he would write the text.<sup>37</sup> Sverdrup's secretary Ruth Ragan recalled that Sverdrup was about to turn it down, but then decided to do the book.<sup>38</sup> By the summer of 1938, Sverdrup had selected his two co-authors, and by October, they had an outline. *The Oceans*, Sverdrup's vision of oceanography, represents what he was trying to accomplish at the institution and what he was trying to build into the curriculum.<sup>39</sup>

Chapter VI, "*The Water Masses and Currents of the Oceans*" has survived the fifty years since its publication.<sup>40</sup> Sverdrup was working on this chapter during the summer of 1940. His office had a small back door opposite a room occupied by his graduate student, Walter Munk. Sverdrup would appear at Munk's door and say quietly, "*Come and listen.*" In the middle of the Director's office a big wooden table was piled high with books and papers in stacks corresponding to



**Figure 5.** Walter Munk and Harald Sverdrup, Scripps Institution of Oceanography, 1940.

major ocean basins. Sverdrup would walk slowly around the table, pick up selected papers, and speak on what he thought were the essential features. He would go through this exercise many times following different guidelines. It was at one of these sessions that he decided to organize the chapter around the Antarctic Ocean, looking at the Atlantic, Pacific and Indian Oceans as northward pointing fingers. When he was ready, he would call in Miss Ragan and dictate a section of the chapter without referring to notes.

Occasionally, Sverdrup would have Munk read off numbers for him to plot (today's computer-generated plots miss the excitement of wondering where the next point will fall). Sverdrup would beam if a point confirmed a developing pattern and scowl if it missed. Each point was taken seriously, and outliers were often rationalized. The procedure was consistent with the motto in the preface:

<sup>36</sup>U.S. National Research Council. Committee on Physics of the Earth. *Physics of the Earth*. Washington: Published by the National Research Council of the National Academy of Sciences, 1931–33; New York, McGraw-Hill, 1939–42. Volume 5, *Oceanography*, was written by a committee of American scientists and published in 1932.

<sup>37</sup>The original letter is in a scrapbook in the SIO Archives, Manuscript and Papers Regarding The Oceans, 1937–1944, accession 81–123, volume 1.

<sup>38</sup>Helen Raitt, noted on an interview with Ruth Ragan, 1965. SIO Subject Files, Box 13, folder 434.

<sup>39</sup>Martin Johnson recalls in his autobiography, "*Oceanographic Medley*," that the reform of the Scripps curriculum and the writing of *The Oceans* were closely connected. "Lack of an integrated text in oceanography was a serious handicap. This led Dr. Sverdrup, Dr. Fleming and me to write such a text after having abandoned an earlier idea of preparing only a syllabus for class use." Martin Johnson Papers, Box 2.

<sup>40</sup>An entire journal issue was devoted to the 50<sup>th</sup> anniversary of the publication of this book, *Oceanography* 5 (1993): 155–157. The book continues to sell. Anna Sverdrup Hamre recently received her 2001 royalty check for twenty dollars.



*"...we have preferred definite statement to mere enumeration of uncorrelated observations and conflicting interpretations, believing the treatment selected would be more stimulating."*

All of Sverdrup's writings were led by observational material. Mathematics was used as a concise *a posteriori* discipline for organizing his thoughts, not as a means of deriving new insights.

The arrival of the first printed copies of *The Oceans* in La Jolla on 19 December 1942 was celebrated at the Sverdrup house. Miss Ragan was temperate, and this was to be the first (and last) time that her lips touched wine. The publication in the United States was followed by an unprecedented delay in distribution overseas. G.A. Morriss of Prentice-Hall wrote Sverdrup, "the Navy Department has just phoned me that it would be of great aid to the enemy should [The Oceans] fall into their hands."<sup>11</sup> The book did not become available abroad until VE Day in May 1945. By then a copy had been hand-carried to England by the Hydrographer, Vice Admiral Sir John Edgell and was reviewed by J.N. Carruthers.<sup>12</sup>

## The War Years

In April 1940, Norway was invaded by the Nazis. The Norwegian King, Haakon VII, fled and established a Free Norwegian government in exile. The occupation of Norway was a traumatic experience for the Sverdrup family. They responded forcefully. Anna became a lieutenant in the U.S. Army Nurse Corps, and Gudrun was active as a nurse's aide and Red Cross worker. Sverdrup's brother Leif, a U.S. citizen, was a major general in the Army Corps of Engineers and served as Chief of Engineers in the Pacific Theater of War under General Douglas MacArthur.<sup>13</sup> Harald Sverdrup felt that he had two choices: return to Norway as "another old man with a gun" or stay in America. On 1 May he wrote to President Sproul requesting that his temporary appointment as director become permanent.<sup>14</sup>

*"...Recent developments have changed all of my plans for the future. I wish now to remain with the University of California, hoping that there are no objections to changing the present temporary arrangement to a permanent one. I am taking this step without having consulted Helland-Hansen, but I am convinced that he will have no objections. Regardless of what happens in the near future, and regardless of the ultimate outcome of the war, Norway will be economically ruined and will have*



**Figure 6.** Richard Fleming, Harald Sverdrup and Walter Munk watch Ruth Ragan type *The Oceans*. Cartoon by Martin Johnson.

*to face a long period of reconstruction. Scientific activity will suffer because all efforts will have to be concentrated upon providing the needs of daily life. My ability and training are not of such nature that I can hope to render active help during such a period. ... In view of these circumstances I feel that my place is here where I may hope to contribute my share toward the further development of research activities. I wish to add that, having the misfortune to be away from Norway during the last crucial weeks and the worse time to come, my family and myself could not have found ourselves in better surroundings. We could not have found greater sympathy and greater friendliness, and I could not have found more absorbing and interesting work. ..."*

On 11 June 1940 Sverdrup, his wife Gudrun and daughter Anna applied for U.S. citizenship.

The University of California, its eye on the unsta-

<sup>11</sup> G.A. Morriss to H.U. Sverdrup, March 2, 1943. Scrapbook, Manuscript and Papers Relating to *The Oceans*, 1937–1944, accession 81–123, volume 4, SIO Archives, UCSD.

<sup>12</sup> J.N. Carruthers. *Quarterly Journal of the Royal Meteorological Society* 70 (1944): 159–160.

<sup>13</sup> Leif's emigration to the United States in 1914 was precipitated by a quarrel with his father. He was naturalized in 1918 and served in the U.S. Army with distinction in two world wars. The close relationship between Leif and Harald Sverdrup is never mentioned in the loyalty investigation.

<sup>14</sup> Sverdrup to Sproul, May 1, 1940, Records of the SIO Office of the Director (Sverdrup), Box 1, folder 16, SIO Archives, UCSD.



**Figure 7.** Anna, Gudrun and Harald Sverdrup, La Jolla, California, c1941. Photo by George Sverdrup.

ble world political situation, created a new laboratory at Point Loma in San Diego, close to naval and dockyard facilities, called the San Diego Laboratory and eventually renamed the University of California Division of War Research (UCDWR). The *E.W. Scripps* was conscripted by the Navy for use at the UCDWR.

Sverdrup had spent a lot of time commuting to UCLA. This slackened off in 1940, permitting him to participate increasingly in the Point Loma program.<sup>45</sup> The wartime work of the Scripps Institution would be increasingly focused at Point Loma. Revelle was commissioned a Lieutenant (j.g.) in the Navy, and Munk enlisted in the Army (injuring a stint with ski troops in winter 1940). On 1 July 1941 Sverdrup took over as head of the UCDWR oceanographic division.

On 1 March 1942 Sverdrup was denied access to the Point Loma laboratory.

## The Loyalty Investigation

It all started on Friday, May 17, 1940 when an unidentified man walked into the FBI field station in San Diego to report that Sverdrup, "purportedly Norwegian" was suspicious because he never discussed the war. The FBI opened a file on Sverdrup, and the following chronology consists of direct quotes from files obtained under a Freedom of Information Act (FOIA) request.<sup>46</sup>

**17 May 1940** Lt. Eckman, G-2 officer at Camp Callan interviews Frank D. Kilmer, a retired coal business executive residing in La Jolla. "Mr. Kilmer stated that he was well acquainted with Dr. Sverdrup and felt it was unusual that subject had made no Pro-Nazi utterances but that subject's wife was very outspoken in Nazi sympathies." Sargent Russ Oliver, SD Police Department, later informed G-2 that the subject "is inclined to be overly imaginative particularly as regards subversive matters." Eckman opens a file on Sverdrup and starts keeping track of all foreigners who visit him.<sup>47</sup>

**2 June 1941** Anonymous letter sent June 1 with a New York postmark received by the FBI. "Sverdrup (?), a Swedish oceanographer, also this year at La Jolla, a friend of the Swedish Nazi No. 1, Sven Hedin, which should make him suspect."

**11 June 1941** NDRC requests clearance for Sverdrup to work on Navy contracts, and refers his name to FBI and Navy Intelligence for background checks.

**1 July 1941** Sverdrup heads NDRC Oceanographic Division.

**24 July 1941** George H. Shea, Commander, Civilian Conservation Corps, Sacramento District writes Eckman questioning Sverdrup's loyalty on the basis of secondhand information apparently from (Scripps technician) Stanley Chambers<sup>48</sup> who was quoted as saying that Sverdrup "surrounded himself with a personnel who, in their actions and statements, had indicated that they had advanced communistic attitudes." This refers particularly to Dr. L. Lek, a Dutch oceanographer resident in La Jolla.<sup>49</sup>

**5 August 1941** Eckman interviews Stanley Chambers whom he identifies as a faculty member.

<sup>45</sup>Gas rationing and tire conservation measures were in place and Martin Johnson, among others, had to give up teaching courses at UCLA.

<sup>46</sup>All phrases and quotations come from files received from the FBI, Army Intelligence, Navy Intelligence and War Department in response to a Freedom of Information Act request for information on Harald U. Sverdrup and Walter Munk submitted by Deborah Day in 1993. These files are available to researchers in the Walter Munk Papers, SIO Archives, UCSD.

<sup>47</sup>Among the foreign visitors was postdoctoral student and marine biologist C.K. Tseng who later became Director of the Chinese Academy Institute in Tsingtao and was a leader of Chinese oceanography until temporarily deposed during the cultural revolution.

<sup>48</sup>Stanley Chambers was born in Truro, Nova Scotia in 1890, studied briefly at Dalhousie University and served in the Canadian army during World War I. He emigrated to the U.S. in 1922, and he and his British wife were naturalized American citizens. He joined the Scripps Institution in 1924 as a general laboratory assistant, and his family lived in cottage No. 28 on campus. Chambers' job was to keep the pier instruments running and record daily logs of sea and weather conditions.

<sup>49</sup>Dr. Ludowyk ("Louis") Lek is best known for his translation into English of Albert Defant's monumental *Physical Oceanography*.

Chambers states "emphatically that subject is pro-Nazi" and that Mrs. Sverdrup had made comments sympathetic to the Nazi movement in front of him and Mrs. Chambers. "The informant felt...that [Sverdrup] should not be trusted with information vital to this country's defense because of his decided sympathies with Germany and the Nazi movement."

**8 August 1941** Eckman initiates investigation of Sverdrup. He reports "...that associates of Dr. Sverdrup are at wide variance of opinion as to his loyalty...it is the opinion of this Intelligence Officer that Dr. Sverdrup ranks high in his field of science and, while he could be valuable to the National Defense Program, there is reasonable doubt that he should have access to secret matters." This report was forwarded by G-2 to "Lt. Col." J. Edgar Hoover on 23 September, to Navy Intelligence and to the Department of State.

**23 August 1941** Navy informs NDRC that employment of Sverdrup on confidential and secret matters pertaining to national defense "was not agreeable" to the Navy "because the subject is an alien and citizen of a Nazi-occupied country."

In September 1941, Sverdrup's brother Einar, engineer and director of the Store Norske Spitsbergen Coal Company A/S goes to England when Spitzbergen is evacuated by Norway.

**9 September 1941** (Berkeley physicist) Ernest O. Lawrence writes John Tate, OSRD about Sverdrup, and passes on his "conviction of his loyalty to our country." John Tate, OSRD, writes BUSHIPS Rear Adm. A.H. Van Keuren, "Dr. Sverdrup probably has better qualifications for assisting us in oceanographic problems than any person living today. Our work at San Diego would suffer immeasurably if he were not given clearance..."

**20 September 1941** Lt. Col. J.T. Bissell writes Deputy Chief of Staff: "After a careful review of all reports and records available to this office, there appears to be evidence, as shown in the attached report, which indicates reason to question the loyalty of the person named below: Harald Ulrik Sverdrup."

**29 September 1941** Sverdrup writes to War Department requesting that Munk be discharged from Army and posted to Navy Radio and Sound Laboratory to work on ASW problems.

**25 October 1941** Vannevar Bush, Director OSRD writes (aeronautical engineer) Jerome Hunsaker that Vern Knudsen, E.O. Lawrence, Robert Gordon Sproul and others vouch for Sverdrup "...it seems to me it would be well to come to some definite conclusion..."

**12 November 1941** Munk is honorably discharged from the Army as a corporal and goes to work as a civilian oceanographer at the Point Loma laboratory.

**27 November 1941** Office of Naval Intelligence requests FBI to investigate Sverdrup under Alien Employment-Aircraft and Munitions Production; special inquiry, in connection with his work at UCDWR.

On 7 December 1941 the Japanese bomb Pearl Harbor.

In 1942, two of Sverdrup's sisters, Marie and Helga were arrested and imprisoned by the Nazis in Norway.

**January 1942** FBI, San Diego, interviews many people acquainted with Sverdrup, collecting both positive and negative assessments of his loyalty. Dr. and Mrs. Roger Revelle gave assurances of Sverdrup's loyalty. (Scripps biochemist) Dr. Denis Fox "stated that he did not think the Sverdrups were loyal to the United States but doubted if they were in touch with the Nazis, but added that it was his belief that if he ever had a chance to give any aid to the Nazis, he would do it." Chambers reported that Sverdrup had ordered Scripps research on anti-fouling to be discontinued even though "the development of any preventative, would be of the greatest military value."

**8 January 1942** J. Edgar Hoover cables the FBI office in San Diego to initiate investigation of Sverdrup per Navy request.

**9 January 1942** Sverdrup is interviewed at FBI San Diego office. He states that at first it was "difficult for his wife to undergo the change between Norwegian habits and American habits," but that he and his family like America and plan to "stay in the United States until he retires from his present position as Director of the Scripps Institution and then he expects to return to Norway." Further, he stated "that no amount of pressure on his relatives in Norway would in any way affect any confidential matter or information which he may have in his possession."

**14 January 1942** FBI, San Diego submits a report on Sverdrup, detailing all San Diego interviews. The summary quotes negative assessments by Chambers, Shea, and others.

**21 January 1942** FBI interviews Dr. Frank Lily<sup>50</sup> in Chicago who "considers Dr. Sverdrup one of the most distinguished oceanographers in America and holds him in high esteem. He described Dr. Sverdrup as a man of courageous and loyal character, of unquestionable integrity and on whom he believes can be thoroughly relied upon."

<sup>50</sup>This is undoubtedly Frank Lillie, a former director of the Marine Biological Laboratory and president of the Board of Trustees of Woods Hole Oceanographic Institution. The files often misspell the names of scientists.

**26 January 1942** Vern Knudsen writes to OSRD "I am fully convinced that we have no one on our staff who is more dependable or who would be more willing to sacrifice for the United States than Dr. Sverdrup. We are continuing to use Dr. Sverdrup in a restricted capacity, strictly in oceanographic work..."

**29 January 1942** FBI interviews (mathematician) Dr. Max Mason at Los Angeles who "described Dr. Sverdrup as genteel, thoroughly cooperative, international in spirit, directly opposed to the Prussian point of view. ... considers no importation from Europe could be more free from the Nazi idea of life or politics than Dr. Sverdrup."

**3 February 1942** FBI interviews Dr. Thomas Thompson (director of the University of Washington oceanographic laboratories), "He advised that in his opinion Dr. Sverdrup is one of the three leading oceanographers in the world .... Continued by stating that he was quite astonished at hearing this rumor because in his association with Dr. Sverdrup he had never heard anything but criticism of the Nazi regime and cited as examples of Sverdrup's opinion on the point the following statement which he recalled Sverdrup to have made: "After this I will never be able to collaborate with any of my German colleagues."

**11 February 1942** FBI interviews (former Woods Hole Director) Henry B. Bigelow at Boston who "advised that he had known subject principally through their mutual scientific interest and stated that Sverdrup is one of the outstanding men in his field of oceanography in the world today. ... he can recall attitudes expressed on the part of Sverdrup which, to his mind, would indicate that he is entirely opposed to the Nazi methods as well as their political theories..."

**11 February 1942** FBI interviews (Woods Hole Director) Columbus Iselin at Woods Hole who related that Sverdrup was closely associated with German scientists in Germany and that due to this fact Germany was more or less his second homeland. It is [his] ... belief that [Sverdrup] still has a great deal of respect for the scientists of Germany who are connected with the science of oceanography. ... however, is of the opinion that Sverdrup does not possess any sympathies whatsoever that might be construed inimical to the welfare of this country... Concerning Sverdrup's ability, ... stated that in his opinion Sverdrup is probably the most outstanding authority in the work of submarine detection in the world today and has an excellent practical background in the science of oceanography."

**11 February 1942** Navy recommends that Sverdrup be denied employment on classified Navy matters.

**26 February 1942** The Secretary of the Navy refuses his consent for employment of Sverdrup on classified Navy contracts citing "Reliable information reports that subject has made remarks which indicates sympathy with the Axis cause and that he is a close friend of a prominent Swedish Nazi."

**1 March 1942** Sverdrup is denied access to the Point Loma Laboratory

**7 March 1942** FBI interviews (former Scripps Director) T. Wayland Vaughan in Washington, D.C. who "...stated that absolutely there could be no question as to Dr. Sverdrup's character, integrity, his honesty, or his loyalty to this Government. Stated that insofar as he personally was concerned, he would not hesitate one minute to risk his entire personal fortune as a bond for the assurance of Dr. Sverdrup's loyalty. ... When asked by Agent as to whether he believed Dr. Sverdrup would be an individual who could be trusted with confidential information if employed in the service of this Government, stated: 'If we can get Sverdrup to work for us, we are damned lucky.'"

**7 March 1942** FBI interviews Lt. Roger Revelle and reports Revelle describes Sverdrup as "an outstanding advocate of the Governmental form of this country and to be absolutely reliable, honest and trustworthy. Unusually discreet. Wife and daughter are reported to be great "fans" for this country and Government." Revelle insists upon calling his wife at home to corroborate his impressions. "Informants advise no grounds for suspicion of un-American or subversive activities."

From this point forward, the loyalty investigations of Sverdrup and Munk are inextricably intertwined.

**1 April 1942** G-2 Agent Neil Ruge interviews Chambers, who gives G-2 a list of Munk's friends and associates and says that he doubts Munk's loyalty because he appeared to avoid military service and is associated with Michael Le Huquet. Ruge finds Chambers credible though possibly over-suspicious. Ruge interviews ZoBell who says he "could not give an estimate of subject's loyalty, integrity or discretion," but said that other members of the staff considered Munk pro-German. Agent Ruge concludes that ZoBell "knows considerably more about subject than he is willing to divulge."

**3 April 1942** Ruge interviews Owen Martin, SIO Janitor,<sup>31</sup> who "believed that subject (Munk) was not loyal to the United States. Martin said subject kept an office at Scripps Institution and he frequently brought girls out to the office at night. Most of these girls spoke with a German accent. Martin said he had got into an argument with subject over the moving of Japanese

<sup>31</sup>Martin was employed at SIO for only a few months. When Martin was discovered examining the contents of the Director's waste paper basket, he stated that he had been instructed to do so by the FBI.



from the coastal area. Munk had stated that there was nothing wrong with the Japanese, that he was an alien and nothing was wrong with him. Martin then replied that he thought General DeWitt knew what he was doing. Martin then stated Munk said the Army didn't know what it was doing and that the Army was 'dumb'. Martin quotes ZoBell as saying that Munk attended a party at Sverdrups' home the night Singapore fell and 'there was much laughter over this event.'

**9 April 1942** Ruge interviews Munk's landlady Mrs. C.F. Cole who vouched for his loyalty, integrity and discretion, but said she wouldn't rent a room to him again because of his extreme untidiness. Ruge interviews Denis Fox. "He stated that he knew nothing definite to discredit Subject's loyalty, but that he 'kept his fingers crossed' concerning him." Ruge interviews ZoBell again. ZoBell refused to give the agent the names of the staff members who considered Munk pro-German because Sverdrup "had told him to forget it. Dr. Sverdrup had also told him that he, ZoBell, was getting over-emotional about the war." Ruge concluded that "ZoBell fears for his position" and had the impression that ZoBell doubted the loyalty of both Munk and Sverdrup.

**15 April 1942** Military Intelligence Division (MID) loyalty report on Munk concludes, "This agent (Ruge) recommends that subject be removed from work on secret and confidential projects." The agent states that while most of the information about Munk is favorable, other information indicates the possibility of disloyalty, and Munk's association with Sverdrup whose pro-German tendencies are proven to the agent's satisfaction, persuade the agent that Munk should not be allowed further access to secret material. This report is forwarded to the Office of Naval Intelligence.

On 14 May 1942, Sverdrup's younger brother Einar Sverdrup leads a joint British-Free Norwegian commando raid in Spitzbergen and is killed.

**27 May 1942** Chief of Naval Operations objects to Munk's employment and cites his relationship with Sverdrup who has been found "guilty of subversive tendencies."

**June 1942** FBI initiates an investigation when two soldiers complain that they encountered Munk at Lake

Hodges where he told them he was going to "blow up the dam." Soldiers give FBI license number of the man's car, registered to Munk.<sup>32</sup>

In parallel with these developments, Captain H.R. Seiwel of the Directorate of Weather, Army Air Forces, requested that Scripps prepare global and local charts of sea surface temperature plus superposed air temperature and wind vectors.<sup>33</sup> The work was done under the supervision of Professor George McEwen with the assistance of Dr. Lek. Sverdrup responded to Seiwel, "fortunately, I have been called to Washington such that it will be possible to discuss the project directly with you" on 25 May.<sup>34</sup> The project was confirmed by the Air Forces with the statement, "it is considered that the wide experience and knowledge of Dr. H.U. Sverdrup will be of unique value as a consultant. The five thousand dollar contingency fund is requested for this purpose."<sup>35</sup>

## Operation PLOUGH

Sverdrup was summoned to Washington on 25 May 1942 by fellow polar explorer Vilhjalmur Stefansson for a meeting with Stefansson<sup>36</sup> and William J. Donovan who was about to be appointed Director of the Office of Strategic Services (OSS). A month later, Sverdrup was again on his way to Washington, this time for a prolonged period. In a letter to the Free Norwegian Embassy, Sverdrup wrote:<sup>37</sup>

*"Yesterday evening Dr. Sverre Pettersen" phoned from Ottawa and asked me to come to Washington to work there for some time. I told him that I can be there...a week from tomorrow. There are some matters I have to attend to here before leaving."*

The next day, Sverdrup wrote President Sproul that things were "running smoothly" at Scripps and that "my presence is not essential."<sup>38</sup> Three days later, Sverdrup and his wife left La Jolla. Fox thought that the Sverdrups were about to skip the country.

**9 July 1942** FBI receives a report from Denis Fox "that the subject has received a communication from the Norwegian Embassy in Washington, D.C. and that he and his wife left for Washington on June 19, 1942. Sverdrup allegedly indicated that his intention of mak-

<sup>32</sup>The FBI subsequently interviewed Munk who "readily admitted having made the statement to the soldiers. He stated that he had been dancing with a lady friend and had been annoyed by questions of the soldiers. ... He stated he made the remark as a jest..." The lady friend was Peggy Scripps, daughter of Robert Paine Scripps. The FBI terminated the investigation.

<sup>33</sup>Seiwel to George McEwen, 13 May 1942. SIO Subject Files, Box 16, folder 37.

<sup>34</sup>Sverdrup to Seiwel, 20 May 1942. Ibid.

<sup>35</sup>Col. Don Z. Zimmerman and Lt. Col. John B. Ackerman, Army Air Forces, to University of California Regents, 4 June 1942, page 2. Ibid.

<sup>36</sup>Telegram 18 May 1942 from Stefansson to Sverdrup. SIO Office of the Director (Sverdrup) Records, Box 1, folder 20.

<sup>37</sup>Sverdrup to Galbe 14 June 1942. Norwegian Embassy Files, Washington, D.C. Riksarkivet, Oslo. Translated by Tor Breivik, Director of Public Services, Riksarkivet, Oslo.

<sup>38</sup>Sverre Pettersen (1898-1974), a leading meteorologist born in Norway, played a significant part in the Allied war effort. He had been a student of Vilhelm Bjerknes in Bergen, and he was a professor at MIT when the war began.

<sup>39</sup>Sverdrup to Robert Gordon Sproul, 15 June 1942. SIO Office of the Director (Sverdrup). Box 1, folder 20.

ing only a brief trip, but Dr. Fox advised that both ... had recently procured passport pictures. It is also reported from another source that the subject is in possession of aerial photographs of the San Diego coast."<sup>1</sup>

Petterssen recalled Operation Plough in memoirs:<sup>2</sup>

*"If the Plough project were to be operated in Norway, someone had to provide detailed information on the geography of snow cover and snow properties and their normal variations during the snowy season. I was fortunate enough to obtain the assistance of two compatriots: Dr. Harald U. Sverdrup, world-famous Arctic explorer and geophysicist, professor of oceanography, and Director of Scripps Institution of Oceanography; and Dr. Gunnar Randers, a young astrophysicist, then at Yerkes Observatory. To avoid waste of time in obtaining security clearances, I rented a pleasant house in Washington. There, Sverdrup and Randers, with the assistance of Mrs. Randers, completed a detailed study of snow and ice in Norway within three weeks."*

What was Project PLOUGH? A brainchild of Lord Louis Mountbatten, it had been briefed to Churchill and to Harry Hopkins and General George Marshall representing President Roosevelt. In essence, the plan was to master the snow bound areas of northern Europe, sabotage hydro-electric power stations in Norway, destroy German bases which threatened allied supply lines to the Soviet Union, and prepare for the re-conquest of Norway to be led by the U.S. 10th Mountain Division (which had absorbed the ski troops with whom Munk had served). PLOUGH required a snow vehicle to be dropped from aircraft behind enemy lines, and Studebaker developed a vehicle called WEASEL capable of operating under a variety of snow conditions.

The Norwegian government in exile did not agree to the destruction of their power network; for this and other reasons PLOUGH was never implemented. However, a number of prototypes of the WEASEL were built, and WEASEL became kin to DUKW, the amphibious military vehicle for Allied landings. DUKW was the workhorse of pioneering wave and

beach studies at Woods Hole and Scripps.<sup>3</sup>

None of this was known to Chambers, Fox, and ZoBell, who found Sverdrup's activities suspicious, dismissed Lek as a dabbler in oceanography and stated that neither Lek nor Munk were professionally qualified to undertake the Air Force research.<sup>4</sup> Further, the proposed employment of Lek and Munk under Army Air Force contract was a:

**7 July 1942** ... subterfuge so as they would be paid from the funds of the Institute rather than the War Department funds so as not to bring them under the jurisdiction of the War Department.<sup>5</sup>

**July 1942** Munk is denied access to the Navy Radio and Sound Lab, Point Loma.

## Operation TORCH

Munk left La Jolla to accept a position as Assistant Oceanographer in the Army Air Force Directorate of Weather (AAFDW) on July 21, 1942 under the command of Major Seiwel. Seiwel knew about Munk's clearance problems with the Navy<sup>6</sup> but assured him that this would not affect his work for the Army Air Force.

Upon his arrival at the Pentagon on 31 August 1942, Munk was briefed on plans for Operation TORCH, an amphibious assault by U.S. forces on the northwest coast of Africa scheduled for 8 November 1942. TORCH was the first American amphibious operation in forty-five years. The North African coast was notorious for mountainous swells in winter. The army was carrying out practice landings on beaches in North Carolina. The landings were halted when LCVP landing craft swamped in breakers exceeding two meters; but winter surf conditions on African beaches were known to exceed two meters most of the time.

High surf on the landing beaches is the result of winter storms in the North Atlantic. The challenge was to forecast the generation and decay of storm waves, to estimate their subsequent transformation in shallow water, and to pick two or three days of acceptable surf conditions. This constituted a radical departure from the Air Force assignment to Scripps which was to prepare charts of surface temperature and wind fields.<sup>7</sup> As

<sup>1</sup>His memoirs were edited by James Rodger Fleming and published in English under the title, *Weathering the Storm: Sverre Petterssen, the D-Day forecast; and the Rise of Modern Meteorology* Boston: American Meteorological Society, 2001, p. 156.

<sup>2</sup>Berkeley engineer Morrough P. O'Brien used DUKW in wartime wave and beach studies, see Morrough P. O'Brien: Dean of the College of Engineering, Pioneer in Coastal Engineering, and Consultant to General Electric, an interview conducted by Marilyn Ziebarth 1986-88. Berkeley: Regional Oral History Office, the Bancroft Library, 1988, p. 70.

<sup>3</sup>Wharton to Hoover, April 29, 1943, page 4. FOIA files.

<sup>4</sup>Branch Office, G-2, WDC & 4th Army, San Diego, July 7, 1942, page 2. HUS FOIA files.

<sup>5</sup>Interviews about Munk's loyalty continued in California even after his departure for Washington, D.C. On September 12, 1942 CalTech President Robert Millikan noted that Munk "was seeking in every way to get on the firing line to help beat the Nazi machine." He agreed that his good impression of Munk could be consistent with that of a clever foreign agent. "However, Informant believes that a "spy" type is normally not as good a student as the subject."

<sup>6</sup>Seiwel to George McEwen, 13 May 1942. SIO Subject Files, Box 16, folder 37.

**Federal Bureau of Investigation  
United States Department of Justice**

1435-37 K Street, Northwest

Washington, D. C.

65-3739

October 27, 1942.

ALL INFORMATION CONTAINED

HEREIN IS UNCLASSIFIED

DATE 7-1-91 BY 1565

Director

Federal Bureau of Investigation  
Washington, D. C.

Attention: Mr. E. A. TAMM

RE: WALTER HEINRICH MUNK;  
HARALD ULRIK SVERDRUP  
ESPIONAGE - G

Dear Sir:

With reference to the captioned individuals, agents of this office conferred with Major General [REDACTED] of G-2 and General [REDACTED] Chief, Technical Services, Army Air Corps. General [REDACTED] advised that subjects, MUNK and SVERDRUP, are employed in the Weather Division of the Army Air Corps and have access to information of great importance. Mr. MUNK has been so employed for some three months and Mr. SVERDRUP for only a few days. General [REDACTED] stated that Major [REDACTED] a well-known authority in Oceanography, was in charge of the work of these men and has been given a more or less free hand in choosing his associates. SVERDRUP's services have been furnished by virtue of a contract entered into by the War Department with the University of California and he is in Washington in a temporary capacity. Messrs. SVERDRUP and MUNK, in their capacity as Oceanographers, have come into possession of information concerning impending military operations which are to take place within the next two weeks. The information in the possession of these individuals is said to be of such a nature that disclosure of said information to enemies of this country would be disastrous.

General [REDACTED] stated in substance "if they are wrong, the damage has already been done". He inferred that Dr. SVERDRUP had once been in the Navy employ and that it was largely through Navy protests that the current investigation had been instituted. He advised further that Major [REDACTED] appears to be a very close friend and associate of the subjects of this case. [REDACTED], according to the General, has been checked by G-2 because investigation had disclosed he had studied in [REDACTED]



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Figure 8. An example of the FBI documents obtained under the Freedom of Information Act (FOIA). Major [REDACTED] refers to Major Seiwell.

part of the Point Loma effort, Sverdrup had been compiling wave and wind statistics<sup>66</sup> dealing with questions such as the *expected* wave height and wind speed off southern California in winter. Now the challenge was to *predict* the wave height on 8 November 1942 on the Casablanca beach. It was like going from climate studies to weather prediction.

Munk spent the month of September assembling data that could provide a few empirical rules as the basis for predicting sea, swell and surf.<sup>67</sup> At the end of the month, Munk told Seiwel that he thought the work could be done, but it would require the unique experience of his mentor, Harald Sverdrup. No one was more qualified in combining a noisy and disparate dataset into believable generalization. If successful, Sverdrup would have the international recognition and prestige to persuade the allied leadership that such a prediction could be relied upon.<sup>68</sup>

Seiwel invited Sverdrup who responded immediately and spent most of October working with Munk in the Pentagon. Unbeknownst to them, they were under twenty-four hour surveillance.

**24 October 1942** Sverdrup writes in his notebook in Norwegian "Met with [blacked out] who had been told to inform me that my 'clearance' has not been arranged. New orders. London? British service? I don't know what I shall do." This item and other papers, including a letter to Sverdrup from his wife, were secretly copied and translated by the FBI.

**27 October 1942** FBI agents meet with Major General [blacked out] of G-2 (Brigadier General Sherman Miles?) and General [blacked out], Chief, Technical Services Army Air Corps in Washington, D.C. The Army Air Corps general informs FBI "Messrs. Sverdrup and Munk, in their capacity as oceanographers, have come into possession of information concerning impending military operations which are to take place within the next two weeks. The information in the possession of these individuals is said to be of such a nature that disclosure of said information to enemies of this country would be disastrous."

G-2 Generals consequently ordered surveillance to continue for two weeks.

At the end of October, Sverdrup recommended

that the method for wave prediction was ready to predict landing conditions;<sup>69</sup> but we do not know whether the prediction rules arrived in time; yet wave conditions on 8 to 10 November were unusually favorable and the landings were successful.

**28 October 1942** Munk's employment on Army Air Force project with Seiwel is permitted on the condition that he be kept under strict surveillance.

On 8 November 1942 Allied troops land in north-west Africa.

**10 November 1942** FBI ends surveillance on Munk and Sverdrup noting "nothing has been developed which would indicate that either of the subjects may have transmitted secret information to any unauthorized person..."

Yet ...

**14 November 1942** Munk employment on Army Air Force project disapproved, and his work "terminated with prejudice" on the basis of reports from military intelligence.

**15 November 1942** Sverdrup's employment with Army Air Forces Project is terminated.

**18 December 1942** Sverdrup and Munk are taken off the Censorship Watch List.

**2 January 1943** War Department again reviews Sverdrup's clearance at request of (Revelle).<sup>70</sup>

**16 January 1943** Military intelligence concludes that Munk "is loyal to the United States and is not engaged in any subversive activities. The few allegations to the effect that subject had pro-Nazi sympathies are unsupported in fact and there is ample evidence obtained from reliable informants indicating that he is actually anti-Nazi. Subject's own actions tend to support the latter conclusion."

**19 January 1943** War Department withdraws all objections and restrictions on employment of Sverdrup.

**9 February 1943** Munk is reinstated on Army Air Forces Project. The project is terminated and turned over to Navy.

<sup>66</sup>UCDWR memorandum, 21 May 1942, Report 40.

<sup>67</sup>At the same time, Instructor-Commander C.T. Suthon of the British Naval Meteorological Service was preparing some rules of thumb for wave prediction. The two groups did not learn about each other's efforts until the planning for the Normandy landings was underway (see Operation OVERLORD).

<sup>68</sup>This problem had received attention at the highest quarters. President Roosevelt had signaled Churchill that bad surf on the Atlantic beaches was a calculated risk. Charles C. Bates and John F. Fuller, *America's Weather Warriors*. College Station: Texas A&M University Press, 1986, 70.

<sup>69</sup>Sverdrup and Munk tried desperately to verify the forecasting rules against observations in the operational area, using wave records in the Azores in support of Pan American Airways seaplane landings. In the process of hindcasting for the Azores sites they noted that occasional high wave conditions were not properly predicted. The wave 'spikes' occurred at regular intervals, and, as it turned out, invariably on Saturday nights.

<sup>70</sup>Ronald Rainger has written about Revelle's role in clearing Sverdrup in his paper, "Science at the Crossroads: The Navy, Bikini Atoll, and American Oceanography in the 1940's," *Historical Studies in the Physical and Biological Sciences* 30 (2000), 362-363.



**19 April 1943** Wallace C. Wharton to J. Edgar Hoover summarizes the report of the Office of Naval Intelligence and refers to informants W, X, Y, and Z as providing information detrimental to Sverdrup. W and X are Shea and Chambers, Z is ZoBell and Y is probably Fox.<sup>71</sup> W stated, "if there were any discoveries made by one scientist, then all the scientists in the world would know," and X reported that on the occasion of the Pearl Harbor attack "Sverdrup was thoroughly amused." Z said that Sverdrup never mentioned the war, which Z found "most unusual, particularly in view of the fact that the wife of this individual was reportedly very pro-Nazi in her conversations with her acquaintances." (See Figure 4.)

**24 June 1943** Navy Bureau of Ships expresses confidence in Sverdrup in view of "numerous signed statements from persons of unquestioned integrity which are favorable to Dr. Sverdrup's character. The Bureau is familiar with the substance of the derogatory reports...and believes that these reports are without foundation."

Returning to La Jolla in February 1943, Sverdrup organized a training course on weather and wave prediction. The course was modified in "real time" to allow for the latest research results. Robert Arthur and Munk participated in teaching the courses. Over two hundred officers from the Air Force, Army, Navy and Marine Corps received the training. The officers participated in the planning and execution of all landings in the Pacific theatre of war, including Iwo Jima, Okinawa and the Philippines, and subsequently in the landings at Sicily and in Normandy.

**30 May 1944** War Department investigation of Munk concludes that he had no pro-Nazi sympathies, and that any evidence that he was pro-German was entirely hearsay.

## Operation OVERLORD

The development of surf prediction methods in La Jolla coincided with planning for the Allied invasion of

Europe. Responsibility for forecasts in support of OVERLORD was assigned to a complex organization comprised of three commands, including British and American meteorologists. Sverre Petterssen was assigned to the British, and American meteorologists included Irving P. Krick and two very young American officers trained in the Sverdrup-Munk method, John C. Crowell and Charles C. Bates. Petterssen recalled:<sup>72</sup>

*Since naval requirements would loom large in the vital operation of landings and supplying the assault forces on the coast of France, I took it for granted that meteorologists from the Royal Navy would be assigned to the team. Professors Walter Munk and Harald Sverdrup...had developed methods of forecasting swell and surf with the aid of meteorological charts. These new techniques had been tested by the [Royal] Naval Meteorological Service and adapted for their special needs. As far as I knew, no one else had real competence in forecasting the state of the sea in the Channel and the surf on the French beaches.*

A severe storm was blowing on 5 June 1944, the original D-Day and the landings were postponed. For the following day, the conditions were correctly predicted to be "unfavorable, but not impossible." The decision to proceed, rather than wait for the next favorable tidal cycle, was made at the

highest Allied command level. Petterssen noted:<sup>73</sup>

*The weather, sea, and surf that caused the postponement [from June 5 to June 6] to be made, as well as the break that made the launching possible on June 6, were predicted sufficiently early to enable the supreme commander to make his decision and issue orders that made it possible (though only barely so) to make full use of the break.*

The Sverdrup-Munk method of wave prediction was declassified in November 1945 and published in two adjoining papers.<sup>74</sup> The published procedures are crude even by the standards of 1946 and totally inade-

<sup>71</sup>Naomi Oreskes and Ronald Rainger, "Science and Security before the Atomic Bomb: The Loyalty Case of Harald U. Sverdrup," *Studies in the History and Philosophy of Modern Physics* 31, no. 23 (2000), 340. Oreskes and Rainger provide a substantial analysis of the Sverdrup case and identify many of the informants.

<sup>72</sup>Sverre Petterssen, *Weathering the Storm*, p. 194.

<sup>73</sup>Ibid. pp. 216–217.

<sup>74</sup>Sverdrup and Munk, "Empirical and theoretical relation between wind, sea and swell," *Transactions of the American Geophysical Union*, 27 (1946): 823–827, and "Theoretical and empirical relation in forecasting breakers and surf," 27 (1946): 828–836. The two papers had previously been published as confidential reports: U.S. Navy Hydrographic Office: Wind Waves and Swell, H.O. Misc. 11275, March 1944, and U.S. Navy Hydrographic Office: Breakers and Surf, H.O. 234, November 1944. A final declassified version of the first paper was published a year later: H.U. Sverdrup and W.H. Munk, *Wind, Sea and Swell: theory of relations for forecasting*, H.O.601, 1947.

NOTE: THIS IS AMONG THE VERY FIRST WAVE FORECASTS  
USING THE SVERDRUP-MUNK OCEAN SWELL GRAPHS  
Sverdrup - Munk  
FORM FOR FORECASTING SEA SWELL

May, 1943

STATION		DATE <i>Nov. 8, 1931</i> TIME	
Area of <i>Casablanca, Morocco</i> Forecast <i>breakwater</i>		Period of Forecast	
Explanation of Terms V-Wind velocity in generating area. F-Fetch. td-Duration of wind. Ho-Height of waves in generating area. D-Distance of decay. H-Height of swell. t-Travel time of swell. T-Period of swell. C-Velocity of swell at arrival. L-Wave length of swell.		Description of Generating Area(s) <i>Strong wind N. of Azores High which protects coast. Vel. of wave generated in high wind comes into calmer zone &amp; does not decay as rapidly. Press field right into coast &amp; increase here &amp; then area behind front.</i>	
Terms	1	Values	3
V(m.p.s.)	<i>17</i>	<i>W.E.</i>	
F(km)	<i>1000 (behind)</i>	<i>12</i>	
td(hrs.)	<i>16</i>	<i>2000</i>	
Ho(cm.)	<i>560</i>	<i>24</i>	
		<i>360</i>	
D(km)	<i>2200</i>	<i>1200</i>	
H(cm.)	<i>180</i>	<i>100</i>	
t(hrs.)	<i>80</i>	<i>61</i>	
T(sec.)	<i>125</i>	<i>85</i>	
C(m.p.s.)			
L(m.)			
Date of Arrival			
<i>Nov. 11, 1931</i>			
Time of Arrival			
<i>2300</i>			

Previous Forecasts Falling Within Same Period

Date of arrival	Date of arrival	Date of arrival
Time of arrival	Time of arrival	Time of arrival
Height	Height	Height

FORECAST

*Region behind front wasn't exactly there 24 hrs. ago, so used 16 hrs.*

Charles C. Bates      2nd Lt.  
Signature of Forecaster      Rank

Figure 9. Sample "hindcast" form for the weather and wave prediction class of two hundred military officers that convened at Scripps from 20 May to 3 August 1943. The November 1942 Casablanca landings served as a model for this exercise. Officers in this class provided the operational wave forecasts for subsequent landings in the Pacific and European theatres of war (courtesy Charles C. Bates).

quate today. In his book on wind waves, Blair Kinsman writes:<sup>75</sup>

*I am sure they [Sverdrup and Munk] were aware of the inadequacies of what they did... [but] as evidence of the discharge of their moral obligation there are some thousands of World War II veterans alive today who would have been dead in the surf had Sverdrup and Munk not done their best with what they had.*

The loyalty investigation had run its course.

## An Appraisal

This brings to an end the account of events from the documents released some fifty years later under the Freedom of Information Act (FOIA). We have stayed away from an analysis; readers should judge the documents for themselves. But before leaving the subject, we will attempt a brief assessment.

Wars, and the present included, awaken paranoid instincts; in passing their concerns to the FBI, W, X (and Mrs. X), Y and Z felt they were discharging their obligations as citizens. The situation is different with regard to the agencies responsible for evaluating the evidence. The FBI, Navy, Army and Army Air Force security officials weighed the statements of informants X, Y, and Z over and above the judgments of a Who's Who in American science and technology. In doing so, the agencies deprived the country of needed talents and put the careers of several individuals in jeopardy. They did so not from wickedness or stupidity, but in response to an ingrained tradition in a community that is unwilling to take calculated risks and unforgiving of any errors. The career of a security officer does not suffer for the exclusion of the many, but may be precipitously terminated for the inclusion of a single security risk. In balance, the true security of the country may well end up on the losing side.

In the Sverdrup case, the situation was eventually patched up by the persistent efforts of one man, Commander Roger Revelle. Sverdrup was permitted to



**Figure 10.** Portrait of Harald Sverdrup by Paul Williams, c1946.

participate in the efforts that led to a final Allied victory. But the participation involved the analysis of Navy data and other second-hand observations, and not the intimate first-hand involvement, which is the hallmark of Sverdrup's entire career.

In Munk's case, this led to a reversal, from a "discharge with prejudice" to a life-long association with Navy problems and an appointment as "Secretary of the Navy Chair in Oceanography."

## The Post-War Years

By 1943, Sverdrup began writing a postwar research plan for the Scripps Institution. He expected postwar research funds from the Navy Hydrographic

<sup>75</sup>Blair Kinsman, *Wind Waves: Their Generation and Propagation on the Ocean Surface*. Prentice Hall, 1965, p. 321.

Office would support basic oceanographic research after the war, and he conferred with Roger Revelle on how Scripps should grow:<sup>76</sup>

*"[Navy supported research] must be formulated such that on the one hand necessary Navy security is not impaired, on the other hand the research oceanographic institutions can be carried out with full freedom of publication."*

He saw that the programs to train oceanographers would have to be expanded and felt that Scripps could make a significant contribution in this effort.

This meant enlarging the faculty as soon as the younger oceanographers were released from military service, expanding facilities on campus, and building a fleet. Scripps' only ship, R/V *E.W. Scripps* was returned to the institution after the war, but it was no longer an ideal oceanographic vessel. There seemed to be two options for obtaining additional vessels. Sverdrup asked Revelle to obtain mothballed government-owned vessels. And he turned to CalCOFI, which was amassing a fleet of vessels for work off the California coast.

## CalCOFI

In 1938, fishing industry representative Julian Burnette contacted Harald Sverdrup to express his concern about the depletion of the sardine from California waters. Over the next ten years, Burnette persuaded Governor Earl Warren and the California Legislature to levy a tax on fish landings and establish a Marine Research Committee to oversee a scientific investigation of the problem. In 1946 and 1947 fishing industry representatives reached out to scientists in California to plan a research program. Sverdrup was involved in planning the California Cooperative Oceanic Fisheries Investigations (CalCOFI), clearly modeled on International Council for the Exploration of the Sea (ICES) studies in the North Sea. The California Legislature provided \$300,000 to establish the Marine Life Research Group (MLRG) at Scripps, a sum close to the on-going Navy support. MLRG was to oversee CalCOFI, which had the ships and the money for regular cruises to build a time series of oceanographic data. What is more, CalCOFI had ships and the money to pay for regular cruises to build a time series of oceanographic data. Sverdrup allocated R/V *E.W. Scripps* for use in CalCOFI cruises, and SIO scientists were invited to participate in cruises on other CalCOFI vessels.

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*It is remarkable that Sverdrup derived what is now known as "Sverdrup Dynamics" not by mathematical manipulation (which is easy enough) but by analysis of observations, his trademark.*

---

The pace of postwar expansion at Scripps was remarkable. While UCDWR closed at the end of the war, some of its contracts became the nucleus for the Marine Physical Laboratory (MPL), established in May 1946. MPL became part of SIO just as Sverdrup left in 1948. The whole university was growing, and Sverdrup found it more difficult to get administrative action from Berkeley in 1946 than it had been in 1936. After participating for three years in the formation of the Institution of Geophysics at UCLA, Sverdrup declined an invitation to be its first Director.

## The Succession

At a Scripps luncheon on January 30, 1947, Sverdrup announced that he intended to leave the institution. He favored Roger Revelle as his successor. Their mutual respect and friendship began in 1936 when Revelle spent his post-doctoral year at the Geophysical Institute in Bergen, Norway, working under the Arctic explorer Bjørn Helland-Hansen. Revelle had been a leader in the early steps toward building a sea-going component at Scripps in the pre-war years. He had stood by Sverdrup in the loyalty investigation, and he persisted to secure a limited clearance, which made it possible for Sverdrup to operate in the postwar years. Sverdrup turned to Revelle to manage the CalCOFI program. In Revelle's words:<sup>77</sup>

*"Sverdrup's support for me as his successor is also based upon the fact that I am practically the only person available who has had extensive experience at sea, in particular in the organization and carrying out of expeditions. He feels that Scripps must be, at least in part, re-oriented toward work on the high seas rather than the inshore and laboratory type of research..."*

But opposition quickly materialized and this postponed Revelle's appointment until July 1951. The opposition was based on a preference for a biologist as Director, but took the form of criticism of Revelle's work habits, and Revelle himself acknowledged:<sup>78</sup>

*"My obvious and numerous weaknesses, such as a tendency to procrastinate, to take on too many obligations, not to delegate authority, and to be high-handed..."*

The opposition was led by some of the same people who had questioned Sverdrup's loyalty. Claude

<sup>76</sup>Sverdrup, "Memorandum on post-war research of interest to the U.S. Navy with Special Emphasis on the Participation of Scripps Institution of Oceanography, University of California." SIO Office of the Director (Sverdrup) Box 1, folder 49.

<sup>77</sup>Revelle to Murrough P. O'Brien, November 7, 1947, in Roger Revelle Papers, MC 6, Box 1, folder 10.

<sup>78</sup>Ibid. page 3.



ZoBell, who was in Europe, wrote to President Sproul expressing his opposition to Revelle. Denis Fox formed an ad hoc committee including Carl Hubbs<sup>79</sup> and Francis Shepard, which took a straw poll of candidates.<sup>80</sup> Sverdrup rebuked them when they blackballed Revelle.

*"I believe that you have placed yourselves in a very weak position because of the procedure you have followed in expressing your views...because blackballing of candidates without statement of reason gives no clue as to the true opinion of the voters. It is a procedure which leaves a bad taste in the mouth..."*<sup>81</sup>

In a letter to the official university Search Committee chair Vern Knudsen, Hubbs notes:<sup>82</sup>

*"During the war, for urgent reasons, research in physical oceanography was greatly expanded. Now, with a major part of the support forthcoming for work bearing on fisheries, there will be a swing toward the biological side."*

But the ad hoc committee was fulsome in its praise of Sverdrup:<sup>83</sup>

*"Scripps Institution, thanks particularly to Dr. Sverdrup's able leadership, now ranks high as a research and training center in oceanography, and by oceanography we mean the balanced ensemble of marine sciences. This position should be maintained, secured and expanded, and with proper leadership and support can be."*

They praised Sverdrup and denigrated Revelle, and Revelle called their bluff:<sup>84</sup>

*"The point of all this is that I think every effort should be made, no trail should be unexplored, no stone be left unturned, in trying to get him to reverse his decision to go back to Norway. I have the feeling he might be persuaded if some arrangement*

*could be made which would not let the Norwegians down too much. Professor Kaplan at UCLA is brooding about this same business and I hope others are too. Why don't you do something?"*

With all of this maneuvering going on, Sverdrup continued his own research.

## The Equatorial Singularity

Perhaps the most far-reaching contribution to meteorology and oceanography is the law of geostrophy: currents (winds) do not go "downhill" but move parallel to the pressure contours, at a rate inversely proportion to sine (latitude). This leads to an embarrassing infinity of velocity at the equator. Sverdrup considers the related balance, not of forces, but of torques.<sup>85</sup> This leads to global well-behaved solutions everywhere but at the boundaries. It is remarkable that Sverdrup derived what is now known as "Sverdrup Dynamics" not by mathematical manipulation (which is easy enough) but by analysis of observations, his trademark. Curiously the associated "western boundary intensification" (the Gulf Stream) was initially derived by Henry Stommel not by analysis, but by noting the simple behavior of numerical computations.<sup>86</sup>

A lot had been accomplished in Sverdrup's personal research, from the unifying thesis of *The Oceans Bible* to the dynamics of the equatorial circulation. But the most important contribution that he left behind was his insistence on a first-hand familiarity with observations and their uncertainties as a basis for subsequent analysis and synthesis. This was a forerunner to the modern practice of objective mapping.<sup>87</sup>

## The Sverdrup California Legacy

Sverdrup summarized his experiences at Scripps in a Charter Day lecture in 1947:<sup>88</sup>

*"Occasionally one can get very discouraged and there are times when one needs a great deal of faith*

<sup>79</sup>Hubbs took it upon himself to write to biologists Henry B. Bigelow and Daniel Merriam virtually offering them the directorship in 1947 and Francis Shepard interviewed geophysicist Sir Edward Bullard. See Carl Leavitt Hubbs Papers, Box 33, folder 44, SIO Archives UCSD.

<sup>80</sup>Denis L. Fox et al. to Robert Gordon Sproul, June 15, 1947. Denis Fox Papers, Box 2, folder 61. The straw poll was taken at a meeting held off campus on Sunday, 15 June, which was attended by Fox, Hubbs, Martin Johnson, McEwen, Rakestraw, Marston Sargent, Shepard and ZoBell.

<sup>81</sup>Harald Sverdrup to Carritt, Fox, Hubbs, Johnson, McEwen, Munk, Rakestraw, Sargent and Shepard, September 18, 1947. Hubbs Papers, Box 33, folder 44.

<sup>82</sup>Hubbs to Knudsen, October 16, 1947. Hubbs Papers, Box 33, folder 45.

<sup>83</sup>Hubbs et. al to Robert Gordon Sproul, September 24, 1947. Hubbs Papers, Box 33, folder 44.

<sup>84</sup>Revelle to Hubbs, October 10, 1947, Hubbs Papers, Box 33, folder 45.

<sup>85</sup>H.U. Sverdrup, "Wind-driven currents in a baroclinic ocean; with application to the equatorial currents of the eastern Pacific." *Proceedings of the National Academy of Sciences* 33 (1947): 318–336. Some of the underlying observations are discussed in the dissertation of Sverdrup's student Robert Reid in R. Reid, "A model of the vertical structure of mass in equatorial wind-driven currents of a baroclinic ocean." *Journal of Marine Research* 7 (1948): 74–99: 304–312.

<sup>86</sup>Henry Stommel, "The westward intensification of wind-driven ocean currents." *Transactions of the American Geophysical Union* 29 (1948): 202–206. "My first idea was to use relaxation methods...It was Phil (Shafer) who suggested I try an analytical solution..." Henry Stommel, *Collected Works*, volume I, pages I-18 to I-23. Nelson Hogg and R.X. Huang, eds., *The American Meteorological Society*, Boston.

<sup>87</sup>F.R. Bretherton, R.E. Davis and C. Faundry. "A Technique for objective analysis and design of oceanographic instruments applied to MODE-73." *Deep-Sea Research* 23 (1976): 559–582.

<sup>88</sup>Harald U. Sverdrup, "Brief Address in Connection with Charter day Celebration, 1947", page 5, SIO Office of the Director (Sverdrup), Box 1, folder 4.

and optimism in order to keep on plodding with Ritter's program in mind. It is so very tempting to follow the road of least resistance, to let the station deteriorate into a marine biological shore station, the work of which can be based on collections above the lowest low tide and on studies in the laboratory.

During the years just before the war, we made a conscious effort to push the work out to sea, but since we were cut off from undertaking any work at sea during the many years of war, we have now to develop that program again nearly from scratch, and we have again to make a large part of the activity at this Institution truly oceanographic."

It was Roger Revelle, not Harald Sverdrup, who would take Scripps to sea again after the war.

Twelve years prior, Sverdrup had found an institution without sea-going facilities and without sea-going oceanographers. There was no teaching program, no underlying research theme. When he left in 1948, the Scripps Institution had three vessels, a kernel of sea-going scientists (to be greatly expanded under Revelle), an ongoing program for monitoring the waters off California, and a coordinated curriculum in oceanography, the first in the United States. The academic staff had grown from six (with Sumner the only member of the National Academy of Sciences) to ten, four of whom were later elected to the academy.

### Sverdrup Returns To Norway

On 30 January 1947, Sverdrup announced that he would step down as Scripps Director in one year and return to Norway. After the decision was announced, the entire faculty and staff (including Chambers) wrote Sverdrup praising "the character of the research, the quality of the instruction and the practical application of various marine sciences" during the years of his directorship, and asking him to reconsider his decision.<sup>89</sup> It was not an easy decision. Harald and Gudrun Sverdrup (she in particular) were homesick. They missed the change of seasons. Moreover, in the spring of 1946 Sverdrup had been asked by the Norwegian Government to take the directorship of the Norwegian Polar Institute.<sup>90</sup>



**Figure 11.** John Giever, Harald Sverdrup, and Gottorm Jacobsen at Maudheim, Antarctica, in 1951. Norwegian Polar Institute.

*"At the time of this writing I expect to leave the SIO in a few weeks and to tackle a new job, hoping that I am not too old to make the change...I hope that because of my many connections in many countries, including the Soviet Union, I may be able to do more in that particular international field from a small country like Norway than can be done from most other countries. ...It will be a particular pleasure for me if in the future a number of American students might find it of advantage to come to Norway for special training. Also I cannot help but feel that having spent by far the greater part of my life in Norway I should like to assist in work of importance to that small nation during a period when it is struggling to get back on its feet after five years of oppression."*<sup>91</sup>

Yet six years previously, a month after Norway was invaded, Sverdrup had written to President Sproul requesting that his appointment as Scripps Director be made permanent.<sup>92</sup>

*"I assumed at that time that my permanent place in the future would be with the University of*

<sup>89</sup>The memorandum is dated February 5, 1947. Denis Fox Papers, Box 2, folder 61.

<sup>90</sup>Robert Marc Friedman, *The Expeditions of Harald Ulrik Sverdrup: Contexts for Shaping an Ocean Science*. La Jolla: Scripps Institution of Oceanography, UCSD, William E. and Mary B. Ritter Memorial Fellowship, pp. 38–39.

<sup>91</sup>Harald U. Sverdrup, "Informal Autobiography", February 6, 1948, SIO Office of the Director (Sverdrup), Box 1, folder 1.

<sup>92</sup>Harald U. Sverdrup to Robert G. Sproul, 1 May 1940, SIO Office of the Director (Sverdrup), Box 1, folder 16.

*California. Consequently I took steps to become an American citizen and was naturalized in 1944. I should have remained here happily ..."*

We will never know all the factors leading to the decision to leave Scripps. Certainly the pull to return home was strong. But we also know that the loyalty investigation left a permanent scar.<sup>43</sup> It did not help that the Director's salary (directly under President Sproul's authority) during Sverdrup's tenure had diminished (allowing for inflation) at the time when Scripps faculty salaries (under Sverdrup's fiscal direction) had risen sharply.<sup>44</sup> When L. Lek telephoned President Sproul on the day of the resignation, the president offered a substantial salary increase. Sverdrup declined.


Back in Oslo, the family quickly settled into their Norwegian lifestyle. Anna, who had been divorced from an American Air Force lieutenant, married Steffan Hamre whose family had farmed a remote valley in Telemark for four hundred years; there Anna and Steffan ran a goat farm under very demanding conditions, and Anna's nursing degree qualified her for a busy career as a midwife. The Sverdrups acquired a "hytte" in the Telemark mountains, two hours from the nearest road. They took a comfortable apartment in central Oslo. A Buick sedan they had purchased upon their arrival in America in 1936 remained their mode of transportation. This was the sole outward expression of their American experience. They kept up with their many American friends and former students.

Munk came to the University of Oslo in the autumn of 1948 on a Guggenheim Fellowship, and the Sverdrups included him in their circle of old friends and colleagues, V. Walfrid Ekman, Helland-Hansen and others. Munk tried to involve Sverdrup in working on a theory combining Sverdrup's interior solution (the "Sverdrup Dynamics") with Stommel's boundary solution. But Sverdrup was by now fully occupied with his new Norwegian responsibilities. He had always been impressed by Fridtjof Nansen's retirement dictum at the age of sixty: a full and sudden withdrawal from (rather than a gradual deterioration in) all scientific activities. Nansen went on to receive a Nobel Prize for peace in recognition of his service for the repatriation of prisoners of war.

For the next nine years, Sverdrup's activities shifted towards humanitarian endeavors, following Nansen's example. The directorship of the Norwegian Polar Institute occupied only a part of Sverdrup's time. The achievement he was most proud of was the reorganization of the Norwegian university system, away

from the autocratic "Herr Professor" atmosphere of the old German type toward the more relaxed American student-faculty relationship. This involved many years of intensive study by a commission still referred to as the Sverdrup Commission.

Sverdrup resumed his earlier career activity by helping in the organization of the 1949–1952 Norwegian-British-Swedish expedition to Antarctica. He was appointed Professor of Geophysics at Oslo University, serving also as Dean of the Science Faculty and Vice-Director of the University. As chairman of the Norwegian relief program in India, he played an active personal role in modernizing traditional Indian fishing practices. Behind the scenes, he worked with his scientific friends in the United States and the Soviet Union in an attempt to ease the Cold War tensions among scientists of the two countries.

Sverdrup knew he had a heart problem, but chose not to pamper it. He died suddenly on 21 August 1957 during a routine checkup at the doctor's office after three weeks residence at the "hytte." Referring to his shipmates, a thirty-seven year old Sverdrup, returning from seven years in the Arctic, had written "The thing I am most proud of is that we departed as friends."<sup>45</sup> Now, at sixty-eight, after some stormy weather, his life ended in a calm landfall, leaving only friends. 

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In February 1938, Sverdrup wrote Vern Knudsen about his mentor:

*"[Vilhelm Bjerknes] impressed upon his assistants the advantages of using a brief and pointed language. I hope I have learned something from him."* Sverdrup, in turn, passed on to his student, Walter Munk, the need for brief and pointed language: "What are you trying to say?" he would ask, "And why didn't you say so?"

<sup>43</sup>Harald Sverdrup's American cousin George Sverdrup wrote Deborah Day, 9 October 1993 "Harald was very upset at not being given security clearance during the war. He felt he had much to contribute..." Sverdrup Family Papers, SIO Archives.

<sup>44</sup>The director's salary (in 1997 dollars) went from \$81,500 in 1937 to \$79,500 in 1947. For comparison, ZoBell's salary went from \$34,000 to \$53,000, Fox from \$30,500 to \$50,600 and Chambers from \$27,000 to \$29,000. All salaries are adjusted for inflation (relative to 1997) by a factor 11.3 for 1937 and 8.03 for 1947. See Value of a Dollar, 1860–1999.

<sup>45</sup>Harald Sverdrup, "Six Years in the Arctic," SIO Office of the Director (Sverdrup), Box 1, folder 2. Sverdrup often repeated this phrase when writing about his Arctic experiences both in Norwegian and English texts.