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HARALD ULRIK SVERDRUP

1888—1957

A Biographical Memoir by

WILLIAM A. NIERENBERG

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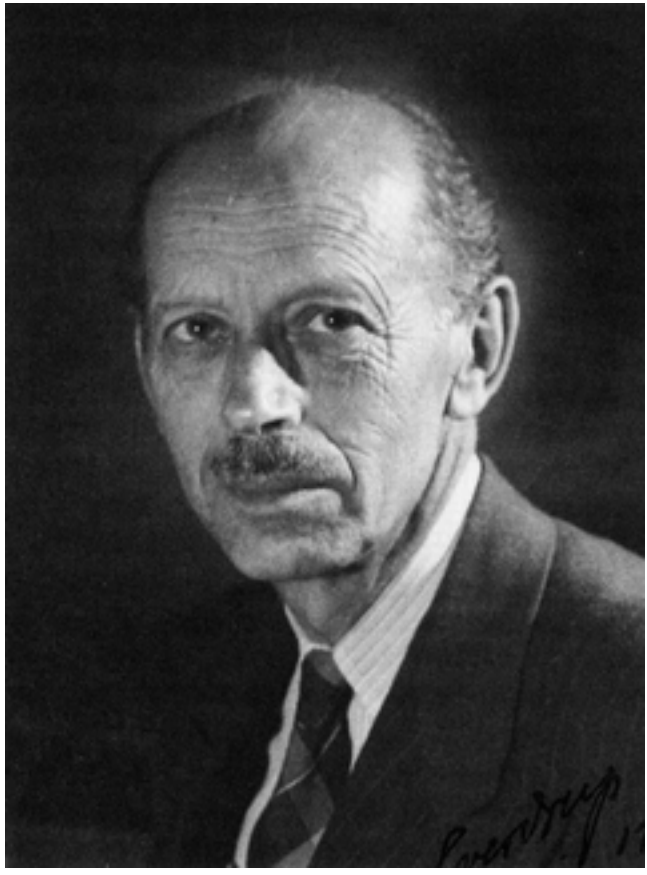

HARALD ULRIK SVERDRUP

November 15, 1888–August 21, 1957

BY WILLIAM A. NIERENBERG

A BIOGRAPHY OF Harald Ulrik Sverdrup written for consumption in his native Norway has a different perspective than one written for the National Academy of Sciences. In the United States, Sverdrup is recognized as the founder of the modern school of physical oceanography. A great scientist and "father" of a school is recognized by the number and fame of his students and colleagues. In Sverdrup's case the list includes Robert S. Arthur, John Crowell, Dale Leipper, Richard Fleming, Walter Munk, and Roger Revelle. This distinguished group formed the nucleus of the development of the science of physical oceanography in the United States, which, before Sverdrup, had been simply a punctuated, part-time effort by a few individuals. This lifetime achievement received most unusual recognition by the naming of an oceanographic term after this great scientist, the Sverdrup, "a unit of volume transport equal to one million cubic meters per second."[1] The American Meteorological Society honored him with the Sverdrup Gold Medal, which recognizes researchers for outstanding contributions to the scientific knowledge of interactions between the oceans and the atmosphere. A building bearing Sverdrup's name is on the campus of the Scripps Institution of Oceanography.

This memoir is being written during the fiftieth anniversary of the publication of *The Oceans*, when ceremonies marking this event are being prepared. Sverdrup was the principal author along with colleagues Martin Johnson and Richard Fleming, and his chapter XV on the oceanic currents is still the most recent publication that treats all the world's oceans in one work. This remarkable text not only marked the onset of modern oceanography but also survives as a leading source today. In the field of science this longevity is almost unique.

In Norway, Sverdrup is not only recognized as a great scientist but also as an arctic explorer and a member of an old and distinguished family. The following is a personal history taken from Sverdrup's unpublished autobiography written for the National Academy of Sciences when he left the United States to return to Norway in 1948.[2] In view of Sverdrup's achievements in establishing a new science in the university, it is of historical value to portray his family and academic background in more detail than is customary in these Academy records in order to appraise their influence on his development.

Harald Sverdrup was born on November 15, 1888, in Sogndal, Sogn, Norway. At the time, his father, Johan Edvard Sverdrup (1866-1923) was teaching at the adult school there. Sverdrup's father, as were his four uncles, was a minister of the State Church of Norway (Lutheran), and in 1894 his father became minister in the island district of Solund, about 40 miles north of Bergen. Then his father moved to Rennsö near Stavanger. In 1908 he became professor of church history in Oslo, where he died in 1923.

The first record of a Sverdrup appeared in Norway in 1620, but Sverdrup can only trace his ancestry on his father's side to his great-great-grandfather, a large land owner in northern Norway. In 1813 one of his three sons, Georg

Sverdrup, was one of the first professors of the University in Oslo in classical philosophy and languages. He participated in the Norwegian constitutional convention and was one of the three authors of the final document. The youngest of the three, Sverdrup's great-grandfather, Jacob Liv Borch Sverdrup (1775-1841), became an expert in land management and established the first agricultural school in Norway. Two of his sons reached considerable prominence. Johan Sverdrup (1816-92), a lawyer, was a member of the Storting and became the leader of the liberal party and succeeded in introducing the parliamentary system.

The older brother, Harald Ulrik Sverdrup (1813-91), Sverdrup's grandfather, was also a churchman who served as a Lutheran minister in Sogndal, Sverdrup's birthplace. He also served a long time in the Storting and was involved in many enterprises, from fruit growing to banking to shipping.

His mother, Maria Vollan, died when her son was still a child. Her family was related to the Grieg family. His maternal grandmother was of Scotch descent, and his maternal grandfather had a religious education also but served as the editor of a large newspaper and was the author of an important arithmetic textbook.

As a result of his father's varied career, Sverdrup spent much of his boyhood in various sites in western Norway and was taught by governesses until he was fourteen years old, when he went to school in Stavanger. During Sverdrup's adolescence, he experienced conflicts between his interest in natural science and his family's profession of theology. By his own account he was an avid reader of a Danish publication, *Frem*, meaning "forward," that spanned the entire gamut of the sciences. He had difficulty reconciling the concept of evolution with his religious upbringing.

It did not occur to Sverdrup at the time that one could

study science in the university whose subject matter to him was synonymous with theology. Thus, when he entered gymnasium in 1903, he chose the classical curriculum instead of the science curriculum. But that gave him the opportunity to read everything he could find on astronomy, his major interest at the time, and when he learned that he could pursue the natural sciences in the university, his career path was determined.

Much of Sverdrup's scientific development was associated with the military. After leaving the gymnasium with honors, he spent a year in Oslo preparing for and passing university preliminary examinations. He decided to combine his compulsory military service at the Norwegian Academy of War with an end toward becoming a reserve officer and having the security of an income. He joined this training with the study of physics and mathematics and thus was able to return to the university. He makes a special point in his memoirs that his year at the academy was not wasted because he needed physical training. He was proud of the fact that he finished the period served (1907-8) as the top man in athletics. It probably was essential to his survival and positive performance later during his long arctic ordeals.

When he entered the university in 1908, Sverdrup's intended major was astronomy. The precise title of the subject at the university was "Physical Geography and Astronomy." He defines the content in more modern terms as including geophysics, meteorology, oceanography, and terrestrial magnetism. His ultimate research interests were fixed in 1911 when he was offered an assistantship with Professor Vilhelm Bjerknes, the preeminent Norwegian meteorologist and founder of the Bergen School.[3] Theirs was not the usual relationship of mentor to student. Bjerknes's assistants were the brightest young scientists of their generation. They included Jacob Bjerknes, Tor Bergeron, Olaf Devik, Theodore

Hesselberg, Carl-Gustaf Rossby, and Halvor Solberg. Bjerknes expected them all to make substantial intellectual contributions to the work. Sverdrup later recalled that Bjerknes's[4]

> . . . own work centered completely around the further development of the theoretical tools. He has to my knowledge never attempted to draw a weather map, nor has he ever discussed actual meteorological observations. In the course of the years many of his assistants worked with the data, they tried to interpret the observed conditions, and, step by step, to gain better understanding of the physical processes in the atmosphere or the ocean. Bjerknes gave them complete freedom in their work. He was no hard taskmaster, but he laid the course.

The Bergen School was supported by an annual grant that Bjerknes received from the Carnegie Institution of Washington almost from the first days of its establishment after his visit to Washington in 1905. Bjerknes received this grant continuously to the end of his career. Sverdrup notes the vital role that the Carnegie Institution played in developing the earth sciences in those early years, and Sverdrup himself received support from the institution throughout his career.

Sverdrup initially expected to continue research in astronomy, but he became more and more interested in meteorology and oceanography and so changed his major. His first published paper (in 1914) was for his candidacy and was in meteorology. When, in 1912, Bjerknes went to the University of Leipzig as professor and director of the new Geophysical Institute, Sverdrup accompanied him and spent January 1913 to August 1917 in Germany. These were war years, and Sverdrup suffered from wartime shortages. He did his thesis for the University of Oslo while there and received his doctorate in June 1917 on a published paper on the North Atlantic tradewinds.

It seems that Sverdrup could not avoid his destiny in the Arctic. In 1913 Roald Amundsen resumed his plan for a

north polar expedition to the Arctic on R/V *Maud*. Sverdrup turned down an invitation as an assistant to the chief scientist because he wished to complete his university work. In 1917 the opportunity resurfaced with the position elevated to that of chief scientist and he accepted. Sverdrup's experiences in the Arctic formed his character both as a man and a scientist.[5] He regaled his students throughout his later life with tales of the hardships of the Arctic and once remarked, "These years were really very valuable because they brought me in the closest possible contact with nature, a circumstance which to one who works in geophysics cannot be overestimated."[6]

The expedition left Norway on July 18, 1918, with a projected duration of three to four years. Instead, it lasted seven and one-half years, including an interruption of ten months in 1921-22 spent in the United States. Sverdrup did not return to Norway until December 22, 1925. In his own words, he would not have missed the experience of any one of those years. He called the most interesting period the eight months of 1919-20 that he spent in Siberia living with nomadic reindeer herders, the Chukchi. This was at the suggestion of Amundsen during a period when the vessel was ice bound. It is not easy to understand his statement, for although Sverdrup gave several lectures and talks on the Chukchi, he never published these. Sverdrup left a handwritten monograph on the Chukchi that was translated and published some thirty years after his death by his colleagues at Scripps as a tribute to Sverdrup,[7] although by then a larger and more authoritative ethnographic study of the people had already been published.

Sverdrup felt that the long years in the Arctic and the heavy responsibilities of his work as chief scientist were justified by the firsthand experience he gained in field research and data taking, but seven years away from home

would seem to have overdone it. His arctic work also allowed him to visit the Carnegie Institution of Washington for the first time in the winter of 1921-22, his first trip to the United States and a very valuable scientific contact.

A more specific justification that Sverdrup gave in support of his concentration on the Arctic was the easier insight it affords in our understanding of the basic physical oceanography of currents. He argued that the effect of the earth's rotation, a fundamental aspect of the dynamics of the oceans, is best and most simply observed in the polar regions, where it is greatest. He recounted how Nansen empirically recognized the possibility of the rotation of the current vector as a function of depth and suggested to Bjerknes that it should be examined more formally. Bjerknes assigned the problem to a young mathematical physicist, V. Walfrid Ekman, who solved it and thereby his name was given to the phenomenon known as the Ekman Spiral. It has never been clear why so much fuss is made over this formula. It is the direct analogy to the Coq effect (skin effect) in the electromagnetics of a resistive conducting medium. This murkiness may be related to the curious fact that the effect of the earth's rotation is called the geostrophic force by the earth scientists where all the rest of physics call it after its elucidator, Coriolis.

Sverdrup had well established his scientific reputation and in 1926 was offered the chair of meteorology at Bergen, which had been vacated by Bjerknes, who had returned to Oslo. There he worked on the data collected on the *Maud* expedition and edited the scientific report of the expedition. He later estimated that he personally contributed two-thirds of the report. Before assuming this post, however he spent ten months at the Carnegie Institution in Washington working on the electric and magnetic records of the same expedition. There he met and made a favorable im-

pression on a number of American scientists and was twice offered and refused permanent positions. He visited several American laboratories, including a brief visit to the Scripps Institution. It is interesting to note parenthetically that if Sverdrup had accepted a Carnegie position he would almost certainly have become the first director of the Woods Hole Oceanographic Institution, organized in 1930.[8] If this had occurred, the institutional history of U.S. oceanography would have been vastly different.

Shortly after his return to Norway, Sverdrup married Gudrun Bronn Vaumund. They had no children, but he adopted Anna Margrethe, the daughter of Gudrun's first marriage.

In 1930 Sverdrup spent another six months at the Department of Terrestrial Magnetism, working on oceanographic data collected by the R/V *Carnegie* for whose cruise he had earlier served as a consultant. Not long after his return from the United States in 1931 he accepted a research professorship in the newly established Christian Michelsens Institute carrying on pretty much the same work on the *Maud* data. In 1931 he was the leader of the scientific group in the Wilkins-Ellsworth North Polar Submarine Expedition, where valuable information was gathered despite the failure to achieve the chief goal of the expedition, the submarine exploration of the Arctic in the *Nautilus*. In 1934 he spent two months studying boundary layer processes over high-lying snow fields in Spitsbergen with glaciologist H. W. Ahlman.

But it was in December 1935 that the great change occurred in Sverdrup's life when the director of his institute, Bjorn Helland-Hansen, just returned from the United States, informed Sverdrup that his name had come up as a possible replacement for Thomas Wayland Vaughan, retiring director of the Scripps Institution of Oceanography in La

Jolla and part of the University of California system.[9] Sverdrup agreed, if he could be given a three-year leave of absence, and he accepted the invitation that was soon tendered. Scripps was positioned to be an important center of oceanographic research, but it badly needed increased resources and rigorous scientific leadership. Sverdrup knew, perhaps more than anyone else in the world, about the emerging sciences of oceanography, meteorology, and geophysics, but he needed a position with the scope to expand the sciences.

As an aside, it is interesting to note that Sverdrup was preceded in his immigration to the United States by his brother, Leif, who had been sent abroad for career purposes. Lief also made a great success of his life. He became an American citizen, a civil engineer, and cofounder of the firm of Sverdrup and Parcel in St. Louis, one of the largest and most important American engineering companies. During the second world war, he served as chief engineer to Douglas MacArthur and rose to the rank of general in the U.S. Armed Forces.

The choice of Sverdrup as director of the Scripps Institution of Oceanography in 1936 was one of the most felicitous decisions made by the University of California and was an action that enhanced the university, the Scripps Institution, and the science and teaching of oceanography. No one could possibly have foreseen the immense consequences except, perhaps, Robert Gordon Sproul, the long-time president of the University of California. Sproul worked steadily with Sverdrup to improve the institution, which had been neglected by former university presidents. In fact, the Scripps Institution had almost lost the support of the Scripps family by neglecting them. When Scripps's major benefactor, Ellen Browning Scripps, was on her deathbed, she expressed her unhappiness with the fact the university regents had never visited the institution. When Sproul learned of her unhap-

piness, he came to La Jolla and called on her at her home to reaffirm his strong interest.

Sproul was a great university president. When he identified exceptional talent, he went all out to support it and made every effort to personally see that the individual was supplied with whatever he or she needed to do the job and to create an environment that would keep the individual at the university. This was certainly how he helped Ernest Lawrence, among many others, achieve his goals by bypassing the university bureaucracy and communicating directly with Lawrence in his early years at the university.

Sproul's sponsorship was all the more remarkable in the case of Sverdrup, who headed what then was an irregular outpost of the university. Scripps was, in 1936, a small rather remote and dusty marine station with one research vessel capable of only coastal cruises and a staff of about thirty people, including eight faculty members. It had an annual operating budget of about $89,000 derived largely from contributions made by the Scripps family and matched by the state of California. It had potential in the form of an endowment provided by Ellen Browning Scripps, a spectacular campus, and a promising staff, including some interesting students. One of these was Roger Revelle, about whom more later, who received his training at the Scripps Institution and his doctorate from the University of California in Berkeley, which was the degree-granting campus for Scripps. Despite the remoteness and the relative insignificance of the Scripps Institution in the university system, Sproul was in constant communication with Sverdrup and particularly helpful in what was Sverdrup's perpetual headache, the operation and maintenance of a research vessel.

Sverdrup remained as head of the institution from September 1936 for almost twelve years before returning to Norway to head the Norwegian Polar Institute. Sverdrup

must have been surprised at the small size and rather poor facilities he found when he arrived in La Jolla in August 1936. He never commented about it, although Gudrun Sverdrup is said to have wept when she first saw the director's little house where the family was to live throughout their years at Scripps. Sverdrup went to work with several immediate goals in mind. He needed a new ocean-going vessel, and he wanted to increase the institution's income, improve staff morale, and establish closer ties among researchers. His longer-term goals were to develop an institution-wide research program and improve teaching at the institution.

Sverdrup got the vessel he needed in 1937 from Robert Paine Scripps, who headed the family in La Jolla at the time. Mr. Scripps was greatly impressed by Sverdrup and agreed not only to provide the institution with an ocean-going schooner, R/V *E. W. Scripps*, but also to increase the annual family contribution to the institution. Sverdrup's hope for long-term support from the Scripps family was dashed by Mr. Scripps's untimely death the following year.

Despite financial worries, Sverdrup pressed forward to improve both the research program and the curriculum of the institution. He evaluated faculty research and was concerned to find that Scripps did not have an institution-wide research program. Each scientist worked independently and set his own research agenda. Sverdrup focused the staff's attention on the California Current, and he organized the several expeditions to the Gulf of California, the first comprehensive hydrographic survey of that area. Sverdrup was alarmed to find that the only physical oceanographer at Scripps was not up to the highest European standards and focused on the preparation of long-range weather forecasts that were "close to witchcraft."[10] The forecasts were terminated, and Sverdrup moved on to improve instruction in physical oceanography and to attract students to the field.

Sverdrup developed close working contacts between Scripps and UCLA, which became the degree-granting campus for Scripps in 1936. He was active in the Academic Senate, taught courses at UCLA, and developed friendships with UCLA administrators and faculty. He found himself among friends there. Two of Vilhelm Bjerknes's other assistants, Jacob Bjerknes and Jorgen Holmboe, were building a department of meteorology at UCLA. Sverdrup also developed close contacts with UCLA physicists such as Vernon Knudsen, dean of the Graduate Division, to improve graduate instruction both at Scripps and UCLA.

Close contact with UCLA was essential as Sverdrup reformed the curriculum in oceanography. Scripps was the first and for a long time the only American institution that offered graduate instruction in oceanography.[11] Sverdrup was fortunate to have several gifted young instructors at SIO when he arrived, including Martin Johnson, Richard Fleming, and Roger Revelle. The faculty included biologists Denis Fox and marine microbiologist Clause ZoBell, and submarine geologist Francis Shepard, who became affiliated with Scripps beginning in 1937. A young physicist, Walter Munk, came to Scripps to study with Sverdrup in 1939. Sverdrup basically formalized a curriculum that included and fully integrated physical oceanography with marine biology, marine geology, and geophysics.

Many historians and scientists have commented on Sverdrup's publication with coauthors Martin Johnson and Richard Fleming of the first comprehensive text in oceanography, *The Oceans: Their Physics, Chemistry and General Biology*.[12] This was the crowning achievement of his teaching career. The book was considered to be of such military value to the Allies when it was published in 1942 that Washington forbade its distribution abroad during the war. After the war, it was distributed broadly and earned the Scripps

Institution an international reputation as a center of oceanographic research.

Sverdrup's contributions to physical oceanography were many and varied, as his publications list indicates, but his major breakthrough in the interpretation of ocean currents was his demonstration that the systematic use of the curl of the vector current greatly simplified the understanding of the movements. In other words, transforming the geodynamic equations of motion from the usual starting point of momentum balance to that of vorticity balance gives a more tractable mathematic approach to the physics of the problem. This is now the practical, accepted starting point in investigations of the oceanic currents. Sverdrup recognized that the curl of the surface wind stress was the primary agent in transferring mechanical energy to the ocean, usually labeled as the wind-induced curl.

Harald Sverdrup's three-year term as director of the Scripps Institution ended just as Norway was invaded and occupied. In his brief autobiography he writes that, when he realized his stay in La Jolla was to be indefinite, he decided to become an American citizen. Other accounts indicate that problems with his security clearances during the war also were an impelling factor. His wartime work required high levels of security, and, because so much of his family remained in occupied Norway, his clearance was intermittently canceled and renewed. This occurred despite the efforts of Roger Revelle, then in the Navy, to regularize Sverdrup's security status. Sverdrup's clearance difficulties were all the more painful as his younger brother, Einar, a captain in the Norwegian Free Forces, had been killed by Nazi forces in action in Spitsbergen in 1942. Sverdrup's student, Walter Munk, had similar problems for similar reasons, but, despite this handicap, they both made extremely important contributions to the Allied war effort.

The American military placed urgent demands on oceanographers and meteorologists as soon as the war began. Antisubmarine warfare became high priority for the military, and the University of California Division of War Research was formed at the Navy Radio and Sound Laboratory at Point Loma to undertake research on this subject. The training of military weather forecasters was also a high priority for several branches of the service. There were many other demands for help in solving urgent problems, such as the recovery of men lost at sea, the control of fouling organisms, and maintaining a steady harvest from the sea. Scripps quickly converted itself to a center of wartime oceanographic research and integrated its activities with those of other academic and navy laboratories working on similar problems. This was a notable feat for, as H. R. Seiwell noted, in 1941 there was

> . . . not a single military or naval organization trained to evaluate information on the oceans and coast lines of the world and to transform it into the type of strategical and tactical intelligence required for military operations.[13]

Probably because of his clearance difficulties, Sverdrup did not have a direct association with the primarily underwater sound work at the University of California Division of War Research. UCDWR was directed by physicist Gaylord P. Harnwell, who later became the distinguished president of the University of Pennsylvania and author of an excellent text on electricity and magnetism. Sverdrup did work on the very important set of problems related to forecasting surf conditions for military beachhead assaults. His current and wave forecasting methods were applied by military weathermen—many of them trained by Sverdrup at Scripps—to predict landing conditions for allied invasions of North Africa, Sicily, Normandy, and many Pacific islands.[14] This work

was credited by naval officers with saving many lives. Sverdrup's student, Walter Munk, was a close associate and valuable contributor in this research. Walter Munk was probably Sverdrup's most important and famous student/associate. Of course, other places and institutions were involved in the same work, among them the group at Berkeley under the leadership of Morrough (Mike) P. O'Brien of engineering who became the famous dean of engineering there immediately after the war. Both the UCDWR and the Berkeley group were to become important sources of manpower and resources for SIO at war's end. John Dove Isaacs, for example, came from the Berkeley group and Carl Eckart from USDWR.

Sverdrup showed much more restraint and perspective in his postwar discussions of the value of his war work than is common among scientists of his caliber. While the achievements were of great practical importance, he would point out that they were based on very old theorems on waves and fetch from classical hydrodynamics. One is struck when reading through his available correspondence by the evenness of his tone whatever the situations, some of which must have been very vexing, unless the academic world was very different from what it is today. That evenness, one could say steadiness, probably accounts for his accomplishing so much in a relatively short time, despite adversity. Sverdrup patriotically considered endurance to be a trait innate to Norwegians, who "having grown up in a sparsely populated rugged country . . . have become self-reliant and resourceful, and have the temperament to endure monotony and loneliness and the daily toil of the trail."[15] If that trait was not innate, it certainly had to have been developed in Sverdrup during his many expeditionary years where he had to adjust and survive so many varied and difficult physical and human situations.

The war years and the immediate postwar period were very important times for oceanography, and Sverdrup knew it. The Navy played a vital role in advancing the field both by providing direct support from the various bureaus and through the formation of the Office of Naval Research, which set the administrative pattern for the immensely successful future of science in the United States. The unwritten story goes so far as to assert that specific navy actions actually saved the Scripps Institution from disappearance when the war was over. It starts with the statement that the regents of the University of California felt that, the war being over, there no longer was a reason for the continuation of the institution. The Navy saw otherwise and approached the regents directly to make a commitment to support the institution financially for "as long as it was budgetarily feasible." The documentary record shows that Admiral Edward Cochrane, with the urging of Roger Revelle, wrote UC President Robert Gordon Sproul offering to continue support for postwar research in oceanography at the Scripps Institution. Sproul, with the urging of Harald Sverdrup, accepted the support and created an administrative structure to oversee large-scale sponsored research at the University of California. Behind the scenes, Sverdrup, Revelle, and Lyman Spitzer consulted with Lieutenant Commander John T. Burwell and other naval officers who fostered the Office of Naval Research.[16]

Continued federal research support was an essential element in Sverdrup's postwar plan for Scripps. He had begun thinking as early as 1943 about the end of the war, and he had a written postwar plan prepared by 1944. Continued navy funding was critical and made all the difference. The university and the Navy entered into a partnership that built the world's leading institution in the field. It was a fruitful partnership that strengthened both the Navy and the aca-

demic spheres. For instance, the accelerated development of magnetic anomaly detection, both ship and airborne, so important in antisubmarine warfare, was one of the two key technologies that brought about the plate tectonics revolution. The other was the advanced acoustic gear for bathymetry that revealed the midoceanic ridges and the thickness of ocean sediments. These were long-term consequences, but the partnership also had immediate advantages. The Navy made a specific commitment to support several professorships at Scripps indefinitely, as well as offering continued research funding. This was important because it allowed Scripps to build academic strength. One professorship kept Carl Eckart in La Jolla. Eckart had spent the war at UCDWR and was prepared to return to his professorship at the University of Chicago. Quick decisions had to be made because of the dissolution of UCDWR at the end of the war, and Sverdrup was well prepared with a plan. In those years Eckart was probably one of the most important members of SIO, second only to Sverdrup. In addition to Eckart, the early navy chairs were used to attract Russell Raitt, among others, who also had been in the UCDWR and was destined to become a principal in the development of plate tectonics.

Sverdrup was the central figure on the West Coast during the postwar development of oceanography and allied sciences. He became increasingly active on scientific committees after the war, and his contributions to science were recognized by his peers. He was elected to the National Academy of Sciences in 1945. He joined the Executive Committee of the American Geophysical Union in 1945 and presided over the AGU Oceanography Section. In 1946 he became president of the International Association of Physical Oceanography. He chaired the Division of Oceanography and Meteorology at the 1946 Pacific Science Confer-

ence. During these years he worked tirelessly to promote and expand research in geophysics.

Sverdrup worked closely with Robert Gordon Sproul, Vern Knudson, Roger Revelle, and many others. However credit is shared, the postwar program in oceanography was an immense success. Sverdrup's postwar plan for Scripps had a number of elements. He wanted to train more oceanographers, expand the Scripps research fleet, and focus institutional manpower and ships on a united scientific research program that would take the institution to sea and address fundamental oceanographic problems.[17] During the immediate postwar period, manpower issues were discussed intensely by Sverdrup, Rossby, Revelle, Iselin, and others concerned with the postwar development of meteorology, oceanography, and geophysics. The newness of oceanographic teaching was underscored by a letter written by Columbus O'Donnell Iselin to John Fleming in 1944.[18] Iselin pointed out that Scripps was the only institution offering graduate degrees in the subject and wondered if another center of training was really needed. Even if it seemed reasonable for Woods Hole to start a teaching program, Iselin, in his characteristically laid-back temperament, said he was not likely to generate the drive to start one.

Sverdrup was a compelling force in two other notable postwar initiatives on the West Coast. He was one of a number of University of California faculty members who convinced Robert Gordon Sproul to establish an institute of geophysics at UCLA. This was the nucleus for the Institute of Geophysics and Planetary Physics with centers both at UCLA and SIO. Sverdrup had established cooperative research projects before the war, and as early as 1945 he discussed the possibility of resuming cooperative research in fisheries with Oscar O. Sette of the U.S. Fish and Wildlife Service. Harry Scheiber characterized Sverdrup as one of

the masterminds of the California Cooperative Fisheries Investigation (CalCOFI), a long-term, broad, coordinated marine fisheries and oceanographic study that made great methodological advances in fisheries research. CalCOFI brought some $400,000 for research to the Scripps Institution. It also allowed the institution to acquire three vessels from the government, with a little help from Roger Revelle, and convert two of them into research vessels, *Crest* and *Horizon.*[19]

Sverdrup left SIO in 1948 to return to Norway. The reason he gave was that he thought he could be more influential in international affairs operating out of a smaller country, something that is certainly true. But there was probably a mixture of other factors as well. For one, the University of California salary scale at the time was notoriously low. Faculty at Berkeley would grumble that the difference was supposed to be made up by the splendid California climate. Undoubtedly, Harald Sverdrup and certainly his wife, Gudrun, were homesick. Sverdrup was away from La Jolla for considerable periods of time, and his wife must have felt isolated in a country in which she was not totally comfortable. She was also concerned that their daughter, Anna, so long away from Norway, was becoming Americanized.

Sverdrup returned to organize and head the Norwegian Polar Institute in Oslo. He resumed his early work on polar exploration by arranging the 1949-52 Norwegian-British-Swedish expedition to Antarctica. He served as professor of geophysics at the University of Oslo from 1949 until his death, serving also as dean of the faculty of science and vice-director of the university. Sverdrup's work at the Norwegian Polar Institute was not of the intensity or depth of what had occupied him at Scripps, but he did achieve his goal of being useful in the international sphere. Specifically, he was successful as chairman of the Norwegian relief

program in India. He also accomplished much in strengthening the Indian fisheries.

One noble goal he set for himself was the easing of the Cold War tensions between the Soviet Union and the United States. He counted on his experiences and associations in both countries.

His greatest achievement, however, was as chairman of the commission that overhauled the Norwegian educational system. The system is still identified with the Sverdrup name.

There are several different accounts of Harald Sverdrup's death. One of his students reported that he suffered a fatal heart attack exactly while his physician was reporting to him that he was in fine shape. Nels Spjeldnaes says he died while attending a meeting. Another report says he knew he had a heart problem but decided not to pamper it. He died suddenly on August 21, 1957.

Harald Sverdrup's correspondence and other papers documenting his career in Norway after 1948 are at the Norwegian Polar Institute in Oslo. His records as director of the Scripps Institution of Oceanography are in the archives at Scripps.

NOTES

1. B. B. Baker et al., ed. *Glossary of Oceanographic Terms*, 2nd ed., p. 160. Washington, D.C.: U.S. Naval Oceanographic Office, 1966.

2. "Informal Autobiography of Harald Ulrik Sverdrup," unpublished manuscript submitted to the National Academy of Sciences c. 1948 in Records of the SIO Office of the Director (Sverdrup), Accession 82-56, Scripps Archives, UCSD, La Jolla, Calif.

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