The 1940s on the Campus of the Scripps Institution of Oceanography, Some Notes and Comments

BY AN INVOLVED GRADUATE STUDENT; MOSTLY ABOUT PHYSICAL OCEANOGRAPHY.

Dale F. Leipper, Ph.D. 1950

Revised 24 March 1994

Contents

drup came up to Los Angeles once a week for twelve weeks to teach us a one unit course in oceanography. I don't think he ever missed a lecture. My notes for this short course are being sent to the Scripps archivist, Deborah Day, who requests such items.

This twelve lecture oceanography course may be of particular interest because it was given the same year that THE OCEANS was published. Thus, Sverdrup's knowledgeable choice of material for this course may be one of the best available indications of what was really most important in physical oceanography at that time. It is still probably a good selection of basic subject matter.

At UCLA, the widely renowned and highly respected Dr. Jacob Bjerknes was one of the meteorology professors. (Harold E Klieforth, a later UCLA graduate in meteorology, told me that Bjerknes and J. Holmboe chose to come to UCLA, when they came from Norway, in order to be close to where Sverdrup was. Holmboe wrote one of the best early texts in dynamic meteorology. His mimeographed chapters were used in our class in 1942 as they were produced.) Another particular emphasis at UCLA was synoptic meteorology, led by Maury Neiburger.

When the first semester, fall of 1942, ended, our entire Air Force class was transferred from UCLA to the University of Chicago. There, in the spring semester of 1943, we were privileged to have lectures from Carl Rossby, Horace Byers and other well known meteorologists. When Chicago celebrated its centennial, Rossby was one of the four professors there who were named as outstanding ones in that first century. The emphasis for us at Chicago was single station analysis and forecasting. This turned out to be very useful when I was stationed at isolated Adak Island in the Aleutian Islands later in 1943 and in 1944.

At the end of the nine month meteorology program on 10 May 1943, our class were commissioned and eight of us were ordered to Scripps for three months of further orientation in oceanography, 17 May to 17 August 1943.

Apparently, these eight were the ones who received the highest grades in the oceanography course offered earlier by Sverdrup at UCLA. They were second lieutenants Charles Bates, Cletus Burke, John C. Crowell, Ralph Klopper, Dale Leipper, Boyd Olsen, George Timpson, and Henry Venn. In the summer of 1943 This was the first of a number of similar short courses, possibly they should be called workshops, for the military at Scripps. Later courses were for six weeks rather than for 12 weeks as was the initial offering.

Other students who were at Scripps at the same time as the first Air Force group were Jack Armstrong, Elmer Dawson, George C. Holliday and Donald Redfield.

because of its critical warfare applications. Two of these applications were the utilization of ocean temperature data in antisubmarine warfare and the prediction of ocean waves and swell for landing operations. In the last two years of this decade, the faculty and staff grew rapidly.

2. The War Years

My academic contact with Scripps began in the fall of 1942. At this time I was one of 110 Air Force cadets studying meteorology at UCLA. Dr. Sverdrup came up to Los Angeles once a week to teach us a one unit course in oceanography. The highly renowned and respected Dr. Jacob Bjerknes was one of the UCLA meteorology professors. (Harold E Klieforth, a later UCLA graduate in meteorology, told me that Bjerknes and J. Holmboe chose to come to UCLA, when they came from Norway, in order to be close to where Sverdrup was. Holmboe wrote one of the best early texts in dynamic meteorology. His mimeographed chapters were used in our class as they were produced.)

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Other students who were at Scripps at the same time as the first Air Force class were Jack Armstrong, Elmer Dawson, George C. Holliday and Donald Redfield.

At Scripps, in the summer of 1943, the special program for our eight newly commissioned Air Force Officers was half devoted to ocean waves and wave forecasting and half to air-sea interaction. Both of these studies in oceanography were in their development stages.

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During the 1943 orientation, my wife Virginia and I (We had been married 14 May 1942) were given the basement room in the big Community Cottage on the cliff just up the hill from the Scripps building. (It can be seen on the upper cover picture of the LEGACY OF EXPLORATION 1993. This publication also contains on the center page a picture of the eight officers of the 1943 class and the other students mentioned above with Dr Sverdrup.) From our one room apartment we could hear and feel the waves breaking on the beach.

Sverdrup and Munk had been asked by the U.S. Navy to develop a forecasting method for waves, swell and surf. There was a possibility that war time landings might be required on beaches where there were no protective harbors. Although surf conditions were critical for such landings, little was known about surf prediction. A report on this subject was completed by Sverdrup and Munk in August 1943, just as our Air Force class completed its work.

There was an unresolved question in ocean wave development. It concerned whether the wind acted by exerting a drag (stress) on the sea surface or by exerting a perpendicular pressure force on the sloping surface of the growing wave. Sverdrup consulted in depth on this and other problems with Carl Eckart, an excellent theoretical physicist, who was then at Point Loma. We students were given some practical relationships describing wave growth under the wind, wave travel and decay over long distances, travel time, and wave build up and direction change in shallow water.

The air-sea studies were in the nature of guided research. The primary problem was to find how cold dry air was modified in travelling over a warm ocean. One eventual product of this work was a publication in the Journal of Meteorology by Cletus Burke.

It was in this research that my interest in west coast and at sea fog was stimulated.

In his lectures and in his personal relationships, Dr Sverdrup was a very soft-spoken man. He was fairly short, about 5 foot 6 inches, possibly eight.(See the picture of him with Roger Revelle.) Thus, it was a surprise to see him for the first time at the beach in a bathing suit. His shoulders were broad and his musculature very well developed. I like the picture of him taken by King Couper at Woods Hole where he was wearing a bow tie.

a. The later war years, August 1943 through 1945

Upon completion in 1943 of the three months of further orientation at Scripps, the eight of us were given various assignments in the war effort. I was ordered to Alaska where one year was spent as a weather forecaster in a Navy Weather Service unit at Adak. The other year was in research work at the Air Force Weather Central in Anchorage.

The Scripps training was fully utilized in these assignments. I produced a method for fog forecasting for Shemya Island (Leipper 1945) and a publication on peculiarities of the wind at Cold Bay in the Aleutians (Leipper and Miller 1946). Also, for practical forecasting use I made up a simple wave forecasting chart which worked very well in the highly variable weather conditions of the North Pacific, see Appendix C.

At Adak I had the interesting experience of being duty forecaster in the early morning hours when the cruiser Baltimore carrying President Roosevelt was due to leave Adak. There was a squall line due in four hours and the ship captain was new to the Aleutians. The station commander looked over my shoulder every morning to advise on forecasts. This particular morning he said, "You're on duty, you do it!" I predicted that the winds would increase from near calm to 40 knots at noon and decrease to light winds 30 minutes later. The captain held his departure and the winds did exactly that. It was a passing squall line, timed in coming over Shemya and Attu.

After the passage of secondary cold fronts at Adak, the sea-air interaction over a distance of some 400 miles behind the front was such that uniform squalls, uniformly spaced, would develop. When one passed a western station, you learned its characteristics. Thus, when it hit Adak with high winds and rain or snow, we were able to tell an inquiring pilot just exactly how many minutes more the bad weather would last. The single squalls were usually about 20 minutes in passing.

A month before the war ended I had been ordered to the University of California at Berkeley to work with them on surf forecasting. I was there when the war ended and never went back to Alaska in uniform. On the basis of my oceanography and meteorology and contacts with Dean Morrow P. O'Brien, I was offered a position after the war in the Department of Civil Engineering at Berkeley but, having no background in civil engineering, (Dean O'Brien told me not to worry about that) I decided to come back to Scripps instead. The offers were the same, half time for $3,000, with a chance to work toward a Ph.D.

After the Scripps orientation in 1943, Charles Bates and John Crowell were to play key roles for the war time landings in Europe.

b. Class members of 1943 after the war

After the war, from this group of eight officers, John Crowell was to become a member of the National Academy of Sciences, Charles Bates and Boyd Olsen were to become successive scientific and technical directors of the U.S. Naval Oceanographic Office, I was to become founding Head for 16 years for the Department of Oceanography at Texas A&M and later first chairman for 11 years of the similar department at the Naval Postgraduate School. Cletus Burke has passed away. I have not been able to follow the other four members.

3. THE LATER YEARS OF THE SVERDRUP REGIME, 1945-1948.

a. The curriculum and related matters

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See DL to JD
27 Apr 1994
for correction.

As I recall, there were seven of us who began the first full new curriculum in physical oceanography after the war in the fall of 1946. Most were meteorologists who had been discharged from the services when the war ended.

The first semester consisted of four courses, all taught in the Scripps building. Dr Sverdrup gave the physical oceanography course. The other courses were taught by Drs Martin Johnson, F.P. Shepard and Norris Rakestraw. This was the first offering of such a curriculum in the United States. THE OCEANS provided much of the subject reference material.

Dr. Sverdrup would come to class without notes. He would start at one end of the blackboard and proceed systematically through a complete presentation. At the end of the period the board would be full and the subject finished.

Ruth Ragan, Scripps Librarian, told me that when Sverdrup dictated his part of THE OCEANS he did it in the same way. She said that, after she typed his dictation, he would look it over and there would be very few corrections or changes needed. I think that, after he earned his Ph.D. in meteorology, the seven years he spent locked in the Arctic ice on the FRAM must have been devoted to the thorough study of oceanography and meteorology. His chapter on the water masses and currents of the oceans is generally recognized as a masterpiece, never since equalled or surpassed. The class benefited greatly from his knowledge.

MAUD
(note by Kathy Dias)

Dr. Sverdrup placed emphasis upon the principles which held oceanography together, those principles which he had described in "The Unity of the Sciences of the Sea" (Sverdrup 1940). Somewhat along this same line and

in the 40s he also published "New International Aspects of Oceanography" (Sverdrup 1947).

For 1946-1947, Sverdrup wrote a summary of research activity at Scripps (Sverdrup 1947). Teaching was closely related to ongoing research.

As an incidental note, I once had an opportunity to travel with Dr. Sverdrup. On the trip home I sat beside him on the plane and looked forward to a relaxed conversation. However, as soon as he settled down, he produced a murder mystery and was absorbed for almost all of the trip.

During the geological course, Dr. Shepard was just writing his book and he would bring mimeographed pages of it to class. One chapter started with a sentence which fascinated me for some reason. It reminded me of Shepard's approach to topics. It was "On many coasts there are few if any beaches." He was fully enthused with his subject of submarine geology and sometimes darted from topic to topic.

One week, in the La Jolla area it was almost dead calm. The waters near and offshore became remarkably clear. Dr. Shepard had wanted photographs of the underwater canyon and this seemed the ideal time to get them. His diver took many rolls of film. He used a new film which was almost able to see in the dark. It was infrared film. None of the photos turned out. Infrared radiation will not penetrate sea water.

My background in biology was weak. When Dr. Johnson assigned reading, it would be difficult. I remember one assignment in THE OCEANS which I checked. On two pages of the assignment, there were 20 words which were new to me. Not only that, many of them were words not found in my dictionary.

A special event in biological research occurred when Boyd Walker, a graduate student in fisheries, had learned to predict the date and hour that a grunion run would likely occur. This was based upon the relation of the run to the tidal height, one of the few really predictable quantities. The runs were occasions for pleasant beach parties. (I have a photo but there have been others published).

Dr. Rakestraw was new to the campus. He was sympathetic to those of us who were not chemists. He emphasized the real value of chemistry in the study of the oceans. He was a good listener and a good advisor. He took a strong interest in the welfare of all students at Scripps.

After the first semester, there were many seminars, a few advanced courses and some practical laboratory and field work. (It was believed that every scientific and technical person who worked at Scripps should have

some knowledge of and interest in the sea. To that end, Bill Woods, an office worker, was scheduled to go on a one week cruise on the E.W. Scripps. According to the report which I received, he became ill just thinking about the cruise and had to be assisted aboard. He stayed in his bunk for the full week and had to be assisted off the ship at the end of the cruise. He sought other employment.)

Several years after this curriculum first had been offered, it led to the publication of an article on Education and Training for Oceanographers (Knudsen et al. 1950). In this article, Roger Revelle and UCLA Dean Knudsen, together with MIT's Dean Schrock and Alfred Redfield from Woods Hole, agreed upon the nature of oceanography and the kind of education an oceanographer required. This article was to guide the development of curricula at Texas A&M University, Oregon State University and a number of other universities. The advice given in this article was forgotten on the East coast (Pedlosky 1992 and Leipper 1992).

b. Course notes for the Sverdrup series

The Scripps archivist, Ms. Day, requested that any class notes from Sverdrup's classes be sent in. I am sending mine. The courses covered are the UCLA short course in 1942, the first and second semester graduate courses in physical oceanography (1946-47) at Scripps and an advanced course in boundary layer problems in 1947-48. Appendix D gives more information about these notes. In reviewing the class notes I was surprised to see how clear and complete they are. This is largely the result of the clear and complete way that Sverdrup presented his lectures.

As I am sending the notes, March 1994, it occurs to me that the offering of the full series of courses covered by the notes may be for the only time that it had been or would be offered in its entirety by Sverdrup. This was because, except for the Short Course, the series began with the first curriculum in 1946 and Sverdrup left Scripps in 1948. He probably had never had any previous opportunity to teach such a series to a class. This makes it a unique and valuable series.

c. Two questions about Scripps works

In the late forties, Henry Stommel of Woods Hole came to Scripps for a period of months thinking that he might work towards a degree. However, he came to believe that he would not gain enough knowledge here to make the effort worth while. Dr. James J. O'Brien, now (March 1994) a distinguished professor of oceanography and meteorology at Florida State University, made telephone comments to me about Stommel and also about another well known scientist who visited Scripps in the forties. I asked him to write the comments down and I quote them here. They are unique.

"Hank Stommel, one of the most famous physical oceanographers of the century, taught himself oceanography when he was a young man. He devoured the book "The Oceans". He was so impressed with its know it all style, said, 'I almost decided to study something else because this book made it seem that everything was known'."

"Koso Yoshida became the most important professor of oceanography in Japan. He was a brilliant ocean modeler. In his early life he went to Scripps to study with Sverdrup. One of the problems he tried to solve was the coastal upwelling problem. He had all the equations correct but could not get the right answer. Why? He was convinced by his colleagues at Scripps that the 50 to 100 km width of cold newly upwelled water had to be explained by any theory. In fact the upwelling width is very narrow, about 10 km off Scripps pier. The scale is called the Rossby Radius of Deformation after the famous meteorologist, rather than the Yoshida scale."

d. Some on-campus activity in physical oceanography

1) EUGENE C. LAFOND

In 1945, Dr. Sverdrup's technical support came mostly from Eugene LaFond. Gene had a broad scientific background and was meticulous in his computational work. He was also an artist and photographer. He did most of the illustrations for THE OCEANS. My first assignment at Scripps in 1946 was to work with him in the compilation of what later became the "LaFond Tables". A key part of these tables was the relation between temperature, salinity, pressure and density of sea water.

In 1946, the Marchand calculator, which cost $800, was the main piece of office equipment. We calculated for the table, step by step, the density of sea water for different temperature and salinity values. With the method used, the correction of the reversing thermometer readings for a single station, the determination of the salinity values and the computation of the density to five decimal places for each Nansen bottle depth at that station required about one man day of effort. With computer programs, it is done rapidly now.

The Navy was ready in 1946 to help start an oceanographic section in the Point Loma laboratory. Gene LaFond was offered the position of branch head. However, he and his wife Katherine had settled for what they thought would be a lifetime as a University family at Scripps. Since I worked in the same room with Gene, I was much involved for several months in his wrenching considerations about making the change from a university position to one in civil service.

2) THE BATHYTHERMOGRAPH SECTION

Gene finally decided to accept the opportunity of working for the Navy, leaving me to be head of the bathythermograph (BT) processing program for the Navy at Scripps. I had this responsibility for about three years. The background for the activity is well described by Shor (1978). The BT group involved some four or five clerical persons and a few graduate students.

Two of the clerical persons hired for the BT section were full Colonels (Col. Bagg and Col. Ottoson) just retired from military service. Col. Ottoson had been in command of the defense of San Diego during the war. They wanted to keep busy and served the project very well. They did not mind doing the routine work of reading BTs. Some other members of the BT section were Marjorie J Oakes, Elaine A. Trowbridge, Barbara Rhimbach and Mildred K. Hunter. The BT group occupied the temporary building south of Scripps Hall and nearest the beach. There was also a cement block building next to it for safe storage of the original slides.

Sverdrup had me give a lecture about BTs and BT processing in his course Oceanography 110.

Some members of the BT group were later to become very well known: e.g.. Wayne Burt who built up oceanography in Oregon, Margaret Robinson who published worldwide temperature-depth information, and Townsend Cromwell for whom the Cromwell Current is named. Wayne took over the BT section when I left in 1949. At Scripps he used to dream and talk about getting back to Oregon and starting oceanography there. He later did it, from zero.

Towny was a very deliberate individual and to some he appeared slow on his feet. He was thus not accepted to undertake graduate work at Scripps. Too bad. Margaret was not encouraged to undertake graduate studies in the 1940s because there was concern about the possible roles of women in oceanography at that time. She later earned a masters degree.

Dr. Sverdrup dropped in to the BT section one day. He said he was going to Hawaii in a couple of days to do some consulting. He asked if we could get him a few typical BTs for that area.

We had just finished a rather comprehensive study of sea temperatures in the Philippine Island area. Everyone in the BT group had participated and had done a certain part of that work. I asked each of them to do the same thing for this new Hawaiian area, using the forms and procedures we had developed for the Philippine study. When Dr. Sverdrup came back in two days we handed him a bound report of about 50 pages (Leipper 1947) including average temperatures, deviations, distribution charts on the surface and subsurfaces, typical BTs and other information. He was greatly

surprised to see all of that and could not believe that we had done it in such a short time. I will never forget his shocked but pleased reaction.

We spent about six months polishing up the Hawaiian report for publication. After all of that additional work, the publication (Leipper and Anderson 1950) was not much better than the two-day report had been. A number of annual reports and reports on BT processing are filed in the Scripps library.

The BT group was one of the largest groups on campus and we would have social functions such as Christmas parties. Roger Revelle came to one of these and sat cross-legged on the floor as did many of the others. We sang carols. Two of the girls sang beautiful duets and I played for them. After the party, Roger said he wished he could play the piano, one of the few things he had not learned to do.

3) THE FOG PROJECT

The Office of Naval Research approved a proposal I had submitted to study coastal fog. In 1946, this may have been Scripps first ONR project. Bob Reid and others spent some time on this project. There are several reports in the Scripps library and there was a publication "Fog Development at San Diego, California" (Leipper 1948). The fog forecasting indices described therein were still in use by the Navy at San Diego in 1992.

A description of the fog project results was made by Sam Hinton into a display for the Scripps museum in the 1940s. There was quite a bit of publicity about this project, e.g. Appendix E. Follow-on work is described in a review article published in the February 1994 issue of the Bulletin of the American Meteorological Society.

When I was ready to submit the 1948 fog article for publication, I took it to R.B. Montgomery for comment and criticism. He, a professor at Brown University, was spending some months on the Scripps campus. Ray had been editor of the Journal of Meteorology for some years and was an extremely meticulous editor. He looked at the manuscript and said it looked pretty good. Then he said, thinking that he would, as he usually could, find a number of suggestions and criticisms, "Now let's really take a look at the first paragraph". He looked and he looked but he could find no problems. He was greatly surprised and so was I.

Visiting the North Island Naval Weather Station in 1946 to discuss fog forecasting, I met Navy Lieutenant John Knauss who was the forecaster on duty at the time. After our discussions I suggested that, when he had completed his tour, we might find work for him in oceanography. After his discharge he came to Scripps for an interview with Dr.. Sverdrup. Dr. Sverdrup sent him to see me. I had no openings at the time but called Gene LaFond at the Navy Lab. He needed help and hired John. That is how

John Knauss began a distinguished career in oceanography, see his letter in Appendix F.

4) COMMENT

Dr. Sverdrup was extremely considerate of his students. I remember one time I thought I had found a remarkable correlation between several oceanic variables. Sverdrup looked it over and when he called me back, he quietly pointed out that two of the variables were really identical and that, of course, there would be a high correlation. Reviewing another manuscript he was not at all impressed. The difficulty was in the misuse of one word. I had used "biannual" incorrectly.

A wording which was and is in general use bothered Sverdrup. It was wording such as in a forecast for " colder temperatures". This wording is not correct. He said that, "temperature is a reading on a stick and a reading cannot be cold or warm." It is the air or the water which is cold or warm.

5) HOUSING:

After the war, housing was extremely scarce and very expensive in La Jolla and there were only a few cottages on the Scripps campus. When we first arrived in La Jolla, Virginia and I were able to get a two bedroom duplex at the Army's Camp Callan on the top of the hill. Sverdrup asked how I did it. Then he made me housing chairman for Scripps and I was able to get a priority for the housing of Scripps students at Callan. This priority held for some time. The housing was formerly quarters for officer families. It was simple but it was not substandard as has once been stated.

Driving up and down the hill between Scripps and Camp Callan, I would pass a beautiful piece of isolated and unused ground at the top of the cliff. It was about seven acres of what I think is now (1994) Ellentown. I often though of trying to buy it (in 1946, on my $3,000. salary!!!).

In 1946, when Winfred Allen retired, Virginia and I were able to move into his cottage on the campus. I still (in 1994) use the swivel chair which I bought from him at my computer desk. The cottage was the northern most of the cottages, next door to Claude and Jean ZoBell and back to back with the Sam Hinton family. (There is a good picture of this cottage.) The only thing between us and the edge of the cliff was Dr. ZoBell's rabbit hatch. (His skill at killing and butchering rabbits was really something to see.)

Butch

4. Carl Eckart

Dr. Eckart was an extremely precise physicist. His mathematically oriented lectures were delivered with great clarity. Dr. Eckart was also a fine person.

When Dr. Sverdrup planned to leave Scripps, it was fairly clear that he had counted upon the appointment of Dr. Revelle as his replacement. However, he did not anticipate the difficulties in obtaining approval for this appointment. It was delayed for some two years, see Dr. Munk's review (I do not recall the reference). Sverdrup was committed to leave on schedule so he turned to his friend Carl Eckart, whose reputation as a scientist and as a person was strong enough that he could be readily accepted as director of Scripps. I do not think that Eckart ever wanted to spend time in administration. He probably took the assignment to Scripps as a temporary one at the request of his friend Sverdrup. He performed the duties of director very conscientiously.

The fact that Scripps was an institution and not a department caused Dr. Eckart and other directors in those years some difficulty. Departments are the regular teaching units of university organization. They carry a commitment from the university (Knauss 1988). For example, degrees could be granted in departments. My degree in August 1950 had to be granted by UCLA.

a. The Dynamics Heights Question

Probably the most significant interaction between Dr. Eckart and oceanographers had to do with his review of the dynamic heights computations so widely used in determining geostrophic ocean currents. In closely studying the equation of state, Eckart found that it would be impossible, using the temperature and salinity data which were available, to obtain density to the five decimal places needed and utilized by physical oceanographers in computing dynamic heights. This conclusion led to two years of concern and to the fear that all previous computations would have to be discarded. This was a truly major concern.

The concern led to the calling of a meeting in 1958 sponsored by the Office of Naval Research and the Committee on Oceanography of the NAS-NRC to consider what should be done. The results of this meeting appeared in NAS-NRC (1959). This publication included my paper on the general nature of the dynamic heights procedure. It also included the definitive paper given by Robert O. Reid. He affirmed that oceanographers did not use absolute values of density as such but used only the differences between values at given depths from two adjacent stations. He showed that when differences between stations were computed, the compression term

dropped out of the equation and that differences to five decimals were significant. Dr. Eckart was satisfied and questioning of the widely used dynamic heights method was terminated.

In the 1940s, it was difficult to obtain verification of currents determined from dynamic height calculations. Thus, it was particularly interesting when LeRoy Cheney, a Coast Guard officer who had studied at Scripps in the forties, wrote back on this subject. He said that his ship had been ordered to follow an iceberg which had been sighted in the North Atlantic. It was in an area where they had recently done a geostrophic currents determination. He said the iceberg followed the contours of dynamic heights "like a trolley on a track".

b. Student Affairs

In 1948, Dr. Eckart became a member of my Ph.D. committee representing Sverdrup, who remained as an in absentia member. Dr. George F. McEwen became chairman, replacing Sverdrup in that function. The other members were Johnson, Bjerknes, and Holmboe. I felt that Sverdrup had given these men good words about me. This would have helped me with Eckart and Holmboe especially since they were not particularly interested in amounts of data analysis such as were contained in my original draft.

I submitted the draft of the dissertation to Eckart. He called me in and suggested that I eliminate four of the five chapters which I had written and use only the fifth chapter as the dissertation. All five chapters are mentioned in the announcement of my final examination, see Appendix G. I ended up with only the one chapter. My dissertation thus was probably the shortest dissertation approved at Scripps in that era. I think it was 28 pages of subject matter. In shortness it was competitive with Walter Munk's. The other four chapters, mostly about coastal sea temperatures, were used in a report which is in the Scripps library.

I took the final exams on 22 August 1949, Appendix G, and the date on the diploma is August 1950. (Raitt and Moulton list it incorrectly as 1951). Sverdrup was at the final examination with the resident members. He reminded me of the sinking of the waters in the North Atlantic and the formation of the deep water masses there. Then he asked, "Where does all of that water come back into the surface layers?" It had to rise somewhere. I had never considered this so he answered for me, that it was in the tropical regions.

It is interesting to note that the Raitt and Moulton history does not list me with the 1948 staff of Scripps as either a graduate student or a research assistant. I was certainly there and deeply involved.

Woodrow C, Jacobs took his examinations on the same day that I did. He was a very sensitive person. After our exams he was so wound up that he wanted to go some place to have a drink and relax so I went along with him. We both needed that. He was to later become head of climatology for the U.S. Weather Bureau and to offer me a job there in marine climatology. He was an early user of the method called "synoptic climatology".

The year following the my graduation with a degree in oceanography, a news article in June 1951 announced the award of three new Ph.D.s in Oceanography, students from the 1940s: Robert M. Norris, William S. Butcher and William Cameron. The article stated that "only nine such degrees have been granted by the University of California since 1925." Bill Cameron was to become the highest Canadian official in oceanography.

1) LETTERS FROM OCEANOGRAPHERS

Many of the students at Scripps in the 1940s and their associates there were to keep in touch with each other almost annually for forty years. This was done by a letter exchange. Each participant would send a letter to me. I would reproduce and compile them and send each participant a full set. There were a total of some 400 letters. A copy of these and some of the original letters have been placed in the archives at Scripps. These letters tell of the many successes of these Scripps graduates. Participation is shown in Appendix H.

If it is desired to describe the role of these early Scripps graduates in building up oceanography programs throughout the world, these letters from oceanographers would provide interesting source material.

There were 50 participants in the exchanges. Eighteen of them are listed in the 75th Anniversary edition of the SIO Alumni biographies, June 1978. Fifteen earned degrees from Scripps between 1947 and 1953. Most of them are physical oceanographers. Ten of the participants wrote in the earliest exchange as well as in the final one 43 years later. Twenty seven of the participants wrote in at least eight exchanges. Dr. Sverdrup took part in eight of them before he died 21 August 1957.

Included in the group of 50 were a core group which King Couper labeled the "Famous 15". These were the full time Scripps students in the first and second curricular offerings. They were Reid, Cochrane, Burt, Pritchard, Ewing, Cameron, Horrer, Anderson, Folsom, Inman, Saur, Carter, Cheney, Leipper, and Couper.

Among the most noticeable students during the 1940s were four Argentine naval officers. Rudolpho Panzarini, Luis Capurro, H. Iglesias and Hector Etchebehre. They were senior officers and were interested and

capable students. Two of them later became admirals. Capurro became well known in international oceanography.

The Argentines were friendly associates while at Scripps. Panzarini once hosted a memorable dinner party in his home. Shortly after we arrived we were shown to a stand up table with a remarkable collection of fine foods. There was a good opportunity for socializing while we ate and drank for two hours or so. I, for one, was satisfied. Then, about eleven o'clock in the evening, a sliding door was opened to the next room and there was dinner! What a surprise, after all of the other food!

c. Other Matters

During the 1940s, there were some interesting visitors. Errol Flynn dropped by one afternoon in his boat. The "Lady with a Spear", Eugenia Clark, studied with Dr.. Hubbs for awhile. (She was really all business). Other visitors were too numerous to mention.

d. The Marine Life Research Beginnings

During the period of Eckart's directorship, Roger Revelle was active in Scripps affairs, filling the new position of associate director beginning in the summer of 1948. He had a lot to do with the initiation of the Marine Life Research (MLR) Program. I was asked to organize the physical oceanography part of that and to plan the cruise pattern. Three ships were to be involved. I requested two additional physical oceanographers to help analyze the data collected. Roger said that it was better to spend the money on work at sea while they had it. He thought that funds might later be obtained for analysis.

It is interesting that Sverdrup once told me that if the person involved in collecting ocean data did not work it up, there was a good chance that no one else ever would (Sverdrup 1947).

On the MLR program I did have the excellent assistance of Hans Klein. In hiring him, I told him about all of the fringe benefits in the University of California such as retirement amd health insurance. That did not impress him at all. He had recently come from Germany. He said he had had all of these benefits built up there and that they had completely evaporated in the war. The possibility of that happening here had never occurred to me and it was a shock to hear about it happening anyplace. We take too much for granted.

Hans and I spent considerable time working up a large nomogram for the correction of deep sea reversing thermometers (Leipper and Klein 1949). However computer programming was soon to take over that procedure.

Work on the modification of the research vessel Horizon was behind schedule and Roger had set a date to begin the MLR work at sea. He was bound to meet that date and apparently informed the contractors that, if they were not finished by the agreed upon deadline, they would have to go to sea, scaffolds and all. It was a close call.

I left Scripps in August 1949 to become head of the newly authorized department of oceanography at Texas A&M University. After that George Wüst was called upon to analyze the data collected on the MLR program. He found that (fortunately, he thought) the ocean stations had been spaced so that there was a minimum of difficulty dealing with the large internal waves which were often present. This was not luck. We had known about the presence of these waves from our BT work and had set the station timing so that all stations hopefully would occur at the same phase of the waves. It was disappointing to have someone suspect that that was just coincidental.

e. Walter Munk

Dr. Munk was a partner to Dr. Sverdrup in the wave work. One of his early papers on other subjects was the classic one on the wind driven ocean circulation. Walter asked me to review his manuscript. He was not a meteorologist and at least once did not distinguish between high and low pressure areas since they were both closed circulations on the map. I ended up with a large number of items to discuss with him about the paper. He waded through all of the comments and made appropriate changes where necessary.

The early manuscript on wind driven currents took the air circulation as a given and described the wind-driven currents which should be set up by that wind pattern. The wind patterns are determined by the atmospheric pressure distribution. I knew that the sea surface temperatures, which were affected by the ocean currents, were an important factor in determining the overlying atmospheric pressure patterns. Thus, I told Walter that the winds could not be taken as a given but that there had to be a two way interaction between them and the ocean currents. He then added a paragraph near the end of the article stating this.

Another article of Walter's in the 1940s, "Notes on the Theory of the Thermocline", deduced that the vertical structure of sea temperature would not be a smooth curve but would have steps in it such as the one often observed at the thermocline. Again we went through the review process. There was an inequality stated which I believed was not correct. Walter eventually agreed but he really hated to remove that inequality since doing so required a major revision of the article, but he did it.

There was an interesting story going around about getting data to verify this step model. Walter was in a boat in a Pacific lagoon looking for steps in BT observations being collected there. The technician knew what Walter was hoping to find and thought he would play a trick on him. Accordingly, he took a smoked glass slide and secretly sketched a BT on it with several sharp steps in the trace. He then, after a BT descent, took that artificial slide and handed it to Walter. Walter was greatly enthused because it was just what he had been seeking. He expressed his enthusiasm to the technician. The technician said, "Here, let me take a look at that". The technician studied it and said quickly, "That observation is obviously no good". He immediately threw the slide into the sea. Walter almost fainted to see his ideal observation thrown away. (It is a good story but I do not know about the truth of it.)

Walter Munk had and has an outstanding ability to express both verbally and in writing what he had learned. When he undertook a problem he once told me that he avoided looking into the literature because he wanted to start with the basics and he felt that other studies might throw him off the track. He did, however, make partnerships with the very best known experts in each study area which interested him.

Walter was very careful throughout the 1940s to minimize the amount of time he spent on administrative or committee type activities. I believe his success at such minimization has been one of the secrets of success.

5. Roger Revelle

a. Some Background

Much has been written about Dr.. Revelle. He was a truly great individual. His career reminds me of the saying, "It is not lack of faults but rather abundance of power that makes a man great." That was certainly true in Roger's case.

As mentioned, Roger's appointment to the directorship in March 1950, after I had left Scripps, had been delayed for some two years for various reasons. For one thing, he was formally opposed in one period by a group of the most senior faculty. However, during this time he was actively involved in Scripps planning and activities. I knew him in this period and came to understand the motto on his wall, "Fan the flames of controversy". He certainly followed that advice and made it work for him. I believe that Sverdrup was anxious to see Roger named director of Scripps because of the ability he demonstrated in Washington to further U.S. and international oceanography. Further, he was certain that Roger would find a way to take Scripps into the world oceans, which Roger did.

Roger had another saying credited to him, "Oceanography is too important to be left to the oceanographers." I always wondered about the verity of this. In my subsequent career, I served as department head for 26 years in two different institutions, During this time, I have worked for a number of college deans. Among them were an English professor, an economist, and a chemist. I also worked under several different navy admirals who were not oceanographers. I had no trouble at all under them.

I had turned down offers to become dean of the Texas A&M Graduate School and to become director of the Texas A&M Research Foundation. This meant that, if I refused to do that level of administration, I would have to be satisfied working under those others who were willing to accept such positions.

Then there came a dean with the major field of education. He seemed to believe that an oceanography department with over 200 persons involved, a ship operation, and a budget of more than $2 million could be administered with no more structure or activity than a history department with ten faculty members. He was horrified when we once lost a BT on a two week cruise. I often wished that he had known something about science and about oceanography in particular. Then there was one admiral who kidded me because I could not tell him off hand the height of the tide at a given time in a protected bay area. He is the one who wanted me to give him a single temperature-depth curve which could be used at all times in the oceans worldwide.

Now, back to Roger Revelle. Roger was often late for appointments and meetings. Coming in after a meeting was well underway, he would often listen until he got the drift of the meeting. Then he would state his position, usually in a very convincing way, and dominate the output from the meeting. There were times when I felt that he might just be playing a game. He would seem to argue for a losing side, just to see if he could establish that side as winner. He usually could.

1) GLOBAL WARMING

In the IGY years, 1958-59, I was to serve with Roger on the International Oceanography Committee. It was at that time that he made a strong push toward avoiding carbon dioxide buildup on a global scale. He was concerned that that would lead to global warming. The CO_2 content of the atmosphere has increased. However, when I last saw Roger at the Monterey meeting of the Oceanography Society in 1991, I asked him if there had yet been any good evidence that global warming had been observed. He said, "No".

I also served on the IGY meteorology committee (panel?) where I pushed for a program of world wide sea surface temperatures. The com-

mittee said that was a subject for the oceanographers. I tried to push it in the oceanography committee. That committee said sea surface temperatures were used only by the meteorologists and that they should handle any project related to it. It did not get done.

b. Notes and Comment involving Dr. Revelle

At the 1991 Oceanography Society meeting I had stopped Roger in the hallway when he was coming out of the meeting. There was no one else in the hall at that time. He was walking with difficulty. As we were talking, a young man rushed up to him and breathlessly asked, "Are you Dr. Munk?". I interrupted the young man and told him, "No. This is Dr. Munk's professor". I then left them talking interestedly to each other.

Roger was a geologist by background. He was very anxious to learn more and more about the other aspects of oceanography as well. However, I do not think he ever felt quite at home in physical oceanography.

Roger was giving a lecture once to the physical oceanography class. It was to be a demonstration of how to compute the half life of radiation. Roger started out with the equation relating "L", the lifetime, to a function of time "t". The problem was to find a value for "t". He shuffled the terms of the equation around in a variety of ways but could not get an answer. He did not want to give up but finally did. He turned around to the class and said to me, "Okay, you do it". It was a matter of replacing "L" with the value "1/2" and solving for "t". I'm not sure why he turned to me on this since others in the class could have seen what to do.

In my graduate research I proposed a model in which the changing range of the coastal tides, acting over an irregular bottom near the coast, could lead to mixing and cooling of the surface layers. Carl Hubbs had found cool areas along the coast where the flora and fauna were typical of areas as much as 1000 miles further north. These seemed to be areas where the coastline jutted seaward and where my model could explain the different temperature regimes. I suggested to Roger that Scripps might take special observations in these areas. He was not interested. He believed that the question concerned too limited an area. (He believed the same thing about the coastal fog forecasting work.) Anyhow, several years later, a survey was organized, probably by Dr. Hubbs, in which some 37 small boats were to make measurements as I had suggested. I did not hear the outcome. Unless the observations were made at a certain stage in the monthly tidal cycle, they might not have shown the cooling effect.

As to fog, it is interesting that Scripps later established a "visibility" laboratory. I believe that the name for that laboratory should be "laboratory for Undersea Visibility". Meteorologists would otherwise assume it was for atmospheric visibility.

If a decision was needed from Roger, it was often difficult to get to see him. If you did catch him, then it was sometimes difficult to get away from him. He liked to complete a discussion even though it might mean missing meals or staying long after hours.

c. Departure of Students

In the 1940s, there were numerous institutions wishing to start oceanography programs but Scripps had only a limited number of qualified oceanographers and there were few other sources. Also, Scripps needed to keep some of its own.

Texas A&M College (now university) was the first institution to establish a full fledged academic department of oceanography on campus, in January 1949. The director of the A&M Research Foundation, Dr. A.A. Jakkula, asked Drs Sverdrup and ZoBell to recommend candidates for head of the new department. They recommended Bob Reid and me. Dr. ZoBell once told me that being six feet tall was a plus factor in such considerations. He prepared a manuscript, Appendix I, about the need for oceanographic studies in the Gulf of Mexico. Dr. Sverdrup wrote me a good letter of recommendation, Appendix J, which I cannot locate right now. He had once told me that Scripps should really try to hold on to Bob Reid.

Bob Reid decided that he did not want an administrative job. I was interviewed at A&M in May of 1949 and went there with my family in August. In the interim I had arranged with Reid to take one of the five initial faculty positions there. Although Roger had been told of this, on the day of Reid's departure from La Jolla in January 1951, by telephone he stopped the moving van in La Jolla and called a meeting in Washington with me and two of his advisors, Dr. Richard Fleming and a navy captain. He wanted Bob to stay at Scripps to work with Dr. Eckart and to have access to the "large piles of MLR data". Appendix K describes the events which led to a cessation of attempts to keep Reid at Scripps.

At Scripps, Bob Reid did not receive his Ph.D. because he was unwilling to devote the great amount of time required to pass the required German examination. I understand this since my German test was so difficult also, being based on the old German containing the long and complex paragraphs. Anyhow, at A&M Bob was to become a member of the National Academy of Engineering, a distinguished professor, and the founding editor of the American Meteorological Society Journal of Physical Oceanography. He was awarded an honorary Ph.D. from Old Dominion University. He has probably served as chairman for more Ph.D. students in oceanography than any other single person. He was eventually talked into becoming head of the department A&M for a period of time.

6. Conclusion

As the 1940s came to a close, the Scripps campus had returned to its emphasis on basic and applied science rather than on the special problems of warfare, it had settled into regular curricular offerings, it was ready to begin its worldwide program of ocean observations and it was ready for the guidance of a new director, Roger Revelle, beginning in a few months.

7. Epilogue

I attended a working group meeting in Goteborg, Sweden January 15-18, 1957 and several follow-up meetings in Europe that year. The meetings concerned Oceanography for the International Geophysical Year. Sverdrup was at one of them. I asked one day if I could take him to lunch. He said yes but he wondered if it would be all right for him to bring Carl Rossby along. (Silly question!). They knew Europe much better than I and it ended up with them taking me to a restaurant where there was the most beautiful display of food I have ever seen. It was quite a thrill to visit with those two remarkable men together. It was simply a friendly lunch and not a business meeting. Sverdrup had a severe cold. It turned out that he died just a few weeks later (21 August 1957, determined by Betty Shor from Dictionary of Scientific Biography). Rossby had died just two days prior. I have never known two men whom I respected as much as I did these two.

Appendices

A. Faculty and staff
B. 1943 course certificate
C. Wave forecast guide
D. Sverdrup course notes
E. Fog project news release
F. Knauss letter
G. Ph.D. final exam announcement
H. Letters from Oceanographers
I. ZoBell on the Gulf of Mexico
J. Recommendation from Sverdrup
K. Reids come to Texas

A

Left to Right

Front Row

F.P. Shepard, geologist
K.O. Emery, geologist
Tschudy, biochemist (?) (BuShips)
---- (from Philippines?)
Willingham, buildings & grounds
Claude ZoBell, bacteriologist
Marston Sargent, botanist
E.C. LaFond, oceanographer
Robert Gordon, mathematician

Standing

Miller, buildings & grounds
Shelden Crane
W. Gorczynski, climatologist
R.B. Tibby, oceanographer
G.F. McEwen, physical oceanographer
J. Lyman, chemical oceanographer
J.C. Hindman, chemist (BuShips)
W.F. Whedon, biologist (BuShips)
Martin Johnson, biologist

(front)

Sid Rittenberg, bacteriologist

(rear)

Lloyd Anderson, electronics engineer
Stanley Chambers, oceanographic technician
Ruth Ragan, librarian
P. Doudoroff, biologist
E.G. Moberg, chemical oceanographer
H.U. Sverdrup, director
R.H. Fleming, oceanographer
Tillie Genter, director's secretary
Helen Stewart, secretary
John Gilbert, meteorologist
Dennis Fox, biochemist
Carl Johnson, buildings & grounds
Thelma Johnson, secretary
Obie Mehler, Buildings & grounds
Jim Ross, supt. of buildings & grounds
Bill Simmons, buildings & grounds
Bill Giroux, buildings & grounds

NATIONAL SCIENCE FOUNDATION
WASHINGTON 25, D.C.

April 29, 1963

Dr. Warren Thompson
Department of Meteorology
and Oceanography
U.S. Naval Postgraduate School
Monterey, California

Dear Warren:

Several Scripps old-timers have looked at the group picture you gave me last fall and we now have identified all but one of the individuals in it.

The occasion on which it was taken has not yet been identified, and the date is not very firm, but clearly not earlier than 1939 and not later than April 1941.

Perhaps Marston Sargent at Scripps can look at some of the old Annual Reports and pinpoint the occasion more closely.

With best regards,

Sincerely,

John

John Lyman
Program Director
for Oceanography
Earth Sciences Section

Copy to:
M. Sargent, SIO

Enclosure

Shadow of SID Faculty -
Staff Picture in 1940 ± 1 yr.
(original is framed)

B

UNIVERSITY OF CALIFORNIA

THE SCRIPPS INSTITUTION OF OCEANOGRAPHY
LA JOLLA, CALIFORNIA

August 14, 1943

This will certify that

Dale E. Leipper, 2nd Lt. AC

has satisfactorily completed a course in oceanography-meteorology during which the following subjects were given:

Wind waves and swells: Theory.
Wind waves and swells: Forecasting.
Interaction, sea-surface - atmosphere: Theory.
Interaction, sea-surface - atmosphere: Applications.
General oceanography.

This course was attended during the period May 24 to August 13, 1943.

H. U. Sverdrup
Director

CALCULATING AND FORECASTING THE HEIGHT OF WIND WAVES

The height of wind waves at sea depends upon the wind velocity, the reach of open sea over which the wind blows called the fetch, and the length of time the wind continues to blow called the duration. To find the approximate height of wind waves at sea, read off the height given in table A and also that given in table B. Reject the larger value. The smaller value is the height of existing waves. To forecast wave heights, make the same calculations using forecasted values of wind velocity, duration, and fetch.

When wind waves travel away from the area in which they were formed they become swells. Additional tables are necessary for forecasting swells.

Table A Wave Heights in Feet where Fetch is the Limiting Factor.

Fetch (naut. miles)	Average wind speed over the fetch in knots										
	10	15	20	25	30	35	40	45	50	55	60
25	2	3	5	6	7	9	10	12	13	14	16
50	2	4	6	8	10	12	14	16	18	20	22
100	2	5	8	10	13	16	19	22	24	27	29
150	2	5	8	12	15	18	21	25	28	31	35
200	2	6	9	12	16	20	24	28	32	36	40
250	2	6	9	13	17	22	26	30	35	40	45
300	2	6	9	13	18	23	28	33	38	43	47
350	2	6	10	14	18	24	29	34	40	45	50
400	2	6	10	14	19	25	30	35	41	48	52
500	2	6	10	15	20	25	31	38	44	51	56
600	2	6	10	15	20	26	33	39	46	53	59

Table B Wave Heights in Feet where Duration is the Limiting Factor.

Duration (hours)	Average wind speed over the fetch in knots										
	10	15	20	25	30	35	40	45	50	55	60
6	2	4	5	7	9	12	14	17	19	22	25
12	2	4	7	10	14	17	21	26	29	33	37
18	2	5	8	12	16	20	25	30	35	42	47
24	3	5	9	13	18	23	29	34	41	48	54
36	3	6	10	14	20	26	33	40	49	56	64
48	3	6	10	16	22	28	35	44	53	62	

These tables are derived from plates 1, 2, and 3 of Wind Waves and Swells, Principles in Forecasting, Scripps Institution of Oceanography, published by the Hydrographic Office.

D

Courses in Physical Oceanography

Taught by Dr Harald U. Sverdrup in the 1940s

Class notes by Dale F. Leipper, then an Air Force Lt., now, as of 11 March 1994, a retired professor of meteorology and oceanography in Reno, Nevada, 716 Terra Court, 89506, (702) 972 6995, FAX (702)972 5011.

This series, consisting of the Short Course, Physical Oceanography 110 and 210, and Boundary Layer Problems was offered, the first in 1942, and the other three in three sequential semesters beginning in the fall of 1946. Because Sverdrup left Scripps in 1948, it is quite likely that he was never again able to offer this full sequence to classes. Also, he apparently never before had had such an opportunity.

One unit Short Course, Fall term 1942 at UCLA

This course was taught for the 110 Air Force cadets who were enrolled there at that time in a nine month meteorology program. Dr Sverdrup came up from La Jolla to give a one hour lecture each week and to take care of other business on the campus. I do not recall that he ever missed a lecture, nor wasted a minute of time in any one lecture. His voice was very soft but he could be heard by anyone who listened carefully.

The text, THE OCEANS, was published in this year, 1942. Thus, the entire work was fresh in Sverdrup's mind. Some topics covered were:

(i) Heat budget of the earth and atmosphere
(ii) Physical properties of sea water
(iii) The transfer of properties
(iv) Distribution of temperature and salinity
(v) Currents

This course represented Sverdrup's selection of the basic phenomena in oceanography. The selection is probably still useful.

Oceanography 110

Three or four Unit course carrying graduate credit. This was the first offering. It was in the fall of 1946, after the war. It was taught by Dr Sverdrup.

This course was a portion of the first formal graduate curriculum in oceanography offered to a class at Scripps, or anywhere. The other first semester courses were in biological, chemical and geological oceanography (marine geology).

The stated purpose of the first semester course in physical oceanography was, "To know data and how to interpret them. Then to study principles." There are about 90 pages of notes plus sections on ocean currents and ocean tides.

Oceanography 210

Three or four unit course, it was the second semester course of the physical oceanography series, spring semester 1947. Taught by Dr Sverdrup.

The physical oceanography students did not continue the non-physical studies into the spring semester except for particular individual interests.

The stated purpose of Oceanography 210 was, "To reverse the procedure of the last semester where observed conditions were taken and explained. Now will take theoretical tools and show how they can be applied to various problems."

Boundary Layer

These were notes from advanced lectures. There are some 30 pages of notes. These notes represented a major research interest of Sverdrup's. One of his well known articles on this subject was "The Humidity Gradient over the Sea", The Journal of Meteorology, Vol 3, No. 1, March 1946.pages one to eight. This article refers to two others on the subject. Another well known article of his concerns the subsidence inversion over the North Atlantic Ocean.

Mystery of Fogs Is Believed Solved by Former Salem Man

E

Dale Leipper Devises Method of Forecasting Fog Attacks

Out at Scripps Institution at La-Jolla, Calif., Dale F. Leipper, a former Salem boy, has formulated a method that will materially advance the ability to predict fog.

Fog is an ancient mystery. In seaports it can be seen hanging offshore for hours. Then it swoops in. Or on a clear day, it suddenly forms and blots out the sun.

Years ago Carl Sandburg of Chicago, wrote that "the fog comes in on little cat feet."

Leipper, a former army captain in the A.A.F. weather service, believes that out of his study made in the Aleutians, during the time that American bombers flew through the "soup" of the North Pacific to bomb the Japanese Kurile bases, he has devised a plan to advance the art of fog-predicting.

Taught School

Dale, who before the war was a teacher in Pacific Beach Junior High school, is the son of Mr. and Mrs. Robert Leipper of LaMesa, Calif. The family moved from Salem five years ago.

His method for saying whether at a definite time tonight or tomorrow a fog will occur is now being studied by meteorologists at the San Diego weather bureau and by army and navy forecasters.

A dozen of them already have reported back that his method is bringing results.

It may be the key to solving the fog mystery so that within a reasonably short time there may be more definite daily fog prediction.

When Leipper taught school before the war, he took no more interest in fog or weather than the average young man who plans a week-end excursion.

Then one day when he was serving as a private at a northern California army post he received a package wrapped in a newspaper. In that newspaper was a story saying the army wanted men who could qualify to study meteorology and become meteorological officers.

Secret Hunted

He applied for the course, and spent 12 months in study, including three months of specialized study at the Scripps Institution. In the course of time he found himself hunting the secret of fog in America's northwest approach, one of the world's foggiest regions.

"It was pretty important," he said. "Our planes would be coming back with their gas tanks nearly empty. And then 10 minutes before they would land, a field of visibility of several miles would close in suddenly to zero.

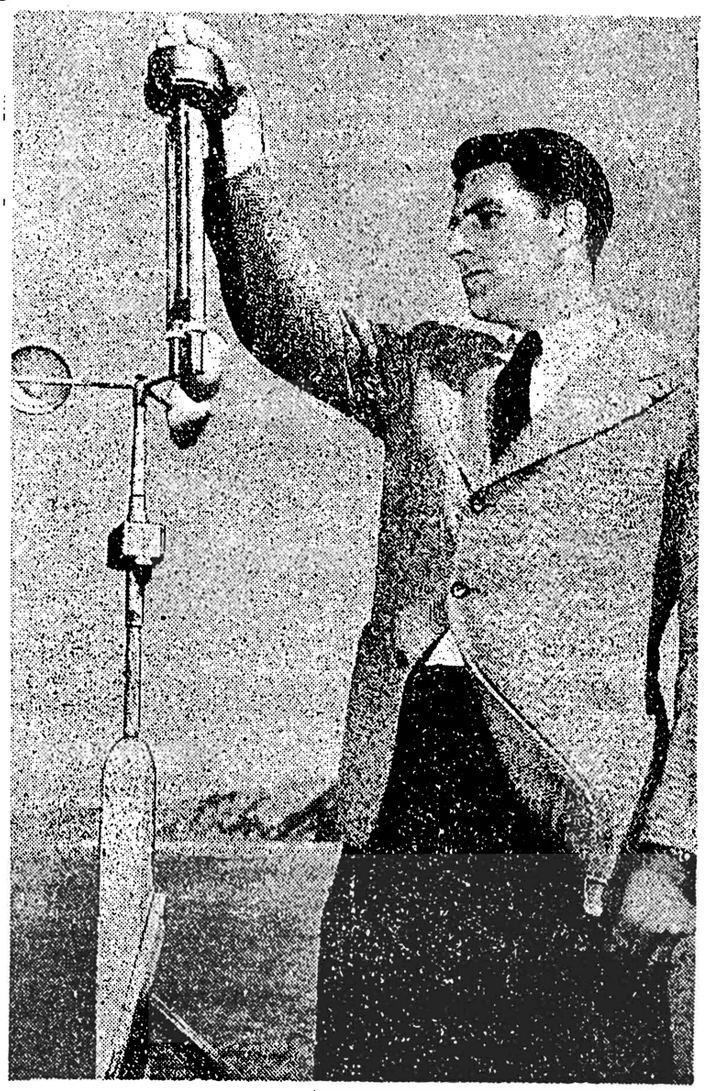
"What we needed was a key to predicting that fog. The army at times needed a forecast 36 hours in advance and we had no methodical way of giving it to them. We set out to find a method. And as a result, I think the number of lives lost because of fog may be materially decreased."

To understand Leipper's method well enough to use it would require a course in meteorology. But the difficulties and the basic idea of his method can be understood by any layman.

Meteorologists already understood the theory of fog. They knew that if moist air became sufficiently chilled, fog was bound to form. They knew just how cold it had to be to produce fog in air of any degree of wetness.

"But that was laboratory science," Leipper said. "We didn't have lab-

Turn to MYSTERY OF, Page 8



Dale F. Leipper, former A.A.F. captain now working at Scripps Institution of Oceanography, believes he's found method to advance art of predicting fog. Before war he taught in Pacific Beach Junior High.

The Salem News
Salem, Ohio
13 April 1946

John A. Knauss
3910 18th Street N.W.
Washington, D.C. 20011

F

February 29, 1992

Dear Dale and Virginia,

I am sorry I cannot be with you to celebrate your fiftieth wedding anniversary, but if present plans hold I expect to be in Kuwait that day celebrating the conclusion of a 100 day oceanographic cruise of our NOAA ship Mt Mitchel in the Persian Gulf, co-sponsored by the International Oceanographic Commission and an organization of the Gulf states. It is part of an international effort to investigate the environmental consequences of the oil spills and fires of last year's Gulf war.

As the above paragraph implies, it has been an interesting 46 years since our paths first crossed in the operations room of the Navy Weather Central at NAS North Island. You may have forgotten, but I have not. My career in oceanography did not develop in a straight forward manner, but it would never have developed at all if I had not pulled the duty that day in 1946 when you came by to learn what you could about how we went about forecasting the onslaught and break-up of ground fog at the air station.

As I recall, you were engaged in a research effort with Sverdrup to learn more about the role of the ocean in generating coastal fog and you had come by the Weather Central to learn what if anything we knew about it. I was the duty officer, and I told you all I knew, which did not take very long, and then informed you that I expected to get out of the Navy soon, would need a job, had a brand new MIT bachelor's degree in meteorology which included a course in oceanography taught out of a Sverdrup book, and San Diego had a pleasant climate.

You carried my case to Sverdrup who apparently did not find my credentials all that impressive, but he did pass the word that the Navy Electronics Laboratory was going to establish a small oceanographic unit under Gene Lafond. I was quickly hired (I believe I was number four in the unit) and the rest as they say is history--or almost. After a year at NEL, I thought physics might be a more honorable calling, and it took two years of study in Ann Arbor and a tough job market to convince me otherwise.

I have had a wonderful life and a wonderful career, and, as I have said on a number of occasions, if it had not been for the luck of the draw--my having the duty on the day of your visit--it may still have been a wonderful life and a wonderful career but I very much doubt if the career would have been oceanography.

Thank you

Sincerely,

John A. Knauss

temperatures from Balboa, Hueneme, and Pacific Grove, 2,800 bucket temperatures in the surf zone from various beaches, 4,000 temperatures at depths to 400 feet obtained from 19 east-west bathythermograph cruises, 1,000 temperatures from bathythermograms made in the vicinity of Scripps Pier, and 100 hydrographic observations at stations located 5 and 11 miles west of Scripps Pier.

VITA

September 8, 1914—Born in Salem, Ohio.

June, 1937—B.S. in Education, Wittenberg College.

June, 1939—M.A., Ohio State University.

February, 1940—General Secondary Teaching Credential, University of California, Los Angeles.

February-September, 1940—Weights and Balance Engineer, Consolidated Aircraft Corporation, San Diego, California.

September, 1940-September, 1941—Teacher, San Diego City Schools, San Diego, California.

September, 1941-December, 1945—U. S. Army Infantry, Signal Corps, and Air Forces. Oceanographer and Meteorologist, research and forecasting in Alaska. Captain.

January, 1946-August, 1949—Oceanographer, Scripps Institution of Oceanography, University of California, La Jolla, California. Research and teaching.

September, 1949—Associate Professor and Acting Head of the Department of Oceanography, School of Arts and Sciences, Agricultural and Mechanical College of Texas, College Station, Texas.

PUBLICATIONS

"On the Representation of Equations Occurring in Geometry, Engineering, Physics and Other Fields." Thesis presented for the Degree of Master of Arts, Ohio State University.

"A Local Geostrophic-Wind Surface-Wind Diagram to Aid in Terminal Forecasting," with D. D. Miller. Bulletin of the American Meteorological Society, June, 1946.

"California Stratus Forecasting Correlations, 1935 and Other Years," Bulletin of the American Meteorological Society, June, 1948.

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UNIVERSITY OF CALIFORNIA
GRADUATE DIVISION, SOUTHERN SECTION

ANNOUNCEMENT OF THE FINAL EXAMINATION FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

of

DALE FREDERICK LEIPPER

B.S. in Education, Wittenberg College
M.A., Ohio State University

MONDAY, AUGUST 22, 1949, AT 1:00 P.M., IN THE SEMINAR ROOM
SCRIPPS BUILDING, LA JOLLA CAMPUS

COMMITTEE IN CHARGE:

PROFESSOR GEORGE F. MCEWEN, *Chairman*
PROFESSOR CARL ECKART
PROFESSOR MARTIN W. JOHNSON
PROFESSOR J. BJERKNES
PROFESSOR J. HOLMBOE
PROFESSOR H. U. SVERDRUP (in absentia)

FIELDS OF STUDY

Major Field: Physical Oceanography

Studies in Physical Oceanography
PROFESSOR GEORGE F. MCEWEN
PROFESSOR H. U. SVERDRUP

Studies in Chemical Oceanography
PROFESSOR NORRIS W. RAKESTRAW

Studies in Marine Biology
PROFESSOR MARTIN W. JOHNSON

Studies in Submarine Geology
PROFESSOR FRANCIS P. SHEPARD

Studies in Meteorology
PROFESSOR J. BJERKNES
PROFESSOR J. HOLMBOE
ASSOCIATE PROFESSOR M. NEIBURGER
PROFESSOR GEORGE F. MCEWEN

ABSTRACT OF THE DISSERTATION

Sea Temperatures in Shallow Water

(Results from 75,000 observations along the California coast, with relations between temperatures, bottom topographies, tidal currents, and winds)

Sea temperature data collected in shallow water along the California coast under the direction of G. F. McEwen show marked local variations in temperature which have not previously been examined. The monthly average range of the daily variations is more than 4 degrees centigrade in the summer months. Such changes in sea temperature are far greater than would be expected from ordinary diurnal effects. Also, the largest changes occur below the surface. These facts indicate that some factor, other than the ones which are usually considered significant in sea temperature studies, plays an important role.

The present study was initiated to describe the observed temperature variations as fully as the available data permit, to demonstrate some of the implications of these variations, to develop a theory to account for them, and to make further observations of special types for the purpose of substantiating or disproving the theory.

The dissertation is in five sections. The first describes the diurnal and day-to-day variations and presents a model to account for the largest variations. This model consists of an area where, because of certain bottom characteristics, tidal currents have widely different velocities in adjacent parts of the area. These differences cause stirring of the surface water layers with deeper layers which are extremely cold. Thus, cold mixed waters are present adjacent to warm unmixed waters. The oscillating tidal movements then lead to large temperature changes at localities where one water type is present part of the time but is replaced often by water of the other type.

The second section considers the year-to-year trends and shows that the observed 32-year variation may be approximately described by an equation involving three simple harmonic curves. Section three gives monthly frequency distributions of temperature, shows the relationship between them, compares the distributions with those which might be expected from the variation theory of section one, and makes use of the frequency distribution curves to prepare charts showing the probability of occurrence of different temperatures on different dates.

Section four is a temperature study in the surf zone at some 75 different beaches. Section five shows daily sea temperatures for 1948 in comparison to mean and extreme values for the period of record.

Observational data used in the dissertation include 14,000 readings at 2-hourly intervals from sea thermographs at Scripps Pier, 12,000 each of daily bottom and sea-surface bucket temperatures, 30,000 daily bucket sea-surface

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PARTICIPANTS, LETTERS FROM OCEANOGRAPHERS

Name	48	1950s	1965	1967	1977	1991
Anderson	x.					
Arthur	xx.	xxxx .xx	x		x	x
Bates		.xxxxx.xxxx	x	x	x	x
Burt	xx.	xxxxx.xxxx	x	x	x	
Cameron	xx.	xxxxx.xx x	x	x	x	x
Capurro	xx.	xxxxx.xxxx	x	x	x	x
Carritt		. x				
Carter	x.					
Cheney	xx.	xx x .xxxx	x	x		
Chew		. xx.xxxx	x			
Cochrane	xx.	. xx	x			
Couper		.xxxxx.xxxx	x	x	x	x
Cromwell	x.	.x				
Etchebehere	xx.	xxxxx.xx x	x	x		
Ewing		.xxxxx.xx x	x			
Gordon	xx.	xxxxx.xxxx	x	x	x	x
Groen		. x x.xxx	x			
Hamill	x.	xxxx.xxxx	x			
Hidaka	x.	xxxxx.xxxx	x	x	x	
Horrer	xx.			x		
Iglesias	x.	x.				
Inman	x	.x .x				
Jacobs	xx.	x x x.xxxx	x	x		
Kielhorn		.xxxx	x	x	x	
LaFond	xx.	x xxx.xxxx	x	x	x	x
Leipper	xx.	xxxxx.xxxx	x	x	x	x
Lockley	x	.xxx .	x	x		
Lyman		.xxxxx.xxxx	x	x		
Mao	x.	xx .				
McConnaughey	x.x					
McLellan		. xxx.xxxx				
Munk	x.	x xxx. x x	x		x	x
Neiburger	x.	xxx.xxxx	x		x	
Ben. Olson	xx.					
Panzarini	x.	xxxxx.xxxx	x	x	x	
Pickard		. xx	x	x	x	x
Pritchard	x	.x x.xx x				
Reid	xx.	xxxx .xxxx	x	x	x	x
Rusk	x.	x				
Saur	x	. xxxx.x xx	x	x	x	
Smith		.x				
Stommel		.xxxxx.xxx	x	x		
Sverdrup	x.	xxxx .xxx				
Thompson	xx.	xxxxx.xxx	x			x
Treadwell	x.	x.		x		x
Vetter		. .x xx	x	x	x	
Wickham	x.					
Williams	x.x					
Wooster	x.	xxxx.xxxx	x	x	x	x

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May 23, 1949

Some Comments on Applied Oceanographic Research in the Gulf of Mexico

by

Claude E. ZoBell*

The study of physical, dynamical, geological, chemical and biological oceanography in the Gulf of Mexico is almost a virgin field. It is a field of far-reaching fundamental importance and of ever-increasing practical significance. It should be considered in its broadest aspects and, for obvious reasons, the interrelationships between the ocean and atmosphere and between the land and sea wherever there is land drainage must be considered.

The ultimate success of a broad research program will depend upon a nice balance between the fundamental and applied approach to the problems. Purely fundamental investigations are essential to push forward the frontiers of human knowledge and to train personnel. The knowledge thus gained and the trained personnel will make significant contributions to the petroleum industry, fishing interests, manufacturing, recreation, public health, agricultures and other activities on or contiguous to the Gulf

The first and most important step in providing permanent machinery for investigating the Gulf and its relation to man is to organize a well-balanced department of oceanography in the region. The department should be represented by men trained in (a) Physical Oceanography, (b) Chemical Oceanography, (c) Marine Meteorology, (d) Submarine Geology and (e) Marine Biology. These men should spend their time teaching and training personnel and conducting or supervising fundamental and applied research work in the Gulf. Such a department of oceanography might well

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Consultant, Texas A. & M. Research Foundation

be located at Texas A. & M. College, where it would receive needed cooperation from Engineering, Chemistry, Biology, Geology, and other departments doing related work.

A laboratory on the water front and seagoing facilities are essential for both the teaching and research program. A small sea-side laboratory and boat may satisfy the teaching requirements; larger, better equipped and more laboratories and vessels may be required to satisfy the needs of the research program.

The same general plan of organization would be prepared to conduct on virtually any scale investigations on beach or bay pollution, organic productivity of water, fisheries problems, offshore structures, recent sediments, problems of public health significance, etc. Depending upon the magnitude of the undertaking and its specific nature, additional personnel of different categories including technicians, marine scientists, engineers, consultants, etc., would have to be obtained for each project. Each project should have its own leader, director or coordinator, and it is of utmost importance that provisions be made for the coordination of results from all projects. Information obtained by the meteorologist on the offshore structure project, for example, may find important applications by the biologist working on beach pollution.

Beach Contamination Investigations

The proposal from Texas A & M Research Foundation for a survey of beach contamination has been studied with care. The proposal appeals to me as being sound and significant except for certain missing details and insufficient emphasis on physical or dynamical oceanography.

Although biological conditions and chemical properties of water or sediments may be the principal manifestations of pollution, the movement of water masses must be carefully considered in the interpretation of results. Therefore it is recommended that observations on tides be supplemented by the study of waves, currents, drifts, turbulence, upwelling and other water movements that may influence the transport of materials, the chemical composition of the water, the deposition of sediments or the biological population of the water. Such studies may entail the use of current meters, drift bottles, tracer substances, data on water densities and other research tools employed by the physical oceanographer.

Unless the topographical features of the Gulf's floor are known, soundings should be made wherever such features might influence the circulation of water, the transport of sedimentary materials or the ecology of organisms. Since the deposition or removal of sand on beaches or in water along the shore is a problem closely related to beach pollution, this may merit careful consideration as influenced by oceanographic conditions, land drainage and man-made structures.

All of the routine tests of water outlined on page 4 of the Texas A & M Research Foundation proposal seem significant, although by no means of coordinate importance. Even if "biological" work is to be minimized during the initial years of the survey, plankton samples should certainly be collected routinely by standard methods. The quantity of plankton at representative stations should be recorded and samples preserved for future reference. The quantity of plankton is one of the best criteria of organic productivity.

Unless such steps have already been taken, it is recommended that you communicate with officers of the U. S. Public Health Service as well as State or Municipal officers in that region who may be actively interested in beach pollution studies. Collaboration with the Beach Erosion Board of the Department of Army Corps of Engineers may also prove to be profitable in the planning and execution of your beach contamination survey.

From my vantage point it appears obvious that the survey should include observations on all possible sources of contamination from rivers, sewage outfalls, industrial wastes discharged in the sea, bleedwaters or petroleum from offshore oil wells, bilgewater and other shipping pollutants, etc. While the immediate objective of the survey may be to ascertain what constitutes normal conditions and the degree of beach and bay contamination accompanying the increasing industrialization and population of the region, it might be desirable to be in a position to trace this contamination to its source.

After agreeing upon the general principles of the problem and the points of attack, I should be pleased to confer with you or your associates regarding personnel and the details of the various investigations. It does not seem profitable to record opinions regarding these details at this time.

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To be inserted

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How Bob and Marjorie Reid came to Texas A & M in 1950

Background: Dr. H. U. Sverdrup, director of the Scripps Institution of Oceanography, once expressed to me the thought that Bob Reid was one person who should be kept at Scripps if it were at all possible to do so.

The TAM plan: When Texas A & M decided in January 1949 to establish a department of oceanography, the Board of Directors set up five academic appointments. Dr. Sverdrup and Dr. Claude ZoBell, a Scripps microbiologist, were asked to consult in choosing a department head. They nominated Bob Reid and me. Bob decided that he was not interested in a full time position in administration. (Fifteen years later he did give it a try and, after two weeks, said he had had enough.)

In August 1949 I became head of the new department and decided to spread the five academic positions among the basic disciplines of oceanography, with one for physical oceanography and one for meteorological. Since Bob and I were both war time meteorologists and physical oceanographers, I decided that the two of us could fill the slots for both disciplines and spent considerable time before leaving Scripps talking to Bob about this combination. He agreed to come to Texas A & M after I was settled there and, I believe, gave the usual notices about leaving Scripps.

The Problem: Dr. Roger Revelle, then director of Scripps, wanted to keep Bob there. He was a man who was somewhat difficult to get to when you had a problem but one who, when he did get started, never gave up until the problem was fully resolved. Well, he started really working on this problem on the day that Bob and Marjories' household goods were packed into a moving van and ready to leave La Jolla for College Station. Dr. Revelle was in Washington and, as I understand it, he telephoned back to La Jolla and asked that the van not start on its trip to Texas until further word from him. Then he arranged a meeting in Washington to discuss the situation.

The meeting was a luncheon for four. I was in Washington that day and was invited, along with Dr. Richard Fleming, an old friend and classmate of Revelle's, a co-author of The Oceans, and Oceanography chairman at the University of Washington. A Navy captain was also invited. Dr. Revelle explained how important Bob was to Scripps, that Dr. Carl Eckart needed him for important work in low frequency sound, and that Scripps had mountains of data for Bob to work with. I talked mostly about the potential which I could see in the new Texas A & M department and how Bob could play a critical role in teaching there.

The Solution: When we had finished our comments, Dr. Revelle turned to Dick Fleming and asked, "Dick, what do you think Bob should do?". Dick thought for a very brief moment and said, "I think Bob should go to Texas A & M." This was like a bomb dropping. There was no further discussion.

Bob followed through on the plans which he and I had made. He came to College Station with Marjorie - I think it was in February 1950 - and has been there ever since. No one could have done a better job than he has for Texas A & M University, the State of Texas and the National Oceanography Program. I am proud to have played the role described here.

Dale F. Leipper
April 3, 1983
Carmel Valley, California